WEAVERS MOUNTAIN WIND ENERGY PROJECT

Environmental Assessment Registration Document

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Environmental Assessment Registration Document

Prepared By:
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Prepared For:
WEB Weavers Mountain Wind Limited Partnership
c/o SWEB Development LP
6080 Young Street, Suite 403
Halifax, NS B3K 5L2

May 2023

May 31, 2023

Ms. Allison Fitzpatrick
Nova Scotia Department of Environment & Climate Change
Environmental Assessment Branch
#2085 - 1903 Barrington Street
PO Box 442
Halifax, NS B3J 2P8

Dear Ms. Fitzpatrick,

Re: Environmental Assessment Registration Document
Weavers Mountain Wind Energy Project

Please find enclosed the Environmental Assessment Registration Document for the Weavers Mountain Wind Energy Project.

The undersigned approves and accepts the contents, as submitted to Nova Scotia Environment & Climate Change, Environmental Assessment Branch.

Sincerely,

Rory Cantwell
Chief Executive Officer
WEB Weavers Mountain Wind Limited Partnership

Michael Peters

Michael Peters
Chief Executive Officer
Glooscap Energy Limited Partnership

EXECUTIVE SUMMARY

WEB Weavers Mountain Wind Limited Partnership proposes to construct and operate Weavers Mountain Wind Energy Project, a 94.4 megawatt (MW) wind development located near the community of Beaver Meadow, Antigonish County, Nova Scotia. The Project will consist of up to 16 wind turbines along with associated infrastructure, including access roads, substation, and interconnection lines. The development of this Project will support Nova Scotia in their target of producing 80% renewable energy by 2030, reducing the province's dependency on coal generated electricity.

The Project is considered a Class I Undertaking under Schedule A of the Nova Scotia Environmental Assessment Regulations, NS Reg 26/95, and therefore, requires the registration of an Environmental Assessment Registration document. The Environmental Assessment Registration document has been completed according to methodologies and requirements outlined in A Proponent's Guide to Environmental Assessment, and has incorporated guidance from the Guide to Preparing an EA Registration Document for Wind Power Projects in Nova Scotia.

Several Valued Components were identified and evaluated as part of this assessment. Based on provincial guidance, desktop analysis, and subsequent field studies. Valued Components determined for assessment were as follows:

- Atmospheric Environment
- Geophysical Environment
- Aquatic Environment
- Terrestrial Environment
- Socioeconomic Environment
- Archaeological and Cultural Resources
- Human Health
- Electromagnetic Interference
- Shadow Flicker
- Visual Aesthetics
- Sound

The results of the assessment indicated that the Project, with the implementation of mitigation and monitoring measures, will not result in significant adverse residual effects. The Project will also have a positive residual effect associated with the reduction of greenhouse gas emissions (i.e., production of renewable energy) and economic prosperity within Nova Scotia. The Project was also determined to not act cumulatively with nearby developments.

WEB Weavers Mountain Wind Limited Partnership has, and will continue, to engage and collaborate with local communities, the Mi'kmaq of Nova Scotia, and government representatives to ensure that any potential concerns identified in association with the Project are addressed and mitigated.

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ACCDC	Atlantic Canada Conservation Data Centre
AQHI	Air Quality Health Index
ARIA	Archaeological Resource Impact Assessment
ATV	All-terrain vehicle
ARD	Acid rock drainage
ARS	Avian radar systems
BBS	Breeding Bird Survey
BCECC	British Columbia Ministry of Environment and Climate Change
BMPs	Best Management Practices
BS	Black spruce
BT	Biological target
°C	Degrees Celsius
CAAQS	Canadian Ambient Air Quality Standards
CanWEA	Canadian Renewable Energy Association
CAO	Chief administrative officer
CCME	Canadian Council of Ministers of the Environment
CCOHS	Canadian Centre for Occupational Health and Safety
CEO	Chief Executive Officer
CEPA	*Canadian Environmental Protection Act*
CH_4	Methane
CMOH	Chief Medical Officer of Health
CO	Carbon monoxide
CO_2	Carbon dioxide
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CPC	Centre for Plant Conservation
CREA	Canadian Renewable Energy Association
CWS	Canadian Wildlife Service
dBA	Decibels A
DEM	Digital Elevation Model
DFO	Fisheries and Oceans Canada
DND	Department of National Defence
DO	Dissolved oxygen
EA	Environmental Assessment
ECCC	Environment and Climate Change Canada
EH	Eastern hemlock
EMF	Electromagnetic fields
EMI	Electromagnetic Interference
EPP	Environmental Protection Plan
FAC	Facultative
FACU	Facultative Upland
FACW	Facultative Wetland
FWI	Fire Weather Index

GHGs	Greenhouse Gases
GIS	Geographic Information System
GOC	Government of Canada
GPS	Global Positioning System
ha	Hectares
Hz	Hertz
KMKNO	Kwilmu'kw Maw-klusuaqn
IBA	Important Bird Areas
IPCC	Intergovernmental Panel on Climate Change
ISED	Innovation, Science and Economic Development Canada
JP	Jack pine
km	Kilometres
km/h	Kilometres per hour
kV	Kilovolts
kW	Kilowatts
kWh/year	Kilowatts per hour per year
LAA	Local Assessment Area
LABO	Eastern red bat
LACI	Hoary bat
LANO	Silver-haired bat
Lpm	Litres per minute
m	Metres
m^2	Square metres
m^3	Cubic metres
m/s	Metres per second
MARI	Maritime Archaeological Resource Inventory
masl	Metres above sea level
MBCA	*Migratory Bird Convention Act*
MBBA	Maritimes Breeding Bird Atlas
MBII	Migratory Bird Interaction Index ($\boldsymbol{M}$)
MEKS	Mi'kmaq Ecological Knowledge Study
mg/L	Milligrams per litre
mins	Minutes
MLA	Member of the Legislative Assembly
mS/cm	MilliSiemens per centimetre
MTO	Ministry of Transportation of Ontario
MW	Megawatt
MYOT	Myotis Species
nBTs	Number of biological targets
NI	No Indicator Status
NL	Not Listed
NO	Nitric oxide
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides

N_2O	Nitrous Oxide
NRCan	Natural Resources Canada
NRCS	Natural Resources Conservation Service
NREL	National Renewable Energy Laboratory
NS	Nova Scotia
NSAQR	Nova Scotia Air Quality Regulations
NSCCTH	Nova Scotia Communities, Culture, Tourism and Heritage
NSECC	Nova Scotia Environment and Climate Change
NSEL	Nova Scotia Environment and Labour
NS *ESA*	Nova Scotia *Endangered Species Act*
NSNRR	Nova Scotia Natural Resources and Renewables
NS Power	Nova Scotia Power
NSPW	Nova Scotia Public Works
NS RBP RFP	Nova Scotia Rate-Base Procurement Request for Proposals
NSSU	Nova Scotia Southern Upland (Atlantic salmon population)
NSTDB	Nova Scotia Topographic Data Base
NWF	National Wildlife Federation
O_3	Ozone
OBL	Obligate
OLA	Office of L'nu Affairs
OMNR	Ontario Ministry of Natural Resources
PESU	Tri-colored Bat
pH	Potential hydrogen
PID	Premises Identification
PM	Particulate matter
PPA	Purchase power agreement
Q_{20}	Long term safe yield
RAA	Regional Assessment Area
RABC	Radio Advisory Board of Canada
RCMP	Royal Canadian Mounted Police
RP	Red pine
rpm	Revolutions per minute
RS	Red spruce
°/s	Degrees per second
SANS	Snowmobilers Association of Nova Scotia
SAR	Species at risk
SARA	*Species at Risk Act*
SGEM	Silvicultural Guide for the Ecological Matrix
SO_2	Sulfur dioxide
SOCI	Species of conservation interest
SP	Scots pine
SREPs	Smart Renewables and Electrification Pathways Program
t	Tonnes
tCO_2e	Tonnes of carbon dioxide equivalent

tCO_2e/kg	Tonnes of carbon dioxide equivalent per kilogram
tCO_2e/km	Tonnes of carbon dioxide equivalent per kilometre
$tCO_2e/tonne{\cdot}km$	Tonnes of carbon dioxide equivalent per tonne-kilometre
tCO_2e/y	Tonnes of carbon dioxide equivalent per year
TRS	Total reduced sulfur
TSP	Total Suspended Particulate
µm	Micrometres
UNKW	Unknown
UPL	Upland
USDA	United States Department of Agriculture
USDE	United States Department of Energy
USEIA	United States Energy Information Administration
US EPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
V	Volts
VC	Valued component
Vestas	Vestas American Wind Technology
VHF	Very high frequency
VOR	VHF OmniRange
WAM	Wet Areas Mapping
WESP-AC	Wetland Ecosystem Services Protocol – Atlantic Canada
WiRE	Women in Renewable Energy
WS	White Spruce
WSS	Wetlands of Special Significance
WTG	Wind turbine generator

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1.0 PROPONENT DESCRIPTION

The Weavers Mountain Wind Energy Project (the Project) is a 94.4 megawatt (MW) wind energy project proposed by WEB Weavers Mountain Wind GP Inc., Glooscap Energy #2 Limited Partnership (as represented by its general partner Glooscap Energy #2 GP Ltd.), and SWEB Development Limited Partnership (as represented by its general partner SWEB Development Inc.), carrying on business as WEB Weavers Mountain Wind Limited Partnership (the Proponent).

The Proponent retained Strum Consulting to support the development and submission of the Environmental Assessment (EA). Strum Consulting is an independent multi-disciplinary team of consultants with extensive experience in undertaking EAs throughout Atlantic Canada. Contact information for the Proponent and their consultant is included in Table 1.1.

Table 1.1: Proponent and Consultant Contact Information

Proponent Information	
Project Name	Weavers Mountain Wind Energy Project
Proponent Name	WEB Weavers Mountain Wind Limited Partnership
Mailing and Street Address	c/o SWEB Development LP 6080 Young Street, Suite 403 Halifax, NS B3K 5L2
Proponent Contact Information for the EA Registration	Jason Parisé Senior Development Manager Phone: 902-329-1494 E-mail: jason.parise@sweb.energy
Consultant Information	
Name of Consultant	Strum Consulting
Mailing and Street Address	Strum Consulting #210 – 211 Horseshoe Lake Drive Halifax, NS B3S 0B9
EA Contact	Scott Dickey, MREM Senior Environmental Scientist Phone: 902-835-5560 E-mail: sdickey@strum.com

2.0 PROJECT INFORMATION

2.1 Project Introduction

The Project is centred on Weavers Mountain, at the border of the St. Mary's River, Antigonish West River, and Barney's River watersheds, between the communities of Beaver Meadow, Kenzieville, Eden Lake, and Lochaber, along the county boundary between Antigonish and Pictou Counties, Nova Scotia (Drawing 2.1).

The Project will use up to 16 wind turbines with a maximum hub height of 125 metres (m) and a maximum rotor diameter of 163 m. The exact wind turbine model has not yet been selected for the Project. The turbine locations are shown in Drawing 2.2. Previous and current land use within the main Study Area is timber harvesting and recreation.

Upon approval of the EA, construction activities are proposed to begin in winter 2024 with major civil and electrical construction activities planned for Q2 2024. It is anticipated that the Project will finish construction and reach commercial operation by the end of 2025 and is expected to be operational for a minimum of 25 years.

2.2 Purpose and Need for the Undertaking

Nova Scotia has set a new target of producing 80% of its energy from renewable sources by 2030, with wind energy development expected to play a significant role in achieving this goal. The proposed Project has been approved as part of the Nova Scotia Rate-Base Procurement Request for Proposals (NS RBP RFP), which supports this renewable energy target.

A dependence on fossil fuels increases the vulnerability of Nova Scotians to volatile international energy prices, weakens energy security, and takes valuable revenue out of the province. This further emphasizes the importance of transitioning to renewable energy sources (NSNRR, 2015). Fossil fuel consumption is also associated with negative impacts on human health, particularly in developing countries, and on the environment, mainly in the form of climate change, which are widely recognized as global challenges.

In its assessment report, Climate Change 2022: Impacts, Adaptation and Vulnerability, the United Nations Intergovernmental Panel on Climate Change (IPCC) provides a detailed synopsis of the impacts associated with climate change on both global and regional scales. Evidence from all continents indicates that many biological systems and habitats are currently being affected by regional climate change. Ecological changes include alterations to the thermal dynamics and quality of aquatic habitats, shifts in the ranges and seasonal cycles of flora and fauna species, changes in fish abundance, and increased risks of loss of forest habitat (IPCC, 2022).

In North America specifically, the increase in ground, water, and atmospheric temperatures has resulted in the direct mortality and redistribution of many flora and fauna species. In addition, coastal flooding, along with an increase in the frequency and intensity of extreme weather events, will continue to impact the socioeconomic environment through displacement and/or damage to communities and economies (IPCC, 2022).

The impacts of climate change are, and will increasingly be, felt across environmental, social, human health, and economic sectors (IPCC, 2022).

Canadian climate experts acknowledge that the debate has largely evolved from questions about the reality and causes of climate change, to what actions can be taken to adapt to the

realities of a changing climate. As the second most important and fastest growing (along with solar) renewable energy source in Canada (NRCan, 2017), wind energy is a critical component of Canada's renewable energy strategy. Wind energy is emission-free; with every MW of wind energy generated, greenhouse gas emissions are reduced in comparison to previous levels associated with coal-related production (NSNRR, 2015). Numerous benefits can be expected from the transition to renewable energy, including:

- Long-term stability in energy prices.
- Long-term security in locally-sourced energy supply and decreased dependence on international markets.
- Creation of jobs and economic opportunities throughout the province.
- Community investment and economic return.
- Protection of human health and the environment.
- Retaining revenue within the province.
- Benefits to Nova Scotia's underrepresented communities.
- Educational opportunities for youth and the broader community regarding renewable energy technology, its benefits, and the role it will play in Nova Scotia's energy future.

As part of this overall strategy, the Project will diversify the energy sources that feed into the electricity grid in Nova Scotia. Wind power is a mature technology that will allow the Proponent to support the province proactively in pursuing a transition to green energy sources and help move away from a dependency on coal, petroleum products and other non-renewable sources for electricity production.

The Proponent is committed to sharing economic opportunities with the local community, via the use of local skilled labour where possible, generating municipal tax revenue, and providing energy literacy/education. The Project Team will continue to work with community members to help identify Project-related opportunities and benefits for the local community. As well, once the Project reaches commercial operation, capacity building initiatives and financial and non-financial benefits will commence with the Project's partners, namely, the Scotia Winds of Change Foundation and Women in Renewable Energy (WiRE). For more information regarding these partnerships, please refer to the Project website: **www.weaversmountainwindenergy.ca**.

2.3 Regulatory Framework

2.3.1 Federal

A federal impact assessment is not required for the Project as it is not located on federal lands or listed as a physical activity that constitutes a designated project as listed in the Physical Activities Regulations under the *Impact Assessment Act*.

Federal approval, permit, notification, and compliance requirements for the Project are provided in Table 2.1.

Table 2.1: Federal Regulatory Requirements

Requirement	Regulatory Body	Status/Comments
Notification of Project	RCMP	Notification sent, response pending
Aeronautical obstruction clearance	Transport Canada	In progress
Lighting design for navigational purposes	Transport Canada	In progress
Final design, location, and height of turbines	Natural Resources Canada (NRCan)	In progress
Land Use Permit	NAV CANADA	In progress
EMI consultation and radio communication layout authorization	Various	EMI and radio communication stakeholders have been contacted. The EMI consultation process is described further in Section 10.2.
Fisheries Act	Fisheries and Oceans Canada (DFO)	Compliance legislation - there is currently no expectation that an authorization under the *Fisheries Act* will be required. If, during the detail design phase, the Project is determined to have potential to impact fish or fish habitat, the Proponent will submit a Request for Project Review to DFO.
Species at Risk Act (*SARA*)	Environment and Climate Change Canada (ECCC), DFO	Compliance legislation – there is no expectation that a *SARA* permit will be required.
Migratory Bird Convention Act (*MBCA*)	ECCC	Compliance legislation – there is no expectation that a *MBCA* permit will be required.

2.3.2 Provincial

The Project is subject to a Class I EA as defined by the Environmental Assessment Regulations, NS Reg 26/95 under the *Environment* Act, SNS 1994-95, c 1. As such, this submission has been prepared in accordance with:

- A Proponent's Guide to Environmental Assessment (NSECC, 2017)
- Guide to Preparing an EA Registration Document for Wind Power Projects in Nova Scotia (NSECC, 2021)

Other provincial approval, permit, notification, and compliance requirements for the Project are provided in Table 2.2.

Table 2.2: Provincial Regulatory Requirements

Requirement	Regulatory Body	Status/Comments
Watercourse Alteration Permit Wetland Alteration Permit	Nova Scotia Environment and Climate Change (NSECC)	Alteration applications will be submitted to NSECC in accordance with the Activities Designation Regulations following EA approval. Locations requiring alteration are described in Section 7.3.
Nova Scotia *Endangered Species Act* (NS *ESA*)	Nova Scotia Natural Resources and Renewables (NSNRR)	Compliance legislation – there is no expectation that a NS *ESA* permit will be required.
Use of Crown lands	NSNRR	Application submitted. In progress.
Notification of blasting (if required)	NSECC, Nova Scotia Health and Safety	To be confirmed following the geotechnical investigations.
Overweight/Special move permit	Nova Scotia Public Works (NSPW)	Future approval
Access permit Work within highway right-of-way Use of right-of-way for pole lines	NSPW	Future approval
Elevator lift license	Nova Scotia Labour Skills and Immigration	Future approval
Archaeology Field Research Permit	Nova Scotia Communities, Culture, Tourism and Heritage (NSCCTH)	Permit obtained to complete the archeology assessment.
Nova Scotia Temporary Workplace Traffic Control Manual	NSPW	Compliance for the use of provincial roads during the construction, operation, and decommissioning phases of the Project.

2.3.3 Municipal

Municipal approval, permit, notification, and compliance requirements for the Project are provided in Table 2.3.

Table 2.3: Municipal Requirements

Requirement	Regulatory Body	Status/Comments
Building and Development Permits	Municipality of the County of Pictou, County of Antigonish	Development Permit applications have been submitted and will be updated following EA Approval. Project Building Permit applications will be submitted at a later date.

2.4 Funding

The Project has received conditional approval and funding from Natural Resources Canada's (NRCan) Smart Renewables and Electrification Pathways Program (SREPs). The program has been developed to significantly reduce greenhouse gas emissions by encouraging the replacement of traditional fossil-fuel generated electricity with renewables.

2.5 Structure of the Registration Document

An outline of the content of each section of the EA Registration Document is provided in Table 2.4.

Table 2.4: EA Registration Document Structure

Section	Content
Section 1	Proponent Description
Section 2	Project Information
Section 3	Description of the Undertaking
Section 4	Project Scope and Assessment Methodology
Section 5	Mi'kmaq of Nova Scotia
Section 6	Public and Government Engagement
Section 7	Biophysical Environment
Section 8	Socioeconomic Environment
Section 9	Archaeological Resources
Section 10	Other Considerations
Section 11	Effects of the Undertaking on the Environment – Summary
Section 12	Effects of the Environment on the Undertaking
Section 13	Accidents and Malfunctions
Section 14	Cumulative Effects Assessment
Section 15	Closure
Section 16	Limitation of Liability
Section 17	References

3.0 DESCRIPTION OF THE UNDERTAKING

3.1 Geographical Location

The Project is located on the border of Antigonish County and Pictou County, west of the community of Beaver Meadow, Nova Scotia (Drawing 2.1). The Project is situated at one of the highest elevations within the county, with a Study Area encompassing nearly 8,000 hectares (ha). The approximate centre of the Project is -62.202015 E, 45.531139 N.

A Study Area was established as a large assessment area based on land parcels (i.e., premises identification (PID) numbers) that are included in the development area (Table 3.1, Drawing 2.2). This Study Area was used for desktop assessments and to subsequently inform and refine field surveys and the Project design. An Assessment Area was subsequently established for detailed field investigations, which includes the physical footprint of the Project where the direct physical disturbance is expected to occur (i.e., the

Project Area), plus a 100 m buffer around the turbine pads and a 25 m buffer on either side of the centreline for the road layout and overhead collector line layout, including areas where collector transmission lines are not following roads. A Legacy Study Area was established in the fall of 2021 and served as a preliminary boundary for field surveys conducted in fall 2021, and winter and spring 2022 (Drawing 2.2). Upon the determination of the development area, the Study Area was revised to include those PIDs where Project activities may occur.

Table 3.1: Land Parcels within the Study Area

PID	Landowner*	Classification
65192882	Privately-owned	Commercial Forest
65040107	Privately-owned	Commercial Forest
00962241	Privately-owned	Commercial Forest
65192890	Privately-owned	Commercial Forest
01040203	Privately-owned	Commercial Forest
01039882	Privately-owned	Commercial Forest
00962175	Privately-owned	Commercial Forest
01241355	Privately-owned	Residential Taxable/Resource Forest
01040187	Privately-owned	Commercial Forest
65232589	Privately-owned	Resource Forest
01241348	Privately-owned	Commercial Forest
01040245	Privately-owned	Commercial Forest
01040179	Privately-owned	Commercial Forest

*The names of privately owned land parcels are omitted for confidentiality.

Table 3.2: Areas Included in the Environmental Assessment

Area of Study	Area (ha)
Study Area	3321.6
Assessment Area	160.6
Project Area*	12.3

*Area is a conservative estimate of the permanent footprint of the Project Area. Temporary Project Area components are shown in Drawing 3.2A – 3.2F but are not included in this calculation. Following the detail design, the area will be refined.

The Study Area has undergone previous development for forestry and recreational activities. The Project will utilize the existing road system where possible to minimize the need for new road construction.

3.1.1 Siting Considerations

The Study Area is an ideal location for a wind farm due to its strong wind resource, proximity to transmission lines, and distance away from residences. Further, historic timber harvesting in the area has created a network of roadways that have allowed the area to be more accessible.

As part of the Project planning, a detailed constraints analysis was conducted to ensure that potential effects to the environment, nearby residents, and sociocultural resources were

minimized. This analysis was continually updated and refined based on the results of desktop studies, modelling, and field assessments. As a result, several layout iterations were reviewed against environmental constraint mapping to incorporate the findings of the environmental work within the Study Area and surroundings before finalizing the layout (Drawing 3.1).

Project and Project component siting included the following considerations:

- Site turbines at locations for efficient capture of wind energy.
- Avoid interference with telecommunication and radar systems.
- Avoid Project component interactions with lakes, or other visible open water bodies and their riparian habitats as identified in 1:50,000 provincial mapping.
- Avoid known protected areas; field identified archaeological, cultural, and heritage resources; significant habitats; and wildlife sites, provincial parks, or reserves.

The minimum setbacks and separation distances applied during the development, design, and siting of the Project are summarized in Table 3.3.

Table 3.3: Summary of Minimum Setbacks and Separation Distances

Setback Category	Distance	Relevant Regulators / Stakeholders
Watercourses	30 m from turbines (from tip of blade – where possible or otherwise where authorized by NSECC)	NSECC
Wetlands	30 m from turbines (from tip of blade – where possible or otherwise where authorized by NSECC)	NSECC, NSNRR
Wetlands of Special Significance	At least 30 m, to be determined in consultation with NSECC	NSECC, NSNRR
Protected Areas and Public Resources	300 m	NSECC, NSNRR
Rare Plants and Lichens	Species specific (Section 7.4.2)	NSNRR
Powerlines	300 m from non-project-related powerlines, except designated crossing locations (1.5 x Turbine Height)	Nova Scotia Power
Shadow Flicker	As necessary to meet shadow flicker constraints based off shadow flicker modelling (Section 10.3)	NSECC
Sound / Noise	As necessary to meet sound/noise constraints based off sound modelling (Section 10.5)	NSECC

Setback Category	Distance	Relevant Regulators / Stakeholders
Dwellings (except for residences on participating lands)	1000 m	Municipality of the County of Pictou
	600 m	Antigonish County
Property lines of non-participating lands	413 m (2 x turbine height)	Municipality of the County of Pictou
	216.5 m (10 m plus the rotor height)	Antigonish County

In addition to the general planning "constraints" and minimum setbacks mentioned above, the Assessment Area and associated layout offers considerable development and ecological advantages that were incorporated into the Project design to minimize potential effects to surrounding land uses, local residents, and environmental features:

- The use of a site that has been previously disturbed by forestry activities (i.e., tree clearing and logging trails/roads are present throughout the Assessment Area).
- Minimize potential impacts to wetlands, watercourses, and their riparian buffers through the use, and rehabilitation, of existing roads, and existing road watercourse crossings.
- Maximize the use of existing roads, and existing cleared areas to minimize habitat fragmentation from new road construction and clearing of mature vegetation stands.

3.2 Physical Components

3.2.1 Turbine Specifications

The Proponent has not yet selected a wind turbine model for the Project but is considering options from several Tier I suppliers. The Nordex N163, Vestas V162, and Enercon E160 are currently under consideration for the Project. At present, this EA considers the following maximum dimensions for the Project to present the largest possible wind turbine model that could be selected:

- Maximum rotor diameter of 163 m
- Maximum blade swept area of 20,867.2 m^2
- Maximum hub height of 125 m
- Maximum capacity of 6.2 MW

This document considers three wind turbine units (Table 3.4).

Table 3.4: Turbine Technical Specifications

Nordex N163 Turbine Component	Nordex N163 Specifications
Rated Capacity	5.9 MW
Rotor Diameter	163 m
Hub Height	118 m
Maximum Sound Pressure Level	109.2 dBA

Nordex N163 Turbine Component	Nordex N163 Specifications
Cut-out Wind Speed	26 m/s
Swept Area	20,867.2 m^2
Rotor Speed (variable)	6.0 – 11.8 rpm
Pitch Control	Double-row four-point contact bearing, electric motors incl. spring-loaded brake and multi-stage planetary gear
Generator	Type: 6-pole doubly-fed induction machine Degree of protection: IP 54 (slip ring box IP 23) Nominal voltage: 750 V Frequency: 50 and 60 Hz Speed range: 50 Hz: 650 to 1500 rpm 60 Hz: 780 to 1800 rpm Number of poles: 6 Weight: Approx. 10.6 t
Brake System	Mechanical brake Type: Actively actuated disk brake Location: On the high-speed shaft Number of brake calipers: 1 Brake pad material: Organic pad material
Yaw Control	Yaw bearing: Double-row four-point contact bearing Gearing/raceway lubrication: Regular lubrication with grease Drive: Electric motors incl. spring-loaded brake and four-stage planetary gear Number of drives: 5-6 Yaw speed: Approx. 0.4 °/s
Remote Monitoring	Supervisory control and data acquisition system
Enercon E160 Turbine Component	**Enercon E160 Specifications**
Rated Capacity	5.56 MW
Rotor Diameter	160 m
Hub Height	114 m
Maximum Sound Pressure Level	106.8 dBA
Cut-out Wind Speed	28 m/s
Swept Area	20,106.19 m^2
Rotor Speed (variable)	4.4 – 9.6 rpm (Tip speed at speed setpoint: 80.44 m/s)
Pitch Control	One independent electrical pitch unit per rotor blade with dedicated emergency power supply
Generator	Wind energy converter concept: Gearless, variable speed, full-scale converter Hub: Rigid Bearing: 2 tapered roller bearings Generator: Direct-driven, permanent magnet synchronous generator IP code/insulation class: IP 54/F
Brake System	Aerodynamic brake: Aerodynamic via 3 independent pitch units with emergency power Rotor holding brake: Hydraulic Rotor lock: Latching every 30°
Yaw Control	Yaw system: Electromechanical yaw system Yaw brake: Hydraulic
Remote Monitoring	Supervisory control and data acquisition system

Vestas V162 Turbine Component	Vestas V162 Specifications
Rated Capacity	6.2 MW
Rotor Diameter	162 m
Hub Height	119 m
Maximum Sound Pressure Level	107.1 dBA
Cut-out Wind Speed	24 m/s
Swept Area	20,611.99 m^2
Rotor Speed (variable)	4.3 – 12.1 rpm
Pitch Control	Type: Hydraulic Number: 1 cylinder per blade Range: -5° to 95°
Generator	Type: Permanent Magnet Synchronous generator Rated Power [PN]: Up to 6450 kW (depending on turbine variant) Frequency range [fN]: 0-138 Hz Voltage, stator [UNS]: 3 x 800 V (at rated speed) Number of poles: 36 Winding type: Form with Vacuum Pressurized Impregnation Winding connection: Star Operational speed range: 0-460 rpm Overspeed limit (2 mins): 720 rpm Temperature sensors, stator: PT100 sensors placed in the stator hot spots. Insulation class: H Enclosure: IP54
Brake System	Aerodynamic brakes: Full feathering
Yaw Control	Type: Plain bearing system Material: Forged yaw ring heat-treated, Plain bearings PETP Yaw gear type: Multiple stages planetary gear Yawing speed (50 Hz): Approx. 0.4 °/s Yawing speed (60 Hz): Approx. 0.5 °/s
Remote Monitoring	The VestasOnline® Power Plant Controller

3.2.2 Road Layout

A comprehensive road network currently exists in the Project Area and is associated with forestry activity and recreational use. These roads will be upgraded as required to safely transport the turbines, provide an appropriate turning radius, and support construction activities in compliance with municipal and provincial guidelines and requirements. In some cases, the construction of new roads will be required to access proposed turbine locations; however, the Proponent is planning to leverage the network of existing roads to the greatest extent possible.

3.2.3 Substation and Power Collection Systems

The Project will also consist of one or more 34.5/230 kV step up transformer(s) located within the Project substation. The Project substation will include all necessary equipment related to protection and control such as breakers, voltage transformers, current transformers, etc. Additionally, the Project will connect to the NS Power electrical system through a 3-breaker ring bus located at the proposed point of interconnection. The project collection system will be comprised of predominantly overhead conductors with a small number of underground conductors around the turbine foundation, as is industry best-practice.

Infrastructure associated with the Project is shown in Drawing 3.2A – 3.2F.

3.3 Project Phases

The Project will include three phases:

- Site preparation and construction
- Operations and maintenance
- Decommissioning

Activities and requirements associated with each phase are discussed in the following sections.

3.3.1 Site Preparation and Construction

Access Road Construction

During the construction phase, Project roads will be maintained with additional gravel or periodic grading. Aggregate material for road construction is expected to be transported from off-site quarries and stored temporarily until used. Any material removed for road construction will be stored or disposed of in accordance with regulations and best practices for road construction. Any material stored on-site will be managed with appropriate erosion and sedimentation control measures or reused. The following equipment is typically used during road upgrading and construction:

- Excavators
- Dump trucks
- Bulldozers
- Rollers
- Graders
- Crusher (not required if a local quarry can supply necessary gravel sizes)
- Light trucks

Approximately 13.3 km of the existing road network will be re-used as part of the Project. Approximately 11.3 km of new road construction is required to provide direct access to the turbines. Access roads will be approximately 6 to 12 m wide. Including ditching and grading, the total corridor will be up to 20 m wide. Wider roads (12 m road surface) are required for the crane to crawl from turbine to turbine and narrower roads (6 m road surface) will be utilized if the crane is mobilized via float trucks.

Laydown Area and Turbine Pad Construction

General activities during the creation of the laydown, turbine pad, and turbine foundation construction areas may include:

- Installation of erosion and sedimentation control measures
- Removal of vegetation

- Removal of overburden and soils
- Blasting/chipping of bedrock (to be determined based on geotechnical conditions and foundation design)
- Pouring and curing of concrete pads (complete with reinforcing steel)
- Placement of competent soils to bring area to grade
- Compaction of soils
- Excavation for electrical conduits and fiber-optic communication trenches

The tower foundations will be approximately 26 m diameter (typical for a wind turbine of the size proposed for the Project) and extend to a depth of 3 to 4 m below grade. Foundations will be backfilled (underground) with the exception of the concrete pedestal which will be 7 to 8 m in diameter and extend up to 0.25 m above ground to support the wind turbine tower structure.

Each wind turbine temporary laydown area is expected to cover up to a 75 m radius around the tower (from the centre of the foundation) to allow for the larger blades, transportation equipment, and cranes. The exact arrangement of each turbine pad and crane pad will be designed to suit the specific requirements of the turbine and the surrounding topography during the detailed design process.

The following equipment may be used for the temporary turbine laydown area and crane pad construction:

- Excavators
- Dump trucks
- Bulldozers
- Rollers
- Graders
- Crusher (not required if a local quarry can supply necessary gravel sizes)
- Concrete trucks
- Light cranes
- Light trucks

Turbine Assembly

The wind turbine assembly includes tower sections, the nacelle, the hub, and three-blade rotors. All sections will be delivered by flatbed truck and the pieces will require a crane for removal from the truck upon arrival at each of the prepared turbine temporary laydown areas.

The tower sections will be erected in sequence starting with the turbine base, followed by the nacelle, hub, and rotor (rotors are usually attached to the hub on the ground prior to lifting). This assembly will occur with the use of cranes. Erection will depend on weather, specifically wind and lightning conditions. Typical assembly duration will be between 3 to 6 days. The following equipment is expected to be used for turbine assembly:

- Main crane unit
- Assembly cranes
- Manufacturer's support vehicles

Collector System, Substation and Transmission Lines

Electricity produced from each turbine will be fed into a local aboveground electrical collector network that will be routed to the Project's substation which will step-up the voltage to 230 kV and connect to NS Power's transmission system at the same voltage level.

The following equipment is expected to be used during the transmission interconnection construction activities:

- Excavator and/or backhoe
- Bucket trucks
- Light cranes
- Light trucks

Removal of Temporary Works and Site Restoration

Upon completion of construction at each turbine location, all temporary works will be removed, and the roads, turbine laydown areas, and other areas within the Project Area will be appropriately graded.

The following equipment is expected to be used in this process:

- Excavator and/or backhoe
- Grader
- Hydroseeder
- Light trucks

Commissioning and Start Up

The turbines will undergo a series of tests for mechanical, electrical, and control functions prior to initializing the turbines start-up sequence. Once the start-up sequence has been initiated, another series of performance checks for safety shutdown systems will be completed. When the turbines have cleared all tests, turbine commissioning can begin.

Commissioning includes performance testing which will be conducted in coordination with NS Power (as the electrical grid operator), to ensure that the generated electricity meets NS Power quality criteria. These performance tests will be completed by qualified wind power technicians, electrical engineering consultants, wind turbine original equipment manufacturer technical representatives, and electrical utility (i.e., NS Power) employees. Additional testing may also be required for transformers, power collection lines, and substation components; all of which will be performed by qualified engineers and technical personnel.

3.3.2 Operation and Maintenance

Maintenance activities will conform to manufacturer's equipment specifications, industry best management practices (BMPs), and facilities standard operating procedures. The Project's operation will be monitored 24/7 by the Proponent's operations centre, local operations staff, and the turbine manufacturer's 24/7 monitoring centre throughout the entirety of Project operations.

The lifespan of the Project is estimated to be a minimum of 25 years. During this time, roads will be used to access the turbines by operations and maintenance personnel and will be maintained as required. During the winter months, all roads will be accessed by way of snow tracking units that do not impact current snowmobile trail use within the Project Area. If necessary for turbine maintenance or in the case of an emergency, roads will be cleared, sanded, and/or salted as needed to ensure safe driving conditions and access.

A vegetation management plan will be initiated to ensure that access roads and turbine locations remain clear of vegetation. Vegetation management will include removal and pruning. The timing of vegetation management will depend on site specific conditions and be beholden to the provisions described in management plans that will be developed prior to the construction.

Due to the potential for public access to the wind farm, signage will be affixed and maintained on all access roads to provide essential safety information such as emergency contacts and telephone numbers, speed limits, and the hazards associated with being within close proximity to the turbines (e.g., ice throw). These signs will be maintained throughout the life of the Project.

Maintenance work will be carried out on a predictive, preventative, and as-needed basis. Maintenance activities may require the infrequent use of a variety of cranes for brief periods of time for replacement of blades and/or other turbine components. The most common vehicle used during maintenance work will be light/medium pickup trucks.

3.3.3 Decommissioning

Prior to decommissioning, NSECC will be provided with decommissioning plans.

Generally, the wind farm decommissioning phase will follow the same steps as the construction phase:

- Dismantling and removal of the turbines and tower sections.
- Removal of the turbine foundations to 1 m below grade and reinstatement with topsoil to ensure stabilization of the land.
- Removal, recycling (where possible), and disposal of collection system, conductor, and poles.
- Removal of all other equipment and associated infrastructure.

3.3.4 Environmental Management and Protection

An Environmental Protection Plan (EPP) will be developed following EA approval. The EPP is the primary mechanism for ensuring that mitigation is implemented, as determined through the EA process, to avoid or mitigate potential adverse environmental effects that might otherwise occur from construction activities, and as required by applicable agencies through permitting processes.

The EPP is developed for all Project personnel, including contractors, and describes the responsibilities, expectations, and methods for environmental protection associated with Project activities. The EPP will incorporate:

- Means to comply with requirements of relevant legislation.
- Environmental protection measures identified as part of the EA.
- Environmental commitments made as part of the EA.

A suggested Table of Contents for the EPP is provided in Appendix A. The EPP will be provided to NSECC prior to the start of construction for review.

3.4 Project Schedule

Table 3.5 presents the Project schedule from EA registration to Project decommissioning.

Table 3.5: Project Schedule

Project Activity	Timeline
EA Registration	Spring 2023
Post-EA Environmental Monitoring Programs	2023 onward
Geotechnical Assessment	Fall 2023/Winter 2024
Engineering Design	Summer/Fall 2023
Municipal Decision on Development Agreement	Spring/Summer 2023
Clearing	Winter 2024
Start of Civil Construction	Spring/Summer 2024
Commissioning	Fall 2025
Operation	End of 2025 onward
Decommissioning	2051 or beyond

4.0 PROJECT SCOPE AND ASSESSMENT METHODOLOGY

As a Class 1 EA, this Registration Document and supporting studies have been developed to meet all requirements under Section 9(1A) of the *Environment* Act, SNS 1994-95, c 1. As such, this submission has been prepared in accordance with:

- A Proponent's Guide to Environmental Assessment (NSECC, 2017)
- Guide to Preparing an EA Registration Document for Wind Power Projects in Nova Scotia (NSECC, 2021)

The Project Team contacted the following regulatory bodies to provide input and advice into the EA scope and planning:

- Canadian Wildlife Service (CWS)
- Nova Scotia Communities, Culture, Tourism and Heritage (NSCCTH)
- NSECC
- NSNRR

4.1 Site Sensitivity

Potential wind farms are assigned a category level, according to a matrix provided in the Guide to Preparing an EA Registration Document for Wind Power Projects in Nova Scotia. This matrix considers the overall Project size and the sensitivity of the Project. The category level then outlines guidance for the collection of baseline data and post-construction monitoring requirements.

As the total turbine height is greater than 150 m, the Project is automatically considered to have a category 4 risk rating.

4.2 Assessment Scope and Approach

EA is a planning tool used to predict the environmental effects of a proposed project, identify measures to mitigate adverse environmental effects, and predict the significance of any residual effects after the application of mitigation measures.

The EA scope focuses on valued components (VCs). VCs are specific components of the biophysical and human environments that, if altered by the Project, may be of concern to regulators, the Mi'kmaq of Nova Scotia, stakeholders, and/or the public. The scope of the EA for this Project includes:

- Identify VCs that the Project may interact with (by activity and phase) within established spatial and temporal boundaries.
- Establish the existing conditions for VCs.
- Identify potential interactions between the Project and the VCs.
- Assess the potential effects that could occur from the interaction.
- Identify mitigation measures to reduce or eliminate those effects.
- Evaluate the significance of the residual environmental effects using VC-specific criteria.
- Identify monitoring of follow-up programs to verify predictions and/or evaluate the need to implement adaptive management.

4.3 Identification of Valued Components

The following VCs were identified based on the experience of the Project Team and through engagement with regulators, the Mi'kmaq of Nova Scotia, and the public:

- Physical environment
  - Weather, climate, air quality
  - Geology, hydrogeology/groundwater
- Biophysical environment
  - Watercourses, fish, and fish habitat
  - Wetlands
  - Flora and fauna (including Mainland moose) habitat
  - Bats
  - Avifauna
  - Species at risk (SAR) (will be considered in the appropriate VC chapter as necessary)
- Human environment
  - Economy, land use, transportation, recreation and tourism, human health
  - Archaeological and cultural resources, land use
  - Electromagnetic interference (EMI)
  - Shadow flicker
  - Visual impacts
  - Sound

4.4 Spatial and Temporal Boundaries

4.4.1 Spatial Boundaries

Spatial boundaries are considered separately for each VC and are typically based on natural system boundaries or administrative/political boundaries, as appropriate. The following spatial boundaries have been established for the effects assessment:

- Project Area – the physical footprint of the Project, where direct physical disturbance is expected to occur.
- Local Assessment Area (LAA) – the area where Project-related effects can be predicted or measured for assessment. The LAA is VC-specific and defined in each VC chapter.
- Regional Assessment Area (RAA) – includes the area established for context in the determination of significance of Project-specific effects. It is also the area in which accidents and malfunctions are assessed. The RAA is VC-specific and defined in each VC chapter.

As detailed in Section 3.1, a Study Area was established as a large assessment area based on PIDs that are included in the development area (Table 3.1, Drawing 2.2). Certain VCs were assessed in the Legacy Study Area (i.e., fauna, avifauna), which was established prior to the determination of the development area. An Assessment Area was subsequently established for detailed field investigations, which includes the physical footprint of the Project where the direct physical disturbance is expected to occur (i.e., the Project Area), plus a 100 m buffer around the turbine pads and a 25 m buffer on either side of the centreline for the road layout and overhead collector line layout, including areas where

collector transmission lines are not following roads. Where appropriate, the Study Area and Assessment Area are identified as the LAA and RAA for specific VCs in the individual VC chapters.

4.4.2 Temporal Boundaries

The temporal boundaries in Table 4.1 apply to all VCs unless otherwise stated.

Table 4.1: Temporal Boundaries

Project Phase	Estimated Temporal Boundary
Site Preparation and Construction	Q4 2023 to Q4 2025
Operation and Maintenance	25 years
Decommissioning	Approximately 25 years post-commissioning unless the Project is permitted to extend its sale of electricity and extends other permits and land access rights

4.5 Potential Project-Valued Component Interactions

The potential interactions between the Project and the VCs, by phase, are presented in the individual VC chapters (Sections 7 to 10), following a description of existing conditions. Where an adverse effect on a VC is identified, strategies for mitigation, avoidance, or compensation are proposed. Where possible, mitigation measures are incorporated into Project design to eliminate or reduce potential adverse effects.

4.6 Effects Assessment Criteria

The significance of the residual effects is determined using defined criteria. Most criteria will be the same for all VCs (Table 4.2); however, magnitude is VC-specific and provided in the individual chapters.

Table 4.2: Effects Assessment Criteria

Rating Criteria	Rating
Magnitude The amount of change in measurable parameters or the VC relative to existing conditions	VC-specific as outlined in individual chapters
Geographic Extent The geographic area in which a residual effect occurs	**Project Area –** residual effects are restricted to the Project Area **Local assessment area –** residual effects extend into the local assessment area **Regional assessment area –** residual effects interact with those of projects in the regional assessment area
Timing Considers when the residual effect is expected to occur	**Not applicable –** seasonal aspects are unlikely to affect the VC **Applicable –** seasonal aspects may affect the VC

Rating Criteria	Rating
Duration The time required until the measurable parameter or VC returns to its existing condition, or the residual effect can no longer be measured or otherwise perceived	**Short term –** residual effect restricted to no more than the duration of the construction phase **Medium term –** residual effect extends through the operation and maintenance phase **Long term –** residual effect extends beyond the decommissioning phase
Frequency Identifies how often the residual effect occurs and how often in a specific phase	**Single event –** occurs once **Intermittent –** occurs occasionally or intermittently during one or more phase of the Project **Continuous –** occurs continuously
Reversibility Describes whether a measurable parameter or the VC can return to its existing condition after the activity ceases	**Reversible –** the residual effect is likely to be reversed after the activity is completed **Irreversible –** the residual effect is unlikely to be reversed

If, based on the criteria in Table 4.2, a residual effect is identified, its significance is then evaluated based on the criteria in Table 4.3.

Table 4.3: Definition of Significant Residual Environmental Effect

Significance Level	Definition
Significant	The potential effect could threaten sustainability of a resource or result in a moderate to high change in baseline levels within the RAA. The effect is anticipated to last for a medium- to long-term duration and will occur on a continuous basis. Research, monitoring, and/or recovery initiatives should be considered and may be required.
Not Significant	The potential effect may result in a negligible to low change in a resource or condition in the RAA but should return to baseline levels within the short-term and occur only once or on an intermittent basis. Research, monitoring, and/or recovery initiatives are not recommended.

4.7 Monitoring and Follow-up

Follow-up programs and monitoring, in some cases developed in conjunction with regulator and other relevant stakeholders, may be recommended to verify predictions and/or assess effectiveness of mitigation measures and the need to implement adaptive management. Follow-up programs and monitoring are presented, as necessary, in individual VC chapters.

5.0 MI'KMAQ OF NOVA SCOTIA

5.1 Overview

The Study Area and Project Area are within the Epekwitk aqq Piktuk District (Territory), centred on Duck Ponds (lake) on 200 m to 225 m elevation and surrounded by high ground of 250 m to 275 m peak elevations. Pictou Landing First Nation is approximately 37 km west-northwest. Paqtnkek First Nation is approximately 37 km east-northeast of the centre of the Project Area and Study Area.

To share information and identify, assess, and avoid potential impacts to the Mi'kmaq of Nova Scotia, thorough community engagement was undertaken, and a Mi'kmaq Ecological Knowledge Study (MEKS) was completed. These efforts are discussed in the following sections.

5.2 MEKS

A MEKS presents a thorough and accurate understanding of the Mi'kmaq use of the land and resources within an area. It is a report of gathered, identified, and documented ecological knowledge which is held by individual Mi'kmaq people. In addition, the MEKS provides information on proposed Project activities that may impact the traditional land and resources of the Mi'kmaq. The MEKS for this Project was completed by Membertou Geomatics Solutions and was geographically scoped to include an evaluation of the Project Area along with a 5 km buffer surrounding the Project Area (referred to as the "Study Area" in the MEKS report). The MEKS has been provided directly to the required reviewers under separate cover.

MEKS considers the land and water areas in which the proposed Project is located to identify what Mi'kmaq traditional use activities have occurred, or are currently occurring, and what Mi'kmaq ecological knowledge presently exists regarding to the area. This process is done in accordance with the Mi'kmaq Ecological Knowledge Protocol, 2nd edition, which was established by the Assembly of Nova Scotia Mi'kmaq Chiefs, and speaks to the process, procedures, and results that are expected of a MEKS.

The MEKS consists of two major components:

- Mi'kmaq Traditional Land and Resource Use Activities
    - Considers both past and present uses of the area.
    - Uses interviews as the key source of information regarding Mi'kmaq use.
- A Mi'kmaq Significance Species Analysis
    - Identifies species in the area and considers resources that are important to Mi'kmaq use (food/sustenance resources, medicinal/ceremonial plant resources, and art/tools resources).
    - Considers resource availability/abundance in the area (along with adjacent areas or in other areas outside), their use, and their importance, with regards to the Mi'kmaq.

A total of 13 interviews were undertaken by the MEKS Team with Mi'kmaq knowledge holders from Pictou Landing First Nation, Paqtnkek First Nation, and Millbrook First Nation between September and November 2022. Interviewees were shown topographical maps of the Project Area and its 5 km buffer and asked to identify where they undertake their activities and to identify where and what activities were undertaken by other Mi'kmaq, if known. These interviews allowed the MEKS Team to develop a collection of data that reflected the most recent Mi'kmaq traditional use in this area, as well as historic accounts. The data gathered was also considered regarding its significance to the Mi'kmaq people. A summary of the MEKS findings is provided below.

Traditional Use in the Project Area

- There is reported Mi'kmaq use within the Project Area.
- Trout and salmon fishing; deer, rabbit, and partridge hunting; and evergreens and wood (e.g., for making axe handles or traps) gathering activities were reported by interviewees in the highest frequency. Other fishing, hunting, and gathering activities were also reported.
- Most activities are considered current use (95% within the last 10 years) timeline category while the remaining activities occurred in the historical past (5% 25+ years ago).

Traditional Use in the Study Area

- There is recent and historic Mi'kmaq use within the Study Area.
- Trout, salmon, gaspereau, and eel fishing; deer, rabbit, and partridge hunting; and blueberry and chaga gathering activities were reported in the highest frequency. Other fishing, hunting, and gathering activities were also reported.
- The activities took place in current use (98%) and historical (2%) timeline categories.

Historic Review

- The known archaeological finds/sites found within the vicinity of the Study Area were mostly found close to rivers and waterbodies as well as among present-day development. Development can be building and road construction including agricultural land use. Most are likely accidental finds, and the site locations provide an indication of where impacts should be minimized, namely at river and brook crossings. The most significant archaeology finds/sites are found within Merigomish Harbour having clusters of archaeology sites on the islands.
- There are potential natural resources within the Pictou-Antigonish Highlands (ecodistrict 330) in areas of exposed bedrock containing Rhyolite stone of suitable properties for tools and weapons for early peoples. There are reported sources of black ash (*Fraxinus nigra*) on the slopes of drainage cuts within the Pictou-Antigonish Highlands. Black ash was and is a valuable resource for tool handles and craft-basket making to early peoples then and to the Mi'kmaq today.
- A review of Specific Claims shows no current and active First Nation Claims within the Project Study Area.

No recommendations were provided in the MEKS; however, the following community concerns were identified during the MEKS interviews:

- "Really good hunting, fishing, and gathering in that area, concerned about effect of turbines/project on these activities."

5.3 Mi'kmaq Engagement

The Proponent engaged the Nova Scotia Office of L'nu Affairs (OLA), which supports with Mi'kmaq engagement planning, from September 2021 to 2022, with the OLA providing guidance and contact information for the Nova Scotia Mi'kmaq Chiefs and Councils.

Outreach and engagement with Mi'kmaq communities specific to the Project has been active since 2020 and is summarized in Table 5.1. Supporting materials are provided in Appendix B.

Table 5.1: Engagement with the Mi'kmaq of Nova Scotia

Community/Organization	Representative(s)	Details
First Nations		
Acadia First Nation	Chief Deborah Robinson Rachel Stevenson	September – October 2020 Introductory e-mail and follow-up call to request virtual meeting. January 2021 Follow-up e-mail to provide a Project update and overview of the NS Green Choice Program RFP. April 2021 The Proponent hand-delivered a letter to provide further details pertaining to the Project. October 2021 E-mail correspondence was sent to provide new details pertaining to the NS Green Choice Program RFP and newly released NS RBP RFP. January 2022 Project update e-mail. March 2022 The Proponent hand-delivered a March update letter to the community.

Community/Organization	Representative(s)	Details
Annapolis Valley First Nation	Chief Gerald Toney John McCaul	September – October 2020 Introductory e-mail and follow-up call to request virtual meeting. January 2021 Follow-up e-mail to provide a Project update and overview of the Nova Scotia Green Choice Program RFP. April 2021 The Proponent hand-delivered a letter to provide further details pertaining to the Project. October 2021 E-mail correspondence was sent to provide new details pertaining to the NS Green Choice Program RFP and newly released NS RBP RFP. January 2022 Project update e-mail. March 2022 The Proponent hand-delivered a March update letter to the community.
Eskasoni First Nation	Chief Leroy Denny Megan Gillis	September – October 2020 Introductory e-mail and follow-up call to request virtual meeting. January 2021 Follow-up e-mail to provide a Project update and overview of the Nova Scotia Green Choice Program RFP. April 2021 The Proponent hand-delivered a letter to provide further details pertaining to the Project. October 2021 E-mail correspondence was sent to provide new details pertaining to the NS Green Choice Program RFP and newly released NS RBP RFP.

Community/Organization	Representative(s)	Details
		January 2022 Project update e-mail. March 2022 The Proponent hand-delivered a March update letter to the community.
Glooscap First Nation	Chief Sidney Peters Michael Peters	September – October 2020 Introductory e-mail and follow-up call to request virtual meeting. January 2021 Follow-up e-mail to provide a Project update and overview of the Nova Scotia Green Choice Program RFP. March 2021 Introductory virtual meeting regarding potential Project opportunities in Nova Scotia such as the Green Choice Program. October 2021 E-mail correspondence was sent to provide new details pertaining to the NS Green Choice Program RFP and newly released NS RBP RFP. October 2021 Follow-up virtual meeting to further discuss the procurement and Project updates. January 2022 Project update e-mail. E-mail correspondence continued. March 2022 The Proponent hand-delivered a March update letter to the community.
L'sitkuk (Bear River) First Nation	Chief Carol Dee Potter Dawn McEwan	September – October 2020 Introductory e-mail and follow-up call to request virtual meeting. January 2021 Follow-up e-mail to provide a Project update and overview of the Nova Scotia Green Choice Program RFP.

Community/Organization	Representative(s)	Details
		April 2021 The Proponent hand-delivered a letter to provide further details pertaining to the Project. October 2021 E-mail correspondence was sent to provide new details pertaining to the NS Green Choice Program RFP and newly released NS RBP RFP. January 2022 Project update e-mail. March 2022 The Proponent hand-delivered a March update letter to the community.
Membertou First Nation	Chief Terry Paul Ike Paul Jason Googoo	September – October 2020 Introductory e-mail and follow-up call to request virtual meeting. January 2021 Follow-up e-mail to provide a Project update and overview of the Nova Scotia Green Choice Program RFP. April 2021 The Proponent hand-delivered a letter to provide further details pertaining to the proposed Project. October 2021 E-mail correspondence was sent to provide new details pertaining to the NS Green Choice Program RFP and newly released NS RBP RFP. January 2022 Project update e-mail. March 2022 The Proponent hand-delivered a March update letter to the community.
Millbrook First Nation	Chief Bob Gloade James Stevens, Economic Development Officer	September – October 2020 Introductory e-mail and follow-up call to request virtual meeting.

Community/Organization	Representative(s)	Details
		January 2021 Follow-up e-mail to provide Project update and overview of the Nova Scotia Green Choice Program RFP. April 2021 The Proponent hand-delivered a letter to provide further details pertaining to the Project. January 2022 Project update e-mail. E-mail correspondence continued and led to planning a virtual meeting. March 10, 2022 Introductory virtual meeting with the Economic Development Officer to discuss the Proponent's proposed Projects for the NS RBP RFP; the Proponent's background and experience in the renewable energy industry; the Proponent's existing projects in the Maritime provinces; an overview of previous partnerships with First Nation communities; a Project progress update, and; the Proponent's interest in further engagement regarding the projects throughout the construction and operation phases. Unfortunately, Chief Gloade was unable to attend the meeting due to a change in schedules; however, the Economic Development Officer noted that he would keep Chief Gloade apprised of the project and the Proponent's development efforts.
Paqtnkek First Nation	(Late) Chief Tma Francis Darryl McDonald Rose Paul	September – October 2020 Introductory e-mail and follow-up call to request virtual meeting. January 2021 Follow-up e-mail to provide Project update and overview of the Nova Scotia Green Choice Program RFP. April 2021 The Proponent hand-delivered a letter to

Community/Organization	Representative(s)	Details
		provide further details pertaining to the Project. October 2021 E-mail correspondence was sent to provide new details pertaining to the NS Green Choice Program RFP and newly released NS RBP RFP. January 2022 Project update e-mail. March 2022 The Proponent hand-delivered a March update letter to the community.
Pictou Landing First Nation	Chief Andrea Paul Heather Mills Barry Francis	September – October 2020 Introductory e-mail and follow-up call to request virtual meeting. January 2021 Follow-up e-mail to provide Project update and overview of the Nova Scotia Green Choice Program RFP. A response was received, and e-mail correspondence continued about the Project. April 2021 The Proponent hand-delivered a letter to provide further details pertaining to the Project. January 2022 Project update e-mail. March 2022 The Proponent hand-delivered a March update letter to the community.
Sipekne'katik First Nation	(Former) Chief Michael Sack Stephanie Doucet Sosep Hatfield	September – October 2020 Introductory e-mail and follow-up call to request virtual meeting. January 2021 Follow-up e-mail to provide Project update and overview of the Nova Scotia Green Choice Program RFP.

Community/Organization	Representative(s)	Details
		April 2021 The Proponent hand-delivered a letter to provide further details pertaining to the Project. October 2021 E-mail correspondence was sent to provide new details pertaining to the NS Green Choice Program RFP and newly released NS RBP RFP. January 2022 Project update e-mail. March 2022 The Proponent hand-delivered a March update letter to the community.
Wagmatcook First Nation	Chief Norman Bernard	September – October 2020 Introductory e-mail and follow-up call to request virtual meeting. January 2021 Follow-up e-mail to provide Project update and overview of the Nova Scotia Green Choice Program RFP. April 2021 The Proponent hand-delivered a letter to provide further details pertaining to the Project. October 2021 E-mail correspondence was sent to provide new details pertaining to the NS Green Choice Program RFP and newly released NS RBP RFP. January 2022 Project update e-mail. March 2022 The Proponent hand-delivered a March update letter to the community.

Community/Organization	Representative(s)	Details
We'koqma'q First Nation	Chief Annie Bernard-Daisley Reg Hurst Susan Raye Googoo	September – October 2020 Introductory e-mail and follow-up call to request virtual meeting. January 2021 Follow-up e-mail to provide Project update and overview of the Nova Scotia Green Choice Program RFP. April 2021 The Proponent hand-delivered a letter to provide further details pertaining to the Project. October 2021 E-mail correspondence was sent to provide new details pertaining to the NS Green Choice Program RFP and newly released NS RBP RFP. January 2022 Project update e-mail. March 2022 The Proponent hand-delivered a March update letter to the community.
Organizations		
KMKNO (Kwilmu'kw Maw-klusuaqn Organization)	Tracy Menge, Benefits Officer	October 2021 The Proponent provided details via e-mail pertaining to the Project and invited members of the KMKNO to further discuss the Project and RFP. Project information provided included: a Project overview; Project location; and details pertaining to the rationale for the Project. Engagement continued via telephone and e-mail on a monthly basis until the end of Q2 2022. March 2022 March update letter sent via e-mail.
Mi'kmaw Economic Benefits Office	General contact (info@mebons.ca)	March 2022 March update letter sent via e-mail.
Mi'kmaq Employment Training Secretariat	Valerie Bowers, Executive Director	March 2022 March update letter sent via e-mail.
Mi'kmaw Native Friendship Centre	Contact form on organization's website	March 2022 March update letter sent via e-mail.

Community/Organization	Representative(s)	Details
Native Council of Nova Scotia	Theresa Cooke, Executive Director/Finance	March 2022 March update letter sent via e-mail.
Ulnooweg	Todd Hoskin, CEO Michelle Richard, Managing Director of Ulooweg Education Centre	March 2022 March update letter sent via e-mail.
Ulnooweg Development Group	Matt Tapper, Business Development Manager	March 2022 March update letter sent via e-mail.
Ulnooweg Indigenous Communities Foundation	Jasmine Seeley, Partnership and Outreach Coordinator	March 2022 March update letter sent via e-mail.
Mi'kmaw Kina'matnewey	General Contact (info@kinu.ca)	March 2022 March update letter sent via e-mail.

5.3.1 Ongoing Engagement

The Proponent is committed to ongoing, meaningful engagement with the Mi'kmaq of Nova Scotia and will continue to provide regular updates and seek feedback throughout the Project. This includes formal engagement facilitated through the KMKNO, as well as engagement with Paqtnkek First Nation and Pictou Landing First Nation led by Glooscap First Nation.

6.0 ENGAGEMENT

The Proponent is committed to meaningful engagement with government, the public, stakeholders, and the Mi'kmaq of Nova Scotia. The Project Team has directly engaged with various stakeholders of the public, municipal leadership and staff, as well as relevant provincial and federal departments through in-person meetings, letters, e-mails, telephone conversations, and multiple open houses (both in-person and virtual). This section provides a summary of the activities that have been conducted by the Proponent and outlines how the Proponent will continue to engage the public throughout the remainder of the Project's permitting, construction, and operational life. Associated presentations, posters, meeting agendas/minutes, and letters of support are provided in Appendix B.

6.1 Engagement with Government Departments, Agencies and Regulators

The Project Team has been in contact with government entities and officials representing federal, provincial, and municipal jurisdictions (Table 6.1) to open lines of communication about the Project and ensure all regulatory requirements are met.

Table 6.1: Government Meetings and Events

Government Departments, Agencies, & Regulators	Representative	Dates, Activities, Comments
Federal Government		
Canadian Coast Guard	Wind Farm Coordinator	April 2023 EMI notification letter sent. May 2023 Letter of non-objection received.
Department of National Defence (DND)	Military Air Defence and Air Traffic Control; Military Radio communication users	Communication throughout 2021-2023 as Project layouts have been updated. April 2023 EMI notification letter sent.
ECCC	Weather Radar Coordinator	April 2023 EMI notification letter sent. May 2023 Letter of non-objection received.
Innovation, Science and Economic Development Canada (ISED)	Nova Scotia District Office	May 2023 EMI notification letter sent. April 2023 Acknowledgement e-mail received.
NAV Canada	Land Use Specialist	Throughout 2021-2023 as Project layouts have been updated. May 2023 EMI notification letter sent.

Government Departments, Agencies, & Regulators	Representative	Dates, Activities, Comments
RCMP	Wind Farm Coordinator	May 2023 EMI notification letter sent. May 2023 Response received requesting coordination with Bell, who are acting on behalf of the RCMP in the province with leased towers.
Transport Canada	Aerodrome Standards Inspector	Throughout 2021-2023 as Project layouts have been updated. Aeronautical Assessment application for marking and lighting was also completed.
Provincial Government		
Member of the Legislative Assembly (MLA) for Antigonish	MLA Michelle Thompson	January – March 2022 Several e-mails were sent to administrative staff. The Proponent was unable to reach MLA Thompson directly.
Department of Public Works	Capital Programs	January - June 2022 Initial outreach regarding the Project and Project location. Proponent requested more information regarding permits required for Project construction and major component/equipment delivery.
OLA	Consultation Advisor	September 2021 Correspondence began in early September of 2021 and has continued into 2022 with the OLA providing guidance and contact information for Mi'kmaq Chiefs and Councils throughout Nova Scotia.
NSCCTH	Director of Special Places Protection	October 2022 E-mail exchanges regarding the confidentiality of archaeological and cultural resources information and approach for incorporating results into the EA.

Government Departments, Agencies, & Regulators	Representative	Dates, Activities, Comments
NSECC	Protected Area Planner Policy & Program Coordinator, Protected Areas & Wetlands EA Supervisor	2021/2022 E-mails and virtual meetings discussing the provision of Project overview, location, timeline, and the NS RBP RFP.
NSECC, Air Quality Unit	Air Quality Protection Advisor	November 2022 Meeting to discuss expectations for the assessment of low frequency noise.
NSECC, EA Branch	EA Officer Supervisor	January 2022 E-mail correspondence regarding data sensitivity for Mainland moose and what data should be provided in the EA versus to NSNRR directly. March 2022 Guide for Wind Energy Environmental Assessments received (NSECC, 2021). October 2022 E-mail exchanges regarding the confidentiality of archaeological and cultural resources information and approach for incorporating results into the EA, and to discuss the timing of the NSCCTH review of the Archaeological Resources Impact Assessment (ARIA).
NSNRR	Species at Risk Biologist	January 2022 E-mail correspondence regarding data sensitivity for Mainland moose and what data should be provided in the EA versus to NSNRR directly. May 2022 E-mail correspondence regarding guidance for bat, bird, and wood turtle surveys. May 2022

Government Departments, Agencies, & Regulators	Representative	Dates, Activities, Comments
		E-mail correspondence regarding the criteria for determining if a site is considered "coastal". June 2022 E-mail discussions about bat monitoring, followed by a call on June 22, 2022. July 2022 Provision of summary table on the status of flora, fauna, and habitat studies. Attempted to schedule a follow-up call.
Municipal Government		
Municipality of the County of Antigonish	Mayor and Councillors Director of Sustainable Communities CAO	June 16, 2021 A virtual presentation (10-12 slides) was delivered by the Proponent to the Director of Sustainable Communities. The presentation provided information regarding the Project, the Proponent's background and experience, the Proponent's existing projects, potential community benefits, a Project timeline, the EA process and planning, and the Nova Scotia RBP and Green Choice Program. After the presentation was delivered, the Director of Sustainable Communities and the Proponent engaged in conversation regarding the Project. The conversation mainly pertained to what benefits might emanate from the Project in the area (both direct and indirect), how the Proponent could engage the council of Antigonish County, and questions regarding the potential for partnerships. Since the meeting on June 16, 2021, the Proponent has continued to send high level updates regarding the Nova Scotia RBP and Green

Government Departments, Agencies, & Regulators	Representative	Dates, Activities, Comments
		Choice Program, as well as updates regarding the Project. No further feedback, questions, or comments have been received to date. November 9, 2021 A virtual presentation (10-12 slides) was delivered by the Proponent to Council and staff. The presentation provided overview of the Project, the Proponent's background and experience, the Proponent's existing projects, potential community benefits, Project timeline, the EA process and planning, and the Nova Scotia RBP and Green Choice Program. After the presentation was delivered, staff and Council posed questions about the Project to the Proponent. Questions mainly pertained to the timeframe for the Project, what benefits might emanate from the Project in the area (both direct and indirect), and questions regarding what work had been completed to date on site. The Proponent answered each question posed by council and staff and the feedback from all staff and council members was very positive. The Proponent provided contact information and invited council and staff to pose more questions via e-mail or telephone if of interest. No further feedback, questions, or comments have been received to date.

Government Departments, Agencies, & Regulators	Representative	Dates, Activities, Comments
Pictou County	Mayor and Councillors CAO Planning staff	June 2021 Pictou County CAO & Staff A virtual presentation (10-12 slides) was delivered by the Proponent to the CAO of Pictou County and staff. The presentation provided overview of the Project, the Proponent's background and experience, the Proponent's existing projects, potential community benefits, Project timeline, the EA process and planning, and the Nova Scotia RBP and Green Choice Program. After the presentation was delivered, the CAO and staff posed questions about the Project to the Proponent. Questions mainly pertained to the timeframe for the Project, what benefits might emanate from the Project in the area (both direct and indirect), and questions regarding what work had been completed to date on site. The Proponent answered each question posed by council and staff and the feedback from the staff and CAO was very positive. The Proponent provided contact information and invited council and staff to pose more questions via e-mail or telephone if of interest. No further feedback, questions, or comments have been received to date. June 2022 – Onward The Proponent has corresponded with planning staff via e-mails and virtual meetings to provide additional information regarding the Project and to gather more information regarding the development permit requirements.

6.1.1 Review of Government Concerns

Discussions with federal and provincial regulators primarily focused on ensuring component studies were scoped appropriately and identifying scenarios where additional study may be warranted (e.g., if wind turbines have tonal characteristics, additional modelling for low frequency sound is required). Questions from municipal government and planners mainly pertained to the timeframe for the Project, community benefits, and on-site work that had been completed to date.

Engagement with government officials will continue through development, construction, and operational phases of the Project.

6.2 Public and Stakeholder Engagement

The Project Team has been involved in formal engagement activities with the public and stakeholders since 2020 to ensure the community was made aware of the Project and given ample opportunity to receive information, ask questions, and share local knowledge. The Proponent directly engaged local landowners regarding the Project and expanded its engagement efforts to include additional landowners near the Project Area throughout the Project's development. The Proponent will continue to engage the public and stakeholders through various communication channels during the Project's development, construction, and operations. Given several members of the Project Team reside within Nova Scotia, the Project Team will be able to respond to questions, comments, and concerns from stakeholders on a timely basis and will be able to visit the Project site on short notice.

Table 6.2 summarizes each of the methods of engagement with stakeholders. Given this Project was submitted to and awarded under the Nova Scotia RBP RFP, several of the engagement activities outlined below refer to this RFP and associated engagement activities.

Table 6.2: Stakeholder Meetings and Events

Community/Stakeholder Organization	Engagement
98.9 XFM and 101.5 The Hawk (local media)	March 3 - 4, 2022 The Proponent sent the Weavers Mountain Virtual Community Engagement Notice to each of the local radio stations to be posted on their community events pages. Members of the public could go to the radio station's website and find an invitation.
Antigonish Sno-dogs Snowmobile Club – President	November 10 - 24, 2021; ongoing correspondence in 2022-2023 This club is registered under the Snowmobile Association of Nova Scotia and is a key stakeholder for the area. An e-mail was sent inviting the president and the Antigonish Sno-dogs Snowmobile Club to the Community Engagement Session. The e-mail also asked if there are any other individuals or recreation clubs that the Proponent should be contacting. Throughout the chain, the President included the General Manager of Snowmobilers Association of Nova Scotia (SANS). A brief discussion of potential impact to the snowmobile trails in the area took place. Additional information regarding the snowmobile trails overlapping the Project area have been shared with Proponent. The Proponent explained plowing would only be necessary for service and maintenance. However, the amount of plowing depends on the topography and the width of the roads. Ideally, the Proponent would only plow one side of the road, just enough to get a service truck in, and leave the other side untouched. This is just one potential plowing plan with snowmobile trails. The Proponent has also investigated allocating extra trail space adjacent to the roads or power line corridors. The Proponent and snowmobile club intend to collaborate on the Project operations plan to ensure snowmobile use can continue throughout Project operations.
Antigonish Rivers Association	November 19, 2021 – April 12, 2022 A member of the Antigonish Rivers Association reached out via e-mail to the Weavers Mountain e-mail address requesting a proposed site map. A response was sent which included a Project Area map as an attachment. A brief discussion of Crown versus private land occurred and a list of PIDs included in the Project Area was requested. The Proponent provided this list via e-mail.
Beaver Bank Community Awareness Association	April 19, 2022 Letter of support received.
Haveracres Maple Farm (local business)	Throughout 2021 The Proponent engaged the landowner/local business regarding the Project and potential to participate in the Project.

Community/Stakeholder Organization	Engagement
LA PICASSE (Cultural Centre) – Executive Director	April 20, 2022 Letter of support received.
Pictou County Partnership (formerly Pictou County Regional Enterprise Network) –Manager of Business Development & Innovation, Scott Ferguson, CEO.	May 4, 2022 Proponent engaged the Pictou County Partnership via e-mail and a virtual meeting about the Project's potential for economic development in the area. Given the meaningful dialogue between the board and the Proponent, the Pictou County Regional Enterprise Network issued a letter of support for the Project on May 5, 2022. October 12, 2022 The Proponent continued to engage about updates to the Project and opportunities for economic development and opportunities in the area. The Proponent is planning to collaborate with the Pictou County Partnership in Q2 2023 to engage local businesses who may be able to participate in the Project or benefit from the development, construction, or operations.
Positive Action for the Keppoch –President	December 7, 2021 A virtual presentation (10-12 slides) was delivered by the Proponent to President of the Positive Action for Keppoch Society Board of Directors. The presentation provided information regarding the Project, the Proponent's background and experience, the Proponent's existing projects, potential community benefits, Project timeline, and the Nova Scotia RBP and Green Choice Program. After the presentation was delivered, discussions continued about potential benefits to the Keppoch Mountain region and the need for a follow-up discussion. Since December 7, 2021, the Proponent has continued to engage the President and his colleagues and has invited the Board of Directors to each of the Project's in-person and virtual engagement sessions. Given the meaningful dialogue between the board and the Proponent, the board issued a letter of support for the Project on March 19, 2021. Conversations are ongoing as the Proponent and board continue to develop potential opportunities for collaboration and benefits as the Project progresses.
Antigonish County Volunteer Fire Department – Chief	April 2023 EMI notification letter sent.

Community/Stakeholder Organization	Engagement
Barney's River Volunteer Fire Department – Chief	April 2023 EMI notification letter sent. April 2023 Question/comment regarding new twinned highway on north side of the powerline on Weavers and Pushie Mountain, which could make it difficult to get equipment and components to the site. April 2023 Project Team responded, clarifying expected primary access routes during the operational lifespan of the Project and confirming permits and consultation with the Nova Scotia Department of Public Works will occur prior to transportation.
Bell Aliant	April 2023 EMI notification letter sent. May 2023 Acknowledgement e-mail received.
Eastlink	April 2023 EMI notification letter sent. April 2023 Acknowledgement e-mail received.
NCS Managed Services Inc.	April 2023 EMI notification letter sent.
Rogers Communications	April 2023 EMI notification letter sent.
Seaside Communications	April 2023 EMI notification letter sent.

Community/Stakeholder Organization	Engagement
Residents	December 2, 2021 In-person community engagement session (more details in Section 6.2.2). March 17, 2022 Virtual community engagement session (more details in Section 6.2.2). November 6, 2022 The Proponent completed an in-person site visit with a landowner from the general area of the Project who had an interest in seeing an operational wind farm. The site visit was at Proponent's currently operating COMFIT Project (Hardwood Lands). The Proponent wanted to provide an in-person experience of seeing a turbine up close so that members of the public and potential landowners could understand the magnitude of the turbine size. November 15, 2022 In-person community engagement session (more details in section 6.2.2).
SANS – General Manager	See Antigonish Sno-dogs Snowmobile Club, above.
Scotian Winds of Change Foundation – Dr. Ronald Milne, Director	April 28, 2022 Letter of support received.
Wagner Forest NS, Ltd (local business) – Ian Johnstone, General Manager	March 9, 2022 Letter of support received.
Wedgeport Tuna Museum – Franklin Cottreau, Manager	April 22, 2022 Letter of support received.
Wildlife advocate (Environmental Technician who lives locally)	November 25-29, 2021 Stakeholder reached out over Facebook when the Proponent announced the Community Engagement Session had been postponed due to the rainstorm and flooding in late November. Stakeholder is a local resident and was curious about the EA work to be completed for the Project. The stakeholder was also looking for a way to work on the environmental aspects of the Project as they are an environmental technician. A link to the Project website was sent which outlined the materials presented at the engagement session. A Project Area map was sent to Stakeholder via e-mail. Resume was received by the Proponent and forward to environmental consultants.
WiRE – President and CEO	April 22, 2022 Letter of support received.

6.2.1 Digital Communications

The Weavers Mountain Wind Energy Project has maintained a website since November 10, 2021 (www.weaversmountainwindenergy.ca). This publicly accessible website continues to be updated regularly. It includes information about the Project, Proponent, and contact information including:

- Physical office address in Nova Scotia
- General office telephone number
- Toll free telephone number
- Name and title of the lead contact for the Project
- Office phone number of the lead contact for the Project
- Mobile phone number of the lead contact
- Project e-mail-address

The Project also has a Facebook, Instagram, LinkedIn, and Twitter page. The Proponent has invited the public to reach out and engage with the lead contact through the social media channels. The public was specifically invited to provide feedback and questions.

6.2.2 Public Open House Events

Three public open house events took place prior to EA registration. Details are provided below.

Open House #1

An Open House was held on Thursday December 2, 2021 from 4:00 – 8:00pm at the St. Joseph's Lakeside Community Centre (2752 Ohio East Rd.). This event was advertised on the Project website and social media platforms including Facebook, Instagram, LinkedIn, and Twitter. To ensure that this notice made an impact on Facebook, the notice was "boosted" via Facebook business advertising in the geographical area where the Project is proposed. The initial Facebook post reached 3,461 people and received 379 post engagements (reactions, comments, & shares). The notice was also sent via e-mail to local elected officials, recreation clubs, and numerous individual stakeholders in the area.

The Project Team presented seven posters and provided a one-page handout, which included contact information for the Proponent and the Project's specific lead contact. The Project Team also answered questions and took feedback about concerns and interest from the local community and various stakeholders. Sign-in sheets were available for participants to provide their contact information and enable follow up. All materials presented at the session were later made available on the Project website.

Open House #2

A second (virtual) Open House was held on Thursday March 17, 2022 from 6:30 – 8:00 pm on Webex. The Weavers Mountain Virtual Community Engagement Notice was posted to the Project website and social media platforms including Facebook, Instagram, LinkedIn, and Twitter. To ensure this notice made an impact on Facebook, the notice was "boosted" via Facebook business advertising in the geographical area where the Project is proposed. The

notice was also sent via e-mail to local elected officials, recreation clubs, and numerous stakeholders in the area, including those who attended the first in-person community engagement session.

During the event, the Proponent presented a PowerPoint presentation reviewing Project details and addressing previous feedback including concerns and interests from local residents. After the formal presentation was complete, a Question & Answer (Q&A) period began. The Q&A period encompassed most of the virtual engagement event. The entire virtual engagement session was recorded and posted to the Project website. The Q&A period was also transcribed into a written format and was posted to the Project website. Proponent staff answered questions and comments on the social media posts regarding the Project and previous community engagement event.

Open House #3

A third Open House was held on Tuesday November 15, 2022 from 4:00 – 8:00pm at the St. Joseph's Lakeside Community Centre (2752 Ohio East Rd.).

The Proponent presented 11 posters and a one-page handout. All materials presented at the session were also made available on the Project website. The Project Team answered questions and reviewed information on the posters with members of the public and various stakeholders.

6.2.3 Review of Concern

Issues and concerns raised by the public have been grouped into broader categories and reference to the relevant section of the EA in which the concern is addressed have been noted (Table 6.3).

Table 6.3: Comments Received from the Public

Key Issues	Proponent Response	Section of EA
Human Health		
Will wind turbines be noisy?	NSECC requires sound levels of no more than 40 dBA outside of a home. For context, 40 dBA is equivalent to the sound of a quiet library. Sound modelling results of the Project indicate that all residences will fall below the 40 dBA threshold. The Proponent has used a minimum setback of 1000 m from all receptors to ensure that noise is mitigated.	Section 10.5
Will there be light pollution due to navigation lighting?	The Proponent will submit all necessary lighting permits and plans to the correct governmental agencies or authorities having jurisdiction for lighting plan review and approval. The Proponent plans to explore aeronautical lighting systems options which use sensors and only illuminate during times of need (i.e., when an aircraft is approaching), as opposed to continuous illumination.	NA

Key Issues	Proponent Response	Section of EA
	These “as-needed” lighting options would greatly reduce the amount of light pollution created by the Project. The Proponent also plans to complete all necessary lighting monitoring post construction and will create a plan to react to any light issues or complaints.	
Socio Economic		
How will this Project impact Mi’kmaq communities?	Proponent engaged Membertou Geomatics who completed a MEKS for the Project. As well, the Proponent has and will continue to engage Mi’kmaq communities throughout the province and welcomes feedback on an ongoing basis.	Section 5
How will this Project impact local traffic?	Traffic during operation will be limited. Access to the site will be gated and keys will only be provided to landowners, Proponents operations staff and suppliers, emergency services, and authorities having jurisdiction. Should there be a considerable concern over traffic, the Proponent can submit a traffic management plan for the construction period.	Section 8.3
How will this impact nearby TV/internet/cell/etc. services?	Consultation with relevant stakeholders has been conducted by the Project Team regarding potential EMI.	Section 10.2
How can we be sure these turbines won’t be stranded?	The Proponent will be contractually required to decommission the turbines after their useful life. The Proponent will be obliged to have some form of security in place with NS Power (Letter of Credit, Bank Guarantee, etc.). If the surety is to be returned, then Proponent must fulfill the obligations of the purchase power agreement (PPA) with NS Power, and this includes decommissioning.	NA
What will be the responsibility or liability of Project partners? For example, if there were accidents, forest fires, etc.?	The Proponent, its contractors, and equipment and service providers will be liable for anything that is caused by the development, construction, or operation of the Project. It depends on what exactly happens and how; however, the Proponent will be held responsible and will be liable for issues caused by the Project. All large Projects are contractually required to have insurance to cover an array of incidents.	N/A
Visual Impacts		
Will there be visual impacts associated with shadow flicker from the wind turbine blades turning?	Shadow flicker is expected to be minimal and within regulations due to the considerable distances between turbines and residences.	Section 10.3

Key Issues	Proponent Response	Section of EA
How will a wind turbine development alter the sightlines in the area?	The Proponent has taken comments and feedback from nearby landowners and interested stakeholders into consideration for turbine placement. Photo renderings of what the Project could look like from specific vantage points and viewsheds have been prepared for this EA.	Section 10.4
Environmental Impacts		
How will this impact wildlife and wildlife habitat, vegetation communities, species at risk, waterbodies, and areas of scientific or natural interest?	A full desktop review and extensive field surveys have been completed to identify the presence of wildlife and wildlife habitat, vegetation communities, species at risk, waterbodies, and areas of scientific or natural interest.	Sections 7.3.2 7.4.1 7.4.2 7.4.3 7.4.4 7.4.5
General		
Where will the turbines be manufactured?	Depending on the final wind turbine procured for the Project, components may be sourced from Germany Spain, Brazil, India, China, the United States, Mexico, or other locations.	NA
Have you ever completed a Project of this size?	The Proponent and its parent company have several projects in development in the US, Canada, and Europe of similar or larger size.	NA

6.2.4 Ongoing Engagement

The Project has evolved significantly to address feedback received from the public. Some examples include:

- Increasing transparency - Proponent staff provided a list of PIDs to members of the public who had questions over the boundaries and locations of the Project Area.
- Additional engagement – the Proponent held a second engagement session based on request for more feedback. This second engagement session was held virtually to accommodate those who could not physically attend the meeting.
- Additional support for local recreation. The Proponent has opened a dialog directly with Positive Action for the Keppoch to ensure that their recreation activities are minimally impacted.

The Proponent will continue to document questions and concerns raised by the public through telephone and e-mail correspondence, and any additional in-person contact with the public. By maintaining a database of public comments, the Proponent is well positioned to design a Project that is sensitive to concerns, while also balancing these concerns with the feasibility of the Project. When possible, the Proponent will directly engage with members of the public, landowners, interested stakeholders, governmental authorities or any other authorities having jurisdiction who have expressed concerns relating to the Project. In addition, the Proponent will reach out to members of the community who have expressed an interest in supporting the Project.

7.0 BIOPHSYICAL ENVIRONMENT

7.1 Atmospheric Environment

7.1.1 Atmosphere and Air Quality

7.1.1.1 Overview

The assessment of the atmospheric environment included a review of weather, climate, and air quality data.

7.1.1.2 Regulatory Context

Relevant legislation includes:

- *Environment Act*, SNS 1994-95, c 1
- Air Quality Regulations, NS Reg 8/2020

7.1.1.3 Assessment Methodology

The assessment was completed through a review of the following resources:

- Ecological Land Classification for Nova Scotia (Neily et al., 2017)
- Environment and Climate Change Canada (ECCC) Weather and Climate (ECCC, 2022a)
- Nova Scotia Environment and Climate Change (NSECC) Ambient Air Quality Data (NSECC, 2022a)

7.1.1.4 Assessment Results

Weather and Climate

Nova Scotia's climate is quite varied and is largely governed by coastal influences and elevation (Davis & Browne, 1996). The Project is located within the Pictou Antigonish Highlands Ecodistrict (330) of the Nova Scotia Uplands Ecoregion (Neily et al., 2017) (Drawing 7.1).

The Pictou Antigonish Highlands Ecodistrict is cold relative to the rest of the province, which can be attributed to its high elevations and limited interaction with the Atlantic Ocean. As a result, the Pictou Antigonish Highlands experience late, cool springs and cold winters, as well as a relatively short growing season (Neily et al., 2017).

The local temperature and precipitation data were obtained from the Collegeville Auto meteorological station (Climate ID 8201001) located approximately 15 kilometres (km) southeast of the Project at 45°29'28.3" N, 62°00'53.9" W (Table 7.1).

Table 7.1: Climate Data from the Collegeville Auto Meteorological Station (2015-2022)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Temperature													
Daily Avg. (°C)	-5.3	-6.1	-3.1	2.9	8.2	13.5	17.8	18.3	13.7	8.5	3.3	-1.7	5.8
Daily Max. (°C)	-0.1	0.2	2.9	8.6	15.3	20.3	24.4	25.1	20.7	14.8	8.4	2.6	11.9
Daily Min. (°C)	-10.5	-12.3	-9.1	-2.9	1.1	6.8	11.1	11.5	6.8	2.1	-1.7	-6.1	-0.3
Extreme Max. (°C)	15.2	14.3	18.4	24.0	31.3	34.3	33.2	33.0	29.9	23.5	23.2	14.8	-
Extreme Min. (°C)	-31.2	-29.9	-27.9	-22.3	-7.4	-4.4	2.3	1.0	-5.4	-8.9	-14.1	-21.3	-
Precipitation													
Precipitation (mm)	137.4	120.7	102.6	127.7	82.3	110.2	83.1	85.8	86.9	130.3	161.5	132.0	1360.6

Source: ECCC, 2022a

From February 2015 to December 2022 (only available data), the mean annual temperature was 5.8 °C, with a mean daily maximum of 11.9 °C and a mean minimum of -0.3 °C. January and February were the coldest months (mean daily average of -5.3 °C and -6.1 °C, respectively), while the warmest months were July and August (mean daily average of 17.8 °C and 18.3 °C, respectively). From February 2015 to December 2022, the meteorological station did not record mean annual snowfall and mean annual rainfall. However, data was recorded in terms of precipitation, with most occurring in November and January (161.5 mm and 137.4 mm, respectively) (ECCC, 2022a).

The wind speed and direction data were also obtained from the Collegeville Auto meteorological station (Table 7.2).

Table 7.2: Wind Data from the Collegeville Auto Meteorological Station (2015-2022)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Maximum Hourly Speed (km/h)	82	75	85	82	65	69	69	50	97	76	70	91
Most Frequent Direction	NW	NW	NW	NW	NW	SW	SW	SW	SW	NW	NW	NW

Source: ECCC, 2022a

The maximum hourly wind speeds recorded at the Collegeville Auto meteorological station between 2015 and 2022 ranged from 50 kilometres per hour (km/h) to 97 km/h. The wind direction most observed at the meteorological station is from the northwest; however, between June and September, wind occurred from the southwest. Note that wind may occur in all

directions; however, during calm wind flows, the direction is not recorded at the meteorological station (ECCC, 2022a). A windrose plot provided for the Tracadie meteorological station (CXTD) located at 45°36'29.988" N, 61°40'46.992" W approximately 41 km northeast of the Project by Iowa State University (2023) demonstrates the wind directions from February 2015 to December 2022 (Figure 7.1).

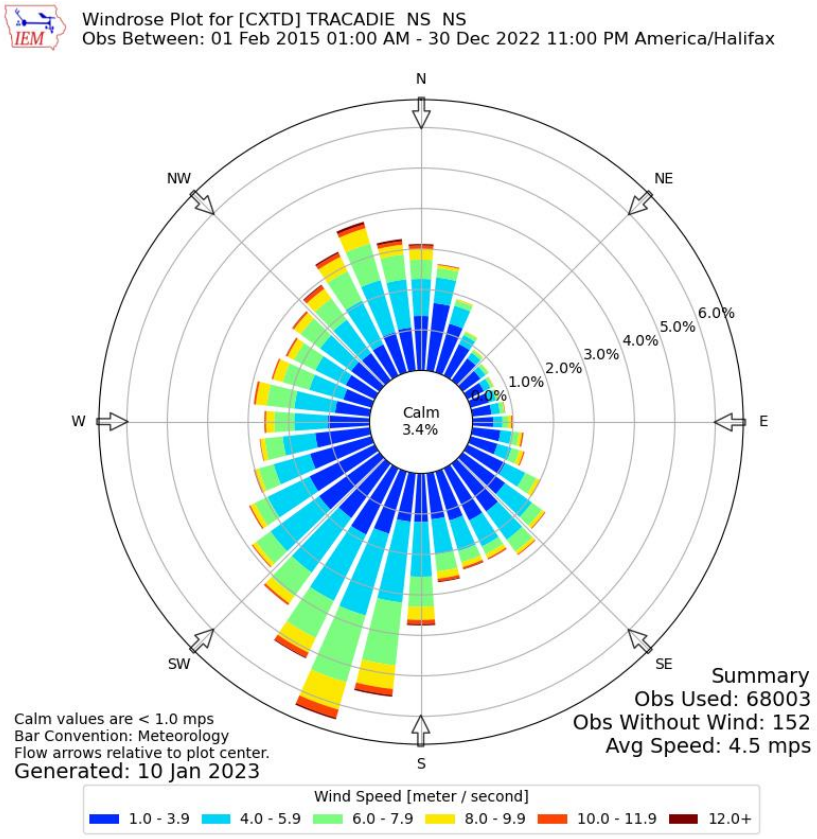

Figure 7.1: Windrose Plot for Tracadie Meteorological Station – February 1, 2015, through December 30, 2022 (Iowa State University, 2023)

Figure 7.1 demonstrates that between February 1, 2015, and December 30, 2021, wind speeds above 12 metres per second (m/s) (43.2 km/h) occurred the most frequently from the northwest and southwest.

Air Quality

The Canadian Council of Ministers of the Environment (CCME) has established Canadian Ambient Air Quality Standards (CAAQS) for fine particulate matter (PM) (≤ 2.5 micrometres (µm) [$PM_{2.5}$] or 10 µm [PM_{10}] in size), ozone (O_3), sulfur dioxide (SO_2), and nitrogen dioxide (NO_2) over select averaging time periods (CCME, n.d.), while the Government of Nova Scotia has legislated Air Quality Regulations (NSAQR), NS Reg 8/2020 under the *Environment* Act, SNS 1994-95, c 1 (Table 7.3).

The ambient air quality standards published in the NSAQR set the maximum permissible ground level concentration limits. Proposed changes to the current NSAQR are underway and will govern future air quality criteria once implemented (NSECC, 2022a).

Table 7.3: Summary of Regulations Pertaining to Ambient Air Quality in Nova Scotia

Contaminant	Averaging Period	Regulatory Threshold (µg/m^3)	
		Existing Provincial[1]	Proposed Provincial[2]
Carbon Monoxide (CO)	1-hour	34,600	35,000
	8-hour	12,700	10,000
Nitrogen Dioxide (NO_2)	1-hour	400	200
	24-hour	-	25
	Annual	100	10
Ozone (O_3)	1-hour	160	-[4]
$PM_{2.5}$	24-hour	-	15
	Annual	-	5
PM_{10}	24-hour	-	45
	Annual	-	15
Sulfur Dioxide (SO_2)	1-hour	900	-
	24-hour	300	40
	Annual	60	-
Total Suspended Particulate (TSP)	24-hour	120	100
	Annual	70[3]	60

[1] Current Ambient Air Quality Standards (NS AAQS) [Air Quality Regulations, NS Reg 8/2020].
[2] Proposed Ambient Air Quality Standards (subject to change) (NSECC, 2022a).
[3] Geometric mean.
[4] Ozone is no longer included as an ambient air quality standard in the Proposed Provincial Guidelines.

Nova Scotia monitors air quality at eight ambient air quality monitoring stations located throughout the province (NSECC, 2022a). Measured parameters at these locations may include the following:

- Carbon monoxide (CO)
- Ground-level ozone (O_3)
- Nitrogen oxides (NO_x)
- Nitric oxide (NO)
- Nitrogen dioxide (NO_2)
- Particulate matter ($PM_{2.5}$)
- Sulfur dioxide (SO_2)
- Total reduced sulfur (TRS)

The NO_2, O_3, and $PM_{2.5}$ values from seven of the eight air quality monitoring stations are used to calculate a score on the Air Quality Health Index (AQHI) (ECCC, 2022c; NSECC, 2022a). The AQHI is a scale from 1-10+, in which scores represent the following health risk categories: Low (1-3), Moderate (4-6), High (7-10), and Very High (10+) (ECCC, 2022c).

The air quality monitoring station closest to the Project is in Pictou, NS, approximately 42 km northwest of the Project at 45°40'57.529" N, 62°41’48.156" W.

Table 7.4 summarizes the current (baseline) maximum ambient air quality conditions observed at the Pictou air quality monitoring station from 2018 to 2022. The monitored parameters are compared to the current NSAQR.

Table 7.4: Current (Baseline) Maximum Ambient Air Quality Conditions in Proximity to the Project

Parameter	Averaging Period	O_3 (ppb)	SO_2 (ppb)	NO_X (ppb)	NO (ppb)	NO_2 (ppb)	$PM_{2.5}$ (ug/m^3)	TSP (ug/m^3)	CO (ppb)	H_2S (ppb)
Pictou Ambient Monitoring 2018-2022	1 hour	83.9	48.0	112.4	80.5	31.9	48.0	-	-	-
	24 hours	53.2	19.1	26.0	11.7	14.2	23.0	-	-	-
	Annual	28.2	0.4	1.2	0.2	0.9	4.8	-	-	-
NS AAQS Schedule A	1 hour	82	340	-	-	210	-	-	30,000	30
	24 hours	-	110	-	-	-	-	120	-	6
	Annual	-	20	-	-	50	-	70*	-	-
Fraction of NS AAQS Schedule A	1 hour	102%	14%	-	-	15%	-	-	-	-
	24 hours	-	17%	-	-	-	-	-	-	-
	Annual	-	2%	-	-	2%	-	-	-	-

Source: NSECC, 2022a
*Geometric mean

As seen in Table 7.4, existing air quality conditions (i.e., baseline data) indicate that most of the measured contaminants are well below their respective NS AAQS Schedule A limits except O_3, which is at 102% of the limit. In reviewing the available data for the Pictou air quality monitoring station, the reported AQHI is typically scored 'low' at all times of the year (ECCC, 2022c).

7.1.1.5 Effects Assessment

Project-Atmospheric Interactions

Project activities will primarily interact with the atmospheric environment through fugitive dust and exhaust emissions from construction equipment (Table 7.5). While this may occur during all phases of the Project, fugitive dust and exhaust emissions would be highest during the construction phase. There are no air emissions associated with the operation of the wind turbines as the generation of wind power will offset power production that would have otherwise been generated from fossil fuels (Section 7.1.2).

Table 7.5: Potential Project-Atmospheric Interactions

Valued Component	Site Preparation and Construction										Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Atmospheric Environment		X	X	X	X	X	X	X		X		X	X	X	X

Assessment Boundaries

The LAA for the atmospheric environment is the Project Area. The RAA for atmospheric is not applicable.

Assessment Criteria

The assessment criteria provided in Section 4.6 apply to the atmospheric environment. The VC-specific definition for magnitude is as follows:

- Negligible – no changes are expected to ambient air quality.
- Low – minimal changes are expected to ambient air quality.
- Medium – some changes are expected to ambient air quality.
- High – widespread changes are expected to ambient air quality.

Effects

Fugitive dust emissions consist of PM and may be generated from open-air activities (e.g., moving earth/disturbing soil, wind erosion, increase in traffic). Fugitive dust emissions are composed mainly of soil minerals, but can also contain salt, pollen, spores, and tire particles. There are two forms of PM which pose the greatest concern for human health: PM with a diameter of 10 µm or less (PM_{10}) and PM with a diameter of 2.5 µm or less ($PM_{2.5}$). PM is measured by Total Suspended Particulate (TSP) and is defined as the mass of airborne particles having a diameter of less than 44 µm.

When fugitive dust enters the atmosphere, it may potentially affect lung and heart functions. PM has been linked to premature death (people with lung and heart disease), non-fatal heart attacks, irregular heartbeat, aggravated asthma, decreased lung function, and increased respiratory symptoms such as irritation of the airways, coughing, or difficulty breathing. People with underlying lung and heart disease, children, and the elderly are the most susceptible to particulate pollution exposure (US EPA, 2022b).

Fugitive dust may also affect the environment through visibility impairment and environmental damage. Fine particles are the leading cause of reduced visibility in many cities, national parks, and wilderness areas. In addition, fugitive dust particles can be carried over long distances (via wind), deposited in other locations, and within surface water features. Some of the effects of particulate deposition may include the following (US EPA, 2022b):

- Increasing lake and stream acidity.
- Altering the nutrient balance in coastal waters and large river basins.
- Depleting the nutrients in the soil.
- Damaging sensitive forests and farm crops.
- Affecting the diversity of ecosystems.
- Contributing to acid rain effects.

Anticipated sources of fugitive dust emissions from the Project will be primarily associated with the construction of the Project and may include the following activities:

- Soil disturbance during site preparation (i.e., clearing/grubbing, grading, blasting).
- Wind erosion from soil or rock stockpiles during grading.
- Increase in traffic on roadways from travel by Project personnel (to/from the site).
- Management of on-site materials transfers (i.e., loading/unloading)

The interaction with local receptors was assessed to determine environmental impacts on ambient air quality from fugitive dust emissions. The closest non-participating receptors are located approximately 1 km from the Project (Drawing 7.2). These receptors are located beyond the extent to which fugitive dust emissions are expected to travel, and, as a result, no impacts are anticipated as fugitive dust emissions are considered short-term (construction), intermittent, and within the LAA.

Construction of the Project may result in an increase of combustion residuals and/or exhaust tailpipe emissions, primarily PM, NO_x, SO_2, and CO from vehicles (i.e., travel by Project personnel, transport/delivery activities) and heavy equipment. The closest non-participating receptors are located approximately 1 km from the Project (Drawing 7.2). Exhaust emissions are primarily anticipated to be associated with local roadways and roads developed for the Project within the Project Area. Exhaust emissions are not anticipated to travel beyond the extent of the Project Area, and as such, impacts to local residential receptors are not anticipated. Overall, exhaust emissions are considered short-term, intermittent, and within the LAA.

Mitigation

An Air Quality and Dust Management Plan will be developed as a component of the EPP to define measures to minimize and mitigate the creation and emission of pollutants, including fugitive dust and exhaust emissions, particularly for the construction phase of the Project.

In addition, general mitigation measures for fugitive (dust) emissions include:

- Conduct grading and site preparation in phases to minimize disturbed soil areas until just prior to construction activities.
- Stabilize exposed soil surfaces by sloping or using vegetation, stone, soil, or geotextiles to prevent dust and airborne particles.
- Compact and/or ridge disturbed soil to prevent dust formation.
- Cease dust-generating construction activities during periods of excessive wind.
- Enclose or cover soil storage and/or stockpile areas.
- Wet (with water) aggregate and soil stockpiles to control dust.
- Design storage areas and material stockpiles with prevailing wind directions in mind.
- Wet roadways and heavy traffic areas with water or dust suppressant technologies to minimize airborne emissions.
- Tie down, cover, and/or store loose site materials and/or products prior to inclement weather and wind events to prevent materials from becoming airborne.
- Wash down vehicles and equipment using hoses and water to remove accumulated mud/dirt on undercarriages, tracks, or wheel wells.
- Ensure Project personnel adhere to all safety protocols and wear appropriate PPE in the event of significant fugitive emissions events (i.e., windstorms, dust storms).

General mitigation measures for exhaust emissions include:

- Ensure equipment meets all applicable provincial and air quality regulations and emissions standards.
- Ensure equipment is fueled using low-sulfur diesel (to reduce SO_x air emissions).
- Maintain engines and exhaust systems according to the manufacturer's specifications and the recommended maintenance schedule.
- Remove from service malfunctioning equipment and/or equipment generating excess amounts of smoke, odour, or noise, until an assessment and necessary repairs can be completed.
- Remove from service construction equipment with improperly functioning emissions control systems.
- Restrict the idling of equipment where feasible.

Monitoring

Given the low to negligible impacts, no monitoring is required.

Conclusion

Results are characterized as low to negligible magnitude, within the LAA, short-duration, intermittent, reversible, and not significant.

7.1.2 Climate Change

7.1.2.1 Overview

Climate change is a long-term alteration of weather patterns and conditions strongly impacted by changes in temperature and precipitation. Climate change typically involves changes in average conditions, as well as changes in variability. The main contributor to climate change is Greenhouse Gases (GHGs) from anthropogenic sources. Since GHGs disrupt the natural heat transfer processes within the Earth's atmosphere, a build-up of these gases has enhanced the natural greenhouse effect. These human-induced enhancements are especially of concern since ongoing GHG emissions have the potential to warm the planet to levels that have yet to be experienced (GOC, 2019a).

The impacts of climate change on the Project are assessed separately under Section 12.1.

7.1.2.2 Regulatory Context

The climate change assessment considered the following Acts and Regulations:

- *Environment Act*, SNS 1994-95, c 1
  - Regulations Respecting Greenhouse Gas Emissions, NS Reg 260/2009
- *Environmental Goals and Sustainable Prosperity Act,* SNS 2007, c 7
- *Canadian Environmental Protection Act, 1999* (*CEPA*)
  - Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations
  - Heavy-duty Vehicle and Engine Greenhouse Gas Emission Regulations
  - Ozone-depleting Substances and Halocarbon Alternatives Regulations

The regulatory guidance was used to determine the appropriate assessment methodologies, mitigation controls, BMPs, and emissions targets.

7.1.2.3 Assessment Methodology

The objectives of this assessment include the following:

- Establish the sources of GHG contributions from the Project.
- Quantify baseline and Project-generated GHG emissions.
- Mitigate and minimize GHG generation from Project-related activities.

Sources of GHG emissions were identified through a review of Project phases, components, and equipment.

Baseline GHGs were quantified using emission factors published in the Nova Scotia Environment and Climate Change Standards for Quantification, Reporting, and Verification of Greenhouse Gas Emissions (2020) and current electricity generating practices from NS Power.

Project-generated GHGs were quantified in accordance with the specifications described in the International Standard ISO 14064 (2019) and using published values found in the literature

(sources provided in applicable sections that follow). GHG emissions and removal enhancements are stated in tons of carbon dioxide equivalent (tCO_2e).

7.1.2.4 Sources of Greenhouse Gas Emissions

The main GHGs of concern include:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Halocarbons
- Water vapour

GHGs may be natural or anthropogenic in origin, except halocarbons, which are human made (GOC, 2019b). The following subsections describe the GHGs and their contributors (sources) as anticipated during each phase of the Project.

Carbon Dioxide

The primary source of atmospheric CO_2 is the anthropogenic burning of carbon-containing fossil fuels (i.e., coal, oil, and natural gas) and deforestation/land clearing activities.

Site preparation and construction for the Project will include several activities that are likely to produce CO_2; these include, but are not limited to, the following:

- Use of heavy equipment (excavators, dozers, cranes, etc.).
- Use of light-duty vehicles and equipment (pick-up trucks, light plants, generators, etc.).
- Land clearing, including the decay of cut foliage (which releases CO_2 slowly).
- Cement production results in the heating of limestone, which releases CO_2 (GOC, 2019b).

During the operations phase, CO_2 emissions will be limited to maintenance activities (i.e., transportation and materials). Where these activities are intermittent and short-term, the GHG contributions from operations are negligible and are not considered further.

Methane

Methane is produced when fossil fuels are burned with insufficient oxygen to complete combustion (GOC, 2019b). Another source of methane is the decay of organic solid wastes and, indirectly, methane can also be released due to disturbances of wetlands (which act as methane sinks).

The Project's construction phase requires heavy- and light-duty equipment, contributing to methane emissions. The potential alterations of wetlands for constructing access roads and wind turbine laydown areas, and the decay of waste (i.e., decomposing cleared vegetation, workforce waste production) will also contribute methane emissions.

During the operations phase, methane emissions will be limited to maintenance activities (i.e., transportation and materials). Where these activities are intermittent and short-term, the GHG contributions from operations are negligible and are not considered further.

Nitrous oxide

The primary sources of N_2O are related to the use of nitrogen-based synthetic fertilizers and manure. These sources have added significant amounts of reactive nitrogen to Earth's ecosystems. Other contributors include the release of N_2O into the atmosphere during the combustion of fossil fuels and biomass (e.g., trees or wood-based fuels) and from some industrial sources (GOC, 2019b).

The Project's construction phase requires heavy- and light-duty equipment, which can contribute to N_2O emissions. Land restoration activities (i.e., soil amendments and reclamation) following construction will also contribute N_2O emissions. Overall, the production of N_2O in association with this Project is anticipated to be minimal.

During the operations phase, N_2O emissions will be limited to maintenance activities (i.e., transportation and materials). Where these activities are intermittent and short-term, the GHG contributions from operations are negligible and are not considered further.

Halocarbons

Halocarbons are a group of synthetic chemicals containing a halogen group (e.g., fluorine, chlorine, and bromine) and carbon (GOC, 2019b). They are typically used in refrigerants, fire-extinguishing agents, solvents, foam-blowing agents, and fumigants (GOC, 2013). There are various industrial sources, but the main contributor is aluminum production (US EPA, 2021).

The primary source of halocarbon emissions from the Project will be associated with coolants in air conditioning units found in vehicles, portable construction buildings (i.e., trailers), and equipment. It is anticipated that air conditioning units will be used during the Project's construction phase. Fire-extinguishing agents (containing halocarbons) may also be used at the Project in the event of an emergency which requires a fire-fighting response.

During the operations phase, halocarbon emissions will be limited to maintenance activities (i.e., transportation and materials). Where these activities are intermittent and short-term, the GHG contributions from operations are negligible and are not considered further.

Water Vapour

Water vapour is the most important naturally occurring GHG. Human activities do not directly influence the amount of water vapour in the atmosphere as it is a function of the atmosphere's temperature. The atmosphere can hold about 7% more water vapour for every additional degree Celsius in air temperature. When the air becomes saturated with water vapour, the water vapour condenses and falls as rain or snow, leading to climate change effects (i.e., variances in weather patterns).

As climate warming gases (i.e., CO_2, CH_4, N_2O) increase in the atmosphere, the resulting temperature rise increases water evaporation from the Earth's surface and increases the atmospheric water vapour concentrations. This increased water vapour, in turn, amplifies the warming from the initial GHGs, causing the cycle to repeat and temperatures to keep rising (GOC, 2019b).

Project activities contributing to GHG emissions are not anticipated to impact water vapour concentrations in the atmosphere.

7.1.2.5 Quantification of the GHG Baseline Conditions

The GHG baseline is a reference of sources, sinks (removing), and reservoirs (storing) occurring in the absence of the Project and is used to compare pre- and post-Project conditions. That said, the baseline determines the quantity of CO_2e emitted from current electricity production methods for the same electrical capacity of the Project.

The baseline sources are related to emissions generated from electricity currently produced in Nova Scotia from coal, oil, natural gas, and wind. There are no sinks and reservoirs attributed to the baseline scenario.

The Proponent has not yet selected a wind turbine for the Project, but is considering units from various suppliers (i.e., Nordex N163, Vestas V162, and Enercon E160). For the purposes of this assessment, the Nordex N163 will be used as it is representative of the various options under consideration (i.e., similar size and capacity).

The Project consists of up to 16 turbines, and based on the Nordex N163, is capable of generating 94.4 MW of renewable energy. Based on the wind turbine design capacity and a capacity factor rating of 39% (Technical University of Denmark, 2023; U.S. Department of Energy, 2023), the Project will be capable of producing approximately 322,508,160[1] kilowatts per hour per year (kWh/year). The lifespan of the Project is estimated to be a minimum of 25 years.

Quantifying GHGs in terms of tCO_2e requires using emission factors published in the Nova Scotia Environment and Climate Change Standards for Quantification, Reporting, and Verification of Greenhouse Gas Emissions (2020) and current electricity generating practices (Figure 7.2).

[1] $5.9\frac{MW}{Turbine} \times 16\,Turbines \times 0.39 \times 365\frac{days}{year} \times 24\frac{hours}{day} \times 1000\frac{kW}{MW} = 322{,}508{,}160\frac{kWh}{year}$

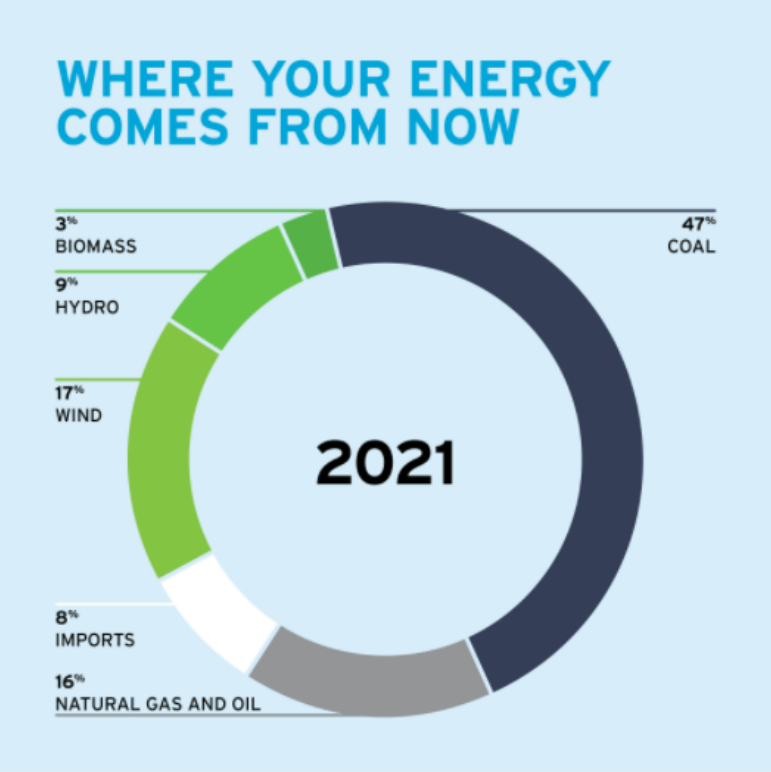

Figure 7.2: NS Power 2021 Energy Statistics

In 2021, electricity generated by NS Power (the leading producer) was produced from the following fuel sources (NS Power, 2022):

- Coal (47%)
- Wind (17%)
- Natural Gas and Oil (16%)
- Hydro and Tidal (9%)
- Imports (8%)
- Biomass (3%)

Most of the electricity generated is through coal, natural gas, and oil at 63%. Renewable sources account for 29% and the remaining 8% consists of imports. For this assessment, the energy imports are distributed amongst coal (+2%), natural gas (+3%), and oil (+3%). Therefore, the fractions used for this assessment were: coal at 49%, natural gas at 11%, and oil at 11%. As most of the renewable energy is generated from wind, quantification considers wind at 29%.

Table 7.6 summarizes the GHG emission factors for the different types of electricity generated in Nova Scotia.

Table 7.6: Electricity Fuel Source Emission Factors

Electricity Fuel Source	Emission Factor (tCO_2e/year)
Coal	0.001251
Natural Gas	0.00044
Oil	0.0011068
Wind	0

Source: USEIA, 2022

Given the current electricity generation methods and the fuel source emission factors (Table 7.6), Table 7.7 summarizes the baseline GHG emissions.

Table 7.7: Baseline Quantification Summary

Electricity Fuel Source	Electricity Generation (kWh/yr)	Emissions (tCO_2e)
Coal	158,028,998	161,998.53
Natural Gas	35,475,898	15,608.85
Oil	35,475,898	39,263.48
Wind	93,527,366	0
Total	**322,508,160**	**216,870.86**

The total annual GHG emissions generated in Nova Scotia for the same electrical capacity of the Project is **216,870.86 tCO_2e.**

Detailed CO_2e calculations are provided in Table 1, Appendix C.

7.1.2.6 Quantification of the Project-generated GHG Emissions

Construction Phase

Access Roads

Most turbines are located adjacent to existing roadways; however, the construction of new roads and upgrading of existing roads will require the removal of vegetation and overburden, which will create fugitive dust and GHG emissions. However, where fugitive dust and GHG contributions for these activities are temporary, short-term, and represent a small incremental addition compared to the overall Project emissions, they were not quantified.

Fugitive dust and air emissions as they relate to the Project, are discussed in Section 7.1.1 (Atmosphere and Air Quality).

Laydown Areas

Laydown areas (estimated 75 m radius = 17,700 m^2 each) are intended to store equipment temporarily and include turbine pad foundation, and the crane pad. These areas will be prepped by removing the vegetation and overburden and placing competent soils. Construction activities and equipment associated with the laydown areas are anticipated to create fugitive dust and

GHG emissions. However, where fugitive dust and GHG contributions for these activities are temporary, short-term, and represent a small incremental addition compared to the overall Project emissions, they were not quantified. Additionally, a vegetation management plan will be initiated to recover the lost flora and reduce dust resuspension while maintaining access and clearances to the turbine.

Concrete Foundation

A concrete tower foundation and pedestal will be required for each wind turbine. As such, the Project will require a significant quantity of concrete to be produced and delivered to each wind turbine location.

In 2017, Casey Concrete Ltd. poured approximately 1,000 cubic metres (m^3) to build the base of a 3 MW wind turbine in Amherst, NS. Transportation of the concrete consisted of 140 truckloads (Kenter, 2017). Note that a concrete supplier has not been procured at this stage; however, for the purpose of this assessment, these concrete quantities will be assumed for GHG quantification. The quantification of the GHG emissions requires the following inputs:

- The vehicle size and fuel type used to transport the concrete.
- The distance travelled to and from the concrete manufacturer to the wind turbine sites.
- The freight and weight associated with each trip (to and from each turbine location).
- The quantity of concrete produced for the wind turbine bases.

Heavy duty diesel concrete trucks will be required to transport concrete to the Project Area. For the purposes of this assessment, transportation distances are based on the nearest known concrete supplier, which is located approximately 13 km from the Project Area. Given the turbine locations are scattered across the Project Area, transportation distances range from 16 km to 29 km (Table 7.8).

Table 7.8: Distance from the Nearest Known Concrete Supplier to Individual Wind Turbine Locations

Wind Turbine	Approximate Distance (km)
1	16.76
2	17.86
3	18.60
4	20.38
5	21.83
6	22.78
7	24.03
8	25.33
9	25.98
10	27.51
11	28.16
12	23.96
13	24.06

Wind Turbine	Approximate Distance (km)
14	25.24
15	25.54
16	25.91
Total	**373.93**

Based on Table 7.8, the total distance between the wind turbines and the nearest concrete supplier is 373.93 km. Assuming 140 truckloads per wind turbine, the total one-way distance travelled is 52,349.5 km. GHG quantification considered travel to and from the nearest concrete supplier to the wind turbine locations.

It is assumed that each concrete truck will carry approximately 17.86 t[2] of concrete per delivery for a total of 2,500 t of concrete per wind turbine.

Table 7.9 summarizes the GHG emission factors for the different components used for concrete-related activities.

Table 7.9: Concrete Manufacturing and Transportation Emission Factors

Component	Emission Factor
Concrete Production	$3x10^{-4}$ tCO_2e/kg
Concrete Truck (Diesel) with Freight	$1.35x10^{-4}$ $tCO_2e/tonne{\cdot}km$
Concrete Truck (Diesel) without Freight	$1.106x10^{-3}$ tCO_2e/km

Source: GHGenius v5.0d (Squared Consultants Inc., 2022)

Given the travelling distances, the quantity of concrete required for the Project, and the emission factors (Table 7.9), the CO_2e emissions are expected to be approximately **12,184.10 tCO_2e** for constructing all the tower foundation and pedestals.

For reference, detailed CO_2e calculations are provided in Table 2, Appendix C.

Turbine

The Project will require wind turbines to be manufactured and delivered to the Project Area. As mentioned, various wind turbines are under consideration, but for this assessment, the Nordex N163/5.X will be used to quantify GHG contributions. This turbine has a rotor diameter of 163 m and can generate up to 5.9 MW of power.

To quantify GHG contributions from the turbines during the construction phase, the following items were assessed:

- The turbine materials and quantity.
- The turbine transportation distances from the manufacturer to the intended wind turbine laydown.

[2] $2{,}500\frac{Tonnes\ of\ Concrete}{Turbine} \div 140\frac{Trucks}{Turbine} = 17.86\frac{Tonnes\ of\ Concrete}{Truck}$

- The vehicle size and fuel type used to transport the wind turbines.

For quantification purposes, the assessment assumed the following:

- Manufacturing material: Steel
- Manufacturing location: Jonesboro, Arkansas (AR), USA
- Nearest US shipping port: Norfolk, Virginia (VA), USA
- Nearest NS shipping port: Port of Sheet Harbour, Sheet Harbour, NS, CA

Wind turbines are typically made up of 12 principal components (Electrical Academia, n.d.):

- Blade (3)
- Drivetrain
- Gearbox
- Generator
- Hub
- Nacelle
- Rotor
- Speed Shafts (low and high)
- Tower

According to the National Renewable Energy Laboratory (NREL) (2017), the total weight of manufacturing material is equivalent to approximately 120,000 kg/MW. Given the Project's wind turbine model capacity of 5.9 MW, the total weight of a wind turbine is approximately 708,000 kg.

GHG emission factor for wind turbine manufacturing is provided in Table 7.10.

Table 7.10: Wind Turbine Manufacturing Emission Factor

Component	Emission Factor (tCO_2e/kg)
Wind Turbine Material (Steel)*	$1.5x10^{-3}$

*Estimated from the UK's mixture of steel types, excluding stainless steel (University of Bath, 2011).

Given the steel required to produce the wind turbines for the Project and the emission factor (Table 7.10), the CO_2eq emissions from the manufacturing of all the wind turbines are expected to be approximately **16,992.00 tCO_2e**.

Nordex SE occupies an onshore turbine manufacturing plant in Jonesboro, AR (Nordex SE, 2010). For the purposes of this assessment, Project turbines are assumed to be manufactured at this location, then will travel to Norfolk, VA, by heavy diesel hauler (transport), where they will be shipped via diesel cargo vessel to the Port of Sheet Harbour, Sheet Harbour, NS. Table 7.11 summarizes the transportation distances from the manufacturer to the Project.

Table 7.11: Wind Turbine Transportation Distances

Originating Destination	Final Destination	Distance (km)
Jonesboro, AR	Norfolk, VA	1,600 (Land)
Norfolk, VA	Port of Sheet Harbour, NS	1,500 (Marine)
Port of Sheet Harbour, NS	Weavers Wind Farm (Project)	140 (Land)

To determine the travel distance for a wind turbine, the following assumptions were made:

- Each component will be individually transported via a single diesel heavy hauler.
  - 12 components per turbine to travel from Jonesboro, AR to Norfolk, VA (total of 19,200 km per turbine).
  - 12 components per turbine to travel from the Port of Sheet Harbour, NS to the turbine location (distance will vary from one turbine location to another).
- Each wind turbine (in its entirety) will be transported via a single diesel cargo vessel.

Land transportation distances were calculated according to the assumptions in Table 7.12.

Table 7.12: Land Distance from the Manufacturer to Individual Wind Turbine Locations

Wind Turbine	Approximate Distance (km)
1	20,925.16
2	20,938.26
3	20,947.23
4	20,968.50
5	20,985.98
6	20,997.33
7	21,012.36
8	21,027.95
9	21,035.75
10	21,054.09
11	21,061.86
12	21,011.55
13	21,012.77
14	21,026.92
15	21,030.53
16	21,034.86
Total	**336,071.10**

*Note: Estimated distances from the Port of Sheet Harbour to the individual turbines one way. The number of trips and the number of transport vehicles should be considered for a cumulative travel distance.

Based on Table 7.12, the total land transportation distance between the wind turbine manufacturer and the wind turbine laydowns (not including marine transportation) is **336,071.10 km**. The total marine transportation distance associated with getting the wind turbines from Norfolk, VA, to the Port of Sheet Harbour, NS, is **24,000 km**. The distances travelled consider travel from the manufacturer to the Project Area only; an equivalent return distance is not considered as the hauling companies would have commitments with other clients, and those GHG emissions would not be attributable to the Project.

GHG emission factors for the different components of wind turbine transportation are provided in Table 7.13.

Table 7.13: Wind Turbine Transportation Emission Factors

Component	Emission Factor (tCO_2e/tonne·km)
Heavy Duty Truck (Diesel) with freight	$1.35x10^{-4}$
Marine Cargo and Container Vessel (Diesel) with Freight	$1.51x10^{-5}$

Source: GHGenius v5.0d (Squared Consultants Inc., 2022)

Given the land transportation distances required to deliver the wind turbines to the Project and the emission factors (Table 7.13), the CO_2e emissions from land transportation of the wind turbines are expected to be approximately **2,676.81 tCO_2e**. In addition, the marine transportation distances required to deliver the wind turbines from the United States to Canada will contribute **256.58 tCO_2e**.

For reference, detailed CO_2e calculations are provided in Table 2, Appendix C.

7.1.2.7 Operations Phase

Following the construction phase, the turbine will be operational, and the sinking of GHG emissions will begin. Based on the wind turbine design capacity and a capacity factor rating of 39% (Technical University of Denmark, 2023; U.S. Department of Energy, 2023), the Project will be capable of producing approximately 322,508,160 kWh/year. Therefore, the renewable energy produced will replace power production from fossil fuels and more intense generation methods described under baseline conditions (Section 7.1.2.5).

According to Padey et al. (2012), maintenance activities are the only contributor of GHGs during the operations phase. The maintenance typically includes replacing approximately 15% of the nacelle components and one blade during the wind turbine's lifetime. According to National Wind Watch Inc. (n.d.), nacelle weights range from 50,800 kg to 68,000 kg and blade assembly weights range from 32,700 kg to 38,100 kg. For the purposes of this assessment, a conservative estimation of 68,000 kg and 38,100 kg was assumed for the nacelle and blade weights, respectively. Given the replacement rates, nacelle material accounts for approximately 10,200 kg and blade replacement 12,700 kg throughout the wind turbine lifetime. The total emission from the replacement material for all the Project's wind turbines is **549.6 tCO_2e** (Table 3, Appendix C).

7.1.2.8 Effects Assessment

Project-GHG Interactions

Project activities will emit GHGs during all phases of the Project (Table 7.14).

Table 7.14: Potential Project-GHG Interactions

Valued Component	Site Preparation and Construction											Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
GHG		X	X	X	X	X	X	X		X		X	X	X	X

Assessment Boundaries

The LAA for GHGs is the Study Area. The RAA for GHGs is not applicable.

Assessment Criteria

Assessment criteria provided in Section 4.6 apply for Project-related GHG contributions. The VC-specific definition for magnitude is as follows:

- Positive – Project is expected to have a positive effect on GHG emissions.
- Negative – Project is expected to have a negative effect on GHG emissions.

Effects

The Project is intended to have a net positive effect on the GHG environment (Table 7.15).

Table 7.15: Project GHG Emission Summary

Component	Emissions (tCO_2e)
Baseline	
Electricity Generated from Coal	161,998.53
Electricity Generated from Natural Gas	15,608.85
Electricity Generated from Oil	39,263.48
Electricity Generated from Wind	0
Total	**216,870.86**
Construction Phase	
Concrete Production and Transportation	12,184.10
Wind Turbine Manufacturing	16,992.00

Component	Emissions (tCO_2e)
Wind Turbine Transportation	2,933.39
Total	**32,109.49**
Operations Phase	
Electricity Generated from Wind	0
Wind Turbine Maintenance	549.60*
Total	**549.60**

Note: The values in this table may differ from the values presented in Appendix D, as a result of rounding errors; however, the rounding errors are negligible and do not change their representation.

*Project lifespan emissions (single event)

As mentioned, the current GHG emissions for the quantity of electricity required by the Project using NS Power's conventional generation methods contribute to **216,870.86 tCO_2e**.

The Project's construction phase will generate the most GHGs from the manufacturing and transportation of the wind turbine, as well as the production and transport of the concrete for the tower foundation and pedestal. The total GHG emission contributions from the construction phase are **32,109.49 tCO_2e**.

The operations phase will generate GHGs from the wind turbines' maintenance (i.e., part replacements) as a one-time (Project lifespan) occurrence of **549.60 tCO_2e**.

Following the commissioning of the Project, the annual Project GHG emission reduction is expected to be **216,870.86 tCO_2e**. A one-time **549.60 tCO_2e** may be subtracted from any annual reduction; however, the annual reduction rate will be applied for the lifespan of the Project (25+ years). The Project is anticipating a 0.1-year[3] payback period to offset the construction-related GHG emissions. Following this period, the Project will positively offset GHG emissions that would typically be emitted from conventional production methods employed by NS Power.

The assumptions considered in this assessment propose a conservative estimate of GHG emissions, which may be lower if turbine and concrete manufacturer locations are closer to the Project and manufacturing materials are less than assumed. Where assumptions may change the values provided in this assessment, the results remain constant; the Project will offset GHGs.

Mitigation

Mitigation measures to reduce the Project's contributions to GHG emissions, thus reducing the overall impact of climate change, include:

- Use locally sourced materials, where possible, to reduce CO_2, CH_4, and NO_x emissions associated with transport.
- Incorporate the shortest construction/transport routes where possible to minimize the use of fossil fuels during construction.
- Recover and recycle construction and demolition waste, where possible.

[3] $\frac{Construction\ Emissions}{Offset\ Emissions} = \frac{32{,}109.49 tCO2e}{216{,}870.86 tCO2e/year} = 0.1 years$

- Recycle and compost workforce waste (i.e., food waste). Diverting this waste will reduce methane generated in landfills as it decomposes.
- Minimize deforestation during land clearing by only clearing the area that will be needed. This will reduce CH_4 and NO_x emissions associated with soil disturbance and limit the use of equipment (lowering emissions produced during equipment operations).
- Plan construction activities to reduce the double handling of materials, reducing GHG emissions associated with heavy equipment operations.
- Use recycled or repurposed materials, where possible, to reduce GHG emissions associated with embodied energy (i.e., the energy associated with manufacturing a product or service).
- Ensure Project equipment meets all applicable provincial and air quality regulations and emissions standards.
- Maintain engine and exhaust systems according to the manufacturer's specifications and applicable maintenance schedule.
- Remove from service malfunctioning equipment or equipment generating excess amounts of smoke, odour, or noise until an assessment and necessary repairs can be completed.
- Ensure construction equipment with an improperly functioning emission control system is not operated.
- Ensure regular equipment maintenance is undertaken to maintain good operations and fuel efficiency.
- Ensure equipment containing coolant (i.e., air conditioning units) undergoes preventative maintenance and inspections (i.e., leak testing).
- Train Project personnel (as appropriate) in the proper disposal of halocarbon-containing substances.
- Dispose of halocarbon-containing substances at an approved hazardous waste facility per applicable regulations and in compliance with local requirements.
- Ensure trucks removing waste from or bringing materials to the Project are filled to the maximum allowable capacity where practical (dependent on the truck size and load weight) to reduce transportation requirements and limit the number of trips, where practical.
- Implement an anti-idling policy to limit GHG emissions from vehicles and equipment and limit the use of fossil fuels.
- Incorporate energy-efficient infrastructure (i.e., solar panels) where feasible to limit GHG emissions and the use of fossil fuels resulting from standard equipment (e.g., diesel-powered generators or light stands).

Monitoring

No monitoring programs are recommended.

Conclusion

Results are characterized as a positive effect within the LAA, medium duration, continuous, irreversible, and significant (positive).

7.2 Geophysical Environment

7.2.1 Overview

The assessment of the geophysical environment included a review of topography, surficial geology, bedrock geology, and hydrogeology/groundwater.

7.2.2 Regulatory Context

Relevant legislation includes:

- Sulphide Bearing Material Disposal Regulations, NS Reg 57/95
- *Environment Act*, SNS 1994-95, c 1

In addition to the above legislation, if blasting is required for the construction of the Project, groundwater wells within 800 m must undergo assessment according to NSECC's Procedure for Conducting a Pre-Blast Survey (1993).

7.2.3 Assessment Methodology

The assessment was completed through a review of the following resources:

- Arial imagery and topography
- Ecological Land Classification for Nova Scotia (Neily et al., 2017)
- Nova Scotia Geoscience Atlas (NSNRR, 2021e)
- Mineral Resource Land-Use Atlas (NSNRR, 2002)
- Nova Scotia Groundwater Atlas (NSNRR, 2021f)
- Karst Risk Map (NSNRR, 2019)
- Well Logs Database (NSECC, 2022b)
- Nova Scotia Pumping Test Database (NSNRR, 2022c)
- Nova Scotia Groundwater Observation Well Network (NSECC, 2015b)
- Potential for Radon in Indoor Air (NSNRR, 2009)

7.2.4 Assessment Results

Topography

The Study Area lies within the Pictou Antigonish Highlands Ecodistrict (330) of the Nova Scotia Uplands Ecoregion (Neily et al., 2017). This Ecodistrict is a rolling plateau that contains some of the highest elevations on the Nova Scotia Mainland, separating lowlands in both Pictou (west) and Antigonish (east) Counties. North of this Ecodistrict is the Northumberland Strait, while the southern extent is bounded by the Chedabucto fault. In the Pictou Antigonish Highlands Ecodistrict, elevations are typically between 210 and 245 m above sea level (masl), with the highest peak located at 300 masl on Eigg Mountain (Neily et al., 2017).

Within the Study Area specifically, topography varies across the landscape, ranging from flat to strongly rolling ridges with many surface boulders (NSNRR, 2021e). In areas containing a thin layer of till, there are ridges of hard rock exposed. There are also an abundance of ground

moraines and streamlined drifts within the Study Area that trend in both the east-west and north-south direction resulting in a hilly landscape (NSNRR, 2021e). Elevations within the Study Area range from approximately 70 to 220 masl (Drawing 7.3).

Surficial Geology

Surficial geology within the Study Area is complex, primarily consisting of stony till plain between 2 m and 20 m in thickness derived from the local bedrock (NSNRR, 2021e) (Drawing 7.4). These plains are comprised of stony-sandy material and are formed as a result of material deposited at the base of melting/receding ice sheets. Other surficial geology units within the Study Area include:

- Colluvial deposits/talus slopes
- Glacially scoured basins and knobs
- Hummocky ground moraines
- Residuum (fragmented bedrock)

Colluvial deposits (also known as talus slopes) are loose deposits of surficial material at the base of steep slopes that are a result of glacial deposition, weathering, and/or ice fractured rock. The thickness of these deposits range from <1 m at the top to 5 m at the bottom of the slope. Colluvial deposits can pose significant geologic hazards as these slopes are subject to sudden and rapid slides/failures (NSNRR, 2021e).

Glacially scoured basins and knobs are areas where glacial activity stripped the landscape of surficial soils/material leaving exposed bedrock of various types that are sometimes overlain by a thin, discontinuous veneer of till (NSNRR, 2021e).

Hummocky ground moraines are concentrations of till material that are formed as a result of sediment deposition from within or the top of melting stagnant ice sheets. The hummocky ground moraines within the Study Area are composed of a loose mixture of sand, gravel, and mud between 2 m and 25 m thick that contains inclusions of water-lain sediment. This results in the formation of stony ridges, depressions, and pits that can pose limitations for construction use (NSNRR, 2021e).

Residuum is an accumulation/collection of fragmented bedrock that was mechanically and chemically broken down before and during glaciation. These surficial units are typically used as a source of road base aggregate (NSNRR, 2021e).

Bedrock Geology

Bedrock geology within the Study Area is also quite complex and contains an abundance of crosscutting fault lines extending primarily northeast-southwest (Drawing 7.5) (NSNRR, 2021e). The dominant bedrock type within the Study Area is the Keppock Formation of the Georgeville Group, which is Neoproterozoic period bedrock consisting of felsic volcanic rock, phyllite, and quartzite (NSNRR, 2021e; White et al., 2020). Other bedrock formations present include:

- James River Formation
- Plutonic Units

All the bedrock types existing within the Study Area date back to the Neoproterozoic period but are comprised of different rock types. The James River Formation (also of the Georgeville Group) is deep water turbiditic conglomerate, mudstone, wacke, and minor basalt. The plutonic units found within the Study Area are intruded formations within the Georgeville Group composed of granitoid to diorite – gabbro that can be found throughout the Antigonish Highlands (NSNRR, 2021e; White et al., 2020).

General Hydrogeologic Conditions

Only 0.5% (or 720 ha) of the Pictou Antigonish Highlands Ecodistrict is comprised of freshwater lakes, streams, and wetlands (dominated by shrub swamps/marshes) (Neily et al., 2017).

The nearest protected water area is the Antigonish – James River Watershed, a 3,916 ha watershed located approximately 6 km north of the Study Area (Drawing 7.6). Designated in 1988 under the *Environment Act*, SNS 1994-95, c 1 (specifically the James River Watershed Protected Water Area Designation and Regulations*,* NS Reg 169/2006) this watershed provides drinking water to the Town of Antigonish and surrounding service areas. The Antigonish – James River Watershed is located on a land owned by the Crown, Town of Antigonish, and few private owners (Town of Antigonish, 2022).

Groundwater Quality and Quantity

The Study Area is predominantly comprised of metamorphic rock (i.e., quartzite) which carries groundwater through fractures and cracks within the bedrock (NSNRR, 2021f). As a result of flow restricted to fractures/cracks, metamorphic groundwater is typically associated with lower quantities of groundwater and consequently lower well yields compared to other regions. Wells located in metamorphic bedrock tend to have lower dissolved solids, hardness, and well water yields as a result of groundwater only flowing through cracks and fractures in the rock. In terms of water quality, metamorphic regions are most often associated with naturally occurring trace metals including uranium, arsenic, iron, and manganese (NSECC & NSNRR, 2009).

There is also a concentrated area of plutonic bedrock within the Study Area. Groundwater within plutonic bedrock regions has similar characteristics to metamorphic bedrock regions (discussed above) as water can also only travel through cracks and fractures present within the bedrock (NSECC & NSNRR, 2009).

Groundwater Wells

Water supplies near the Study Area consist of 33 individually drilled and dug wells. Water well use is classified as either domestic (27) or unspecified (6). A summary of well properties within 2 km of the Study Area as per the NSECC Well Logs Database (2022c) is presented in Table 7.16, and a complete characterization log of water wells within 2 km is provided in Appendix D.

Table 7.16: Summary of Well Records within 2 km of the Study Area

	Drilled Date (year)	Well Depth (m)	Casing Depth (m)	Depth to Bedrock (m)	Static (m)	Estimated Yield (Lpm)
Minimum	1967	3.04	3.04	0.91	-0.03	0.00
Maximum	2011	144.64	38.37	25.88	16.75	681.00
Average	n/a	43.82	17.71	10.33	6.21	56.51

Source: NSECC Well Logs Database, 2022c

Based on short term driller's estimates for the wells located within 2 km of the Study Area, the average yield is approximately 56.51 litres per minute (Lpm) and average well depth is approximately 43.82 m. These measurements represent very short-term yields estimated by the driller at the completion of well construction (NSECC, 2022b).

Four of the 33 water wells identified are located within the Study Area (Drawing 7.7, none of which are within the Assessment Area), which are summarized in Table 7.17.

Table 7.17: Summary of Water Well Records within the Study Area

Well ID	Community	Use	Depth (m)	Casing (m)	Bedrock (m)	Static (m)	Yield (Lpm)	Easting	Northing	Distance to AA* (km)
780385	Kings Head	Domestic	41.72	11.57	9.14	-0.03	36.32	559387	5041092	0.43
780394	Eureka	Domestic	30.45	13.45	11.57	6.39	18.16	562657	5039581	1.30
931291	James River	Domestic	85.26	85.26	23.75	12.18	3.18	566500	5045500	0.50
940914	Marshy Hope	Domestic	73.08	16.44	11.57	15.22	3.18	562500	5044500	0.92

*Distance (km) to the nearest point of the Assessment Area

The NSNNR Pumping Test Database (2022a) provides longer term yields for select wells throughout the province. A well located 0.6 km north of the Study Area in the community of James River (Test ID: ANT-12) indicates a long-term safe yield (Q_{20}) of 7.7 Lpm and an apparent transmissivity of 0.5 m^2/day. This well is located in metamorphic bedrock of the James River Formation and was tested for the James River Park/Beaver Mountain Provincial Park in 1972 (NSNRR, 2022c).

NSECC maintains the Nova Scotia Groundwater Observation Well Network (2015a). The nearest provincial observation well to the Study Area is North Grant (ID 054) located approximately 13 km northeast, near the community of Lower North Grant. This well was drilled to a depth of 45.7 m through shale/slate bedrock. The provincial observation well was constructed and has been monitored since 1987 (data gap between 1997 and 2006). Water levels since 2006 have remained relatively consistent between 19.0 to 20.0 masl but have dropped slightly from water levels recorded from 1987 to 1997 (range of approximately 19.25 to 20.5 masl) (NSECC, 2015b).

7.2.5 Effects Assessment

Project-Geophysical Interactions

Project activities will primarily interact with the geophysical environment during earth-moving activities (Table 7.18).

Table 7.18: Potential Project-Geophysical Interactions

Valued Component	Site Preparation and Construction											Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Geophysical Environment		X		X	X	X				X				X	X

Assessment Boundaries

The LAA for the geophysical environment is the Assessment Area. The RAA is the Study Area (Drawing 2.2).

Assessment Criteria

Assessment criteria provided in Section 4.6 applies for the geophysical environment. The VC-specific definition for magnitude is as follows:

- Negligible – no expected changes to local topography or geology; no anticipated impacts to the quality/quantity of groundwater wells (no wells within 2 km of the Assessment Area).
- Low – changes to local topography/geology are possible but not anticipated as no geologic hazards are presence within the Study Area; impacts to the quality/quantity of groundwater wells are possible but not anticipated (wells exist between 800 m and 2 km from the Assessment Area).
- Moderate – changes to local topography/geology are possible as geologic hazards exist within proximity to the Assessment Area; impacts to the quality/quantity of groundwater wells are possible (wells exist within 800 m of the Assessment Area).
- High – changes to local topography or geology are anticipated due to the presence of geologic hazards within the Assessment Area; impacts to the quality/quantity of groundwater wells are anticipated (wells present within Assessment Area).

Effects

The geophysical environment will be disturbed within the Assessment Area during the site preparation and construction phase, and again during infrastructure removal and site reinstatement. During these phases, potential impacts related to the geologic environment are primarily due to the presence and subsequent disturbance of geologic hazards including:

- Sulfide bearing slates (i.e., acid generating rock)
- Karst topography
- Radon
- Arsenic and/or uranium containing bedrock

In Nova Scotia, several bedrock formations are known to contain acid generating rock (sulfide minerals such as pyrite, pyrrhotite) that, when disturbed, can result in the production of acid rock drainage (ARD). ARD occurs when sulfide-bearing rocks are disrupted and exposed to air or water, producing sulfuric acid and metal oxides that are subsequently mobilized/leached through freshwater systems (NSNRR, 2021a). Construction activities in the presence of ARD can result in the acidification of surface and groundwater and promote the mobilization and leaching of toxic contaminants into the environment, including heavy metals. Within the Assessment Area and larger Study Area, there are no records of sulfide-bearing slates (NSNRR, 2002). The likelihood of ARD occurring will be determined following the results of the geotechnical evaluation.

According to the Karst Risk Map, the Assessment Area is in a “Low Risk” area of encountering karst terrain and/or naturally occurring sinkholes (Drawing 7.8) (NSNRR, 2019). Karst topography is produced by the erosion and dissolution of soluble bedrock, such as limestone. Based on the low risk of karst topography, impacts are anticipated to be minimal.

Radon potential mapping shows the Assessment Area is primarily located in “Low Risk” area (Drawing 7.9) for radon in indoor air (NSNRR, 2009). Radon is present in some bedrock types similar to granite within the Assessment Area; however, there is no indoor air pathway for radon gas associated with the Project. Radon gas is not considered a risk for outdoor inhalation. Though some radioactive shows have been recorded in bedrock similar to the type within the Assessment Area, no shows or radioactive mineralogy above ambient levels are known within the boundaries of the Project.

Construction activities, primarily blasting (if required), have the potential to impact the quality and quantity of surrounding groundwater supply depending on the proximity to drinking water wells and extent of disturbance caused by construction activities. Disturbance of arsenic and/or uranium containing bedrock can mobilize arsenic/uranium within groundwater, and subsequently degrade nearby groundwater well quality. Environmental risk mapping shows that the Assessment Area is located within an area categorized as “Low Risk” (Georgeville Group) to “High Risk” (Plutonic units) for arsenic containing bedrock (Drawing 7.10) and “Low Risk” to “Medium Risk” area (Drawing 7.9) for uranium containing bedrock (NSNRR, 2021f). In addition to water quality, groundwater quantity can potentially be impacted if blasting activities (as required)

alter local hydrogeological flow regimes, resulting in groundwater draining from or flowing towards existing wells. As a result of potential impacts to groundwater quality and quantity, wells located within 800 m of potential blasting activities require monitoring per NSECC's Procedure for Conducting a Pre-Blast Survey (1993). No water wells exist within the Assessment Area; however, three were identified within 800 m of the Assessment Area (Well IDs: 680073, 780385, and 931291). The requirement for blasting and potential for impacts to nearby groundwater wells will be confirmed and assessed further during geotechnical investigations.

Mitigation

Avoidance of any geologic hazards and groundwater resources during the Project's design and development was the priority. In addition, the use of existing road networks, siting in previously disturbed areas, and use of existing right-of-way's minimized the Project's impact to the geologic environment.

The following general mitigation measures are recommended if blasting is required:

- Conduct blasting, if required, in accordance with provincial legislation and subject to terms and conditions of applicable permits.
    - Ensure all blasts are conducted and monitored by certified professionals.
    - Ensure all protective measures outlined in the EPP are implemented in advance of blasting activities.
    - Notify landowners within 800 m of any blasting activities.
    - Conduct a pre-blast survey for wells within 800 m of the point of blast in accordance with NSECC's Procedure for Conducting a Pre-Blast Survey (1993) to monitor for changes in well quality or quantity.
    - Recover and revegetate exposed soils or bedrock as required to minimize any exposure following blasting.
- Include specific mitigation for sulfide bearing materials in the EPP, if they are identified through pre-construction geotechnical surveys.
- Plan site work to minimize disturbance of slate bedrock and exposure of disturbed slate bedrock to rainfall.
- Avoid locating any disturbed or stockpiled slate within or near wetlands, watercourses, and/or waterbodies.
- Ensure rock removal in known areas of elevated sulfide potential will conform to the Sulphide Bearing Material Disposal Regulations, NS Reg 57/95 and any requirements from relevant regulatory departments.
- Store all soil removed during the excavation phase according to provincial standards and best practice guidelines.
- Store any soil needed for backfilling, after foundations have been poured, temporarily adjacent to the excavations until needed. Any remaining excavated material will be used on-site or removed and sent to an approved facility.
- Install erosion and sedimentation control measures prior to excavation activities and inspect controls on a regular basis.
- Remove temporary erosion and sedimentation controls once backfilled material has

stabilized. Attention will be paid during site reinstatement to ensure areas will promote wildlife return to the area, to the extent possible.

Monitoring

The presence of acid generating rock/drainage will be assessed during detailed geotechnical investigations, although no records of acid generating rock have been identified within the Study Area. If acid generating rock is discovered, monitoring plans will be developed as required by applicable regulations/standards.

If blasting is required for the construction of the Project, wells within 800 m of potential blasting activities will undergo pre-blast surveys as per the Procedure for Conducting a Pre-Blast Survey (NSECC, 1993).

Conclusion

Results are characterized as moderate magnitude, within the LAA, medium duration, continuous, reversible, and not significant.

7.3 Aquatic Environment

7.3.1 Waterbodies and Watercourses

7.3.1.1 Overview

The objective of the waterbody and watercourse assessment was to inform the Project's design and collect the information necessary to assess potential impacts to waterbodies, watercourses, and fish habitat (assessed separately in Section 7.3.2) resulting from the Project. This was accomplished using the following approach:

- Identify watercourses and waterbodies within the Study Area using desktop resources (Drawing 7.11).
- Use the information collected to inform Project design (e.g., avoid/minimize impacts to waterbodies and watercourses) and develop an Assessment Area.
- Traverse the entirety of the Assessment Area to ground truth waterbodies and watercourses and provide characterization of any identified features (Drawings 7.12A to 7.12Q).
- Use the information collected to inform mitigation and management practices and further refine the Project Area.

7.3.1.2 Regulatory Context

Under the *Environment Act,* SNS 1994-95, c 1, NSECC has the authority to promote the sustainable management of water resources in Nova Scotia. More specifically, as per section 5A of the Activities Designation Regulations, NS Reg 47/95, the alteration of a watercourse or the flow of water within a watercourse is an activity that requires an approval from NSECC, or a notification to NSECC if the work will be completed in accordance with the Nova Scotia Watercourse Alterations Standards.

There are also federal regulations that impact the management of watercourses. DFO has a responsibility to oversee the protection of fish and fish habitat in accordance with the *Fisheries Act* and *SARA*. Furthermore, the *Canadian Navigable Waters Act* gives Transport Canada the authority to regulate interferences with the public right to navigable waters, including approving and setting the terms and conditions for works within navigable waterways.

7.3.1.3 Desktop Review

Waterbodies

A desktop review was conducted to identify mapped and potential waterbodies within the Study Area, along with any associated aquatic species-at-risk (SAR), using the following sources:

- CanVec Database – Hydrographic Features (NRCan, 2022a)
- Significant Species and Habitats Database (NSNRR, 2018a)

A review of the federal CanVec Database – Hydrographic Features (NRCAN, 2022a) identified one named and four unnamed waterbodies within the Study Area, along with 10 named and 22 unnamed features within 5 km. Duck Ponds is the largest open body of water within the Study Area, approximately 1.83 ha in size, located near the center. A complete list of named waterbodies located within 5 km of the Study Area is provided in Table 7.19.

Table 7.19: Named Waterbodies Within 5 km of Study Area

Name of Waterbody	Distance (km)
Waterbodies Within the Study Area	
Duck Ponds	--
Waterbodies Within 5 km of the Study Area*	
Indian Lake	0.10
Robertson's Lake	0.11
Malcolm's Lake	0.57
MacEachern's Lake	0.74
Cameron's Lakes	0.85
Haggart's Lake	1.77
Brora Lake	3.04
St. Josephs Lake	4.68
MacKays Lake	4.82
Weavers Lake	4.98

*Measurement from the nearest point of the Study Area.

According to the Significant Species and Habitats Database (2018a), none of the waterbodies within the Study Area contain significant species and/or their habitat.

The results of the desktop review indicated that Project infrastructure will not interact with any waterbodies. This was later confirmed by the results of the field assessments. As such, waterbodies are not discussed further in this section.

Watercourses

A desktop review was conducted to identify mapped and potential watercourses within the Study Area, along with any associated aquatic SAR, using the following sources:

- NS Topographic Database (NSTDB) – Water Features (GeoNOVA, 2022)
- CanVec Database – Hydrographic Features (NRCan, 2022a)
- Significant Species and Habitats Database (NSNRR, 2018a)
- Wet Areas Mapping (WAM) (NSNRR, 2012)
- NS 1:10,000 Primary Watersheds (NSECC, 2011)

A review of the NSTDB – Water Features (GeoNOVA, 2022) identified 217 watercourse feature segments within the Study Area and 973 feature segments within 5 km of the Study Area. Several named watercourses were identified within the Study Area including:

- Middle Brook (draining northwest)
- Cameron's Brook (draining east)
- Black Brook (draining south)
- Baxter Brook (draining northeast)

The watercourses within the Study Area drain through three primary watersheds referred to as the South/West River Primary Watershed (1DR), the French River Primary Watershed (1DQ), and the St. Mary's River Primary Watershed (1EO) (Drawing 7.13) (NSECC, 2011). The South/West Watershed drains roughly half of the Study Area to the northeast, eventually discharging into the Northumberland Strait. The French River Watershed drains the northwest quadrant of the Study Area, and eventually discharges into the Northumberland Strait. Finally, the St. Mary's River watershed drains the southwest quadrant of the Study Area and ultimately discharges into the Atlantic Ocean. There are also several secondary watersheds the Project intersects including Barney's River (1DQ-3), West River (1DR-5), and St. Mary's River (1EO-1). Further, there are five tertiary watersheds (i.e., 1DQ-3-B, 1DQ-3-D, 1DQ-3-E, 1DR-5-E, and 1EO-1-H) that control and direct localized drainage within the Study Area (NSNRR, 2021f).

Throughout the Study Area, WAM data shows groundwater ranges from 0 m to >10 m of the surface, with the majority being 2.01 m to 10 m of the surface on account of the area being well to moderately-well drained (Drawing 7.14). These results generally aligned with the locations of watercourses identified using topographic mapping and highlighted the potential for additional watercourses throughout the Study Area (NSNRR, 2012).

According to the Significant Species and Habitats Database, the Study Area is recorded to contain significant species and/or their habitat (NSNRR, 2018) (Drawing 7.15A – 7.15D). The Barneys River system, of which Middle Brook is a tributary, has recorded observations of Wood turtle (*Glyptemys insculpta*). Further, the East River St. Mary's, of which Black Brook is a tributary, has recorded observations of both Wood turtle and Brook floater (*Alasmidonta varicose*). The presence of these significant species and/or habitat was taken into consideration

and the Assessment Area was designed to utilize preexisting infrastructure and avoid any new direct interactions with these tributaries.

7.3.1.4 Field Assessment Methodology

The results of the desktop review were used to inform Project design (e.g., avoid/minimize impacts to waterbodies and watercourses) and determine the Assessment Area. Given that no waterbodies are located within the Assessment Area, field assessment efforts were focused on potential Project-watercourse interactions.

Watercourse assessments were completed during the summer months of 2021 and 2022. Desktop-identified watercourses, along with WAM and predicted flow data, were provided to field staff to guide the identification and assessment of watercourses within the Assessment Area. Field crews assessed the entire footprint of the Assessment Area. Any watercourses identified were delineated (until their extent reached the Assessment Area boundary) and assessed for general watercourse characteristics. Supplementary information on fish/fish habitat and incidental observations of SOCI were also recorded during the surveys (Section 7.3.2). Information collected included:

- Date and time
- Weather
- Watercourse type
- Flow characteristics (direction, velocity, etc.)
- Physical characteristics (width, length, etc.)
- Substrate composition
- Instream cover
- Riparian habitat
- Bank stability and siltation presence
- Fish presence/habitat potential (Section 7.3.2)
- Photos, Global Positioning System (GPS) location, etc.

This information was collected and georeferenced using Survey123, an ESRI application for creating, sharing, and analyzing data. As a result of identified environmental constraints (such as watercourses), the Project's turbine layout underwent several iterations to minimize potential interactions and limit the number of required watercourse crossings. Information collected on watercourses was also used to guide further freshwater species assessments (i.e., fish and herpetofauna).

7.3.1.5 Field Assessment Results

A total of 17 watercourses were identified within the Assessment Area (Appendix E and Drawing 7.12A to 7.12Q), including small permanent (8), large permanent (5), ephemeral (3), and intermittent (1) features ranging in bankfull width from 0.04 m to 7 m. There were no incidental observations of aquatic SAR identified during the watercourse assessment. Potential turtle habitat is discussed in Section 7.4.3.

Permanent watercourse features see flow for the vast majority, if not the entirety, of the year. Their continuous flow is often attributed to their direct connection to stable sources of water, including lakes and groundwater springs (US EPA, 2013). Small permanent features include

streams, brooks, and creeks. These features are often first- and second-order streams fed by springs, groundwater, and run-off, and often act as tributaries to larger features, creating larger permanent features at their confluence. Large permanent features often exhibit lower flow path gradients, larger channel dimensions, and an increased flow (US EPA, 2013).

Ephemeral watercourses do not have stable courses of water, and exhibit flow only after heavy precipitation or significant snowmelt events. Runoff is the primary source of water for these features, and they serve an important role of redirecting overland flow towards more established riverine environments (US EPA, 2013). As such, these features also play an important part in the flood prevention and nutrient cycling regimes of their respective environment.

Intermittent watercourses exhibit overland flow in intervals throughout the year. They typically have well-defined stream morphology, and often have subterranean flow when overland flow is absent (US EPA, 2013). These features are heavily influenced by seasonality, often displaying characteristics similar to permanent features during periods of heavy rain, or after significant snowmelt. During drier times of the year, flow velocity within these features may reduce to pools of standing water, or eventually dry stream beds (US EPA, 2013).

Of the 17 identified watercourses, five are located along pre-existing roads and have evidence of alteration including metal culverts, plastic culverts, and clear span bridges. The remaining 12 watercourses do not have crossing structures along the surveyed reaches.

7.3.1.6 Effects Assessment

Project-Watercourse Interactions

Project activities, primarily those that involve earth moving, vegetation removal, and road construction have the potential to impact watercourses (Table 7.20). These potential impacts could include habitat loss, changes to hydrology, and/or displacement of sediment.

Table 7.20: Potential Project-Watercourse Interactions

Valued Component	Site Preparation and Construction										Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Watercourses			X	X	X	X			X				X		X

Assessment Boundaries

The LAA for watercourses includes the Assessment Area. The RAA for watercourses includes the Study Area (Drawing 2.2).

Assessment Criteria

The assessment criteria provided in Section 4.6 also apply to watercourses. The VC-specific definition for magnitude is as follows:

- Negligible – no loss of aquatic habitat and no expectation for altered hydrology.
- Low – no loss of aquatic habitat, with minimal potential for altered hydrology.
- Moderate – small loss of aquatic habitat and altered hydrology expected but can be managed with routine measures.
- High – loss of aquatic habitat, with altered hydrology expected that would be challenging to manage with routine measures.

Direct Effects

A geographic information system (GIS) suitability analysis was conducted to design a Project Area that would minimize the placement of Project infrastructure within or near watercourses and waterbodies. To further meet this goal, the Project design utilizes as many pre-existing roads as possible. In areas where Project-watercourse interactions cannot be avoided, direct effects such as habitat loss or altered hydrology may arise. Furthermore, direct effects to watercourses are likely to be most prominent during construction. As such, effect-specific active management, mitigation, and monitoring are required to eliminate, mitigate, or otherwise manage the magnitude of these direct effects.

Habitat Loss

Watercourse alterations required to facilitate Project developments have the potential to impact aquatic habitat, with the biggest risk being in the immediate area of where the watercourse will be crossed. The removal of overhanging vegetation from stream banks decreases shade/cover for fish resulting in increased vulnerability to predators. Likewise, the removal of instream cover, such as coarse woody debris or edge habitat (e.g., undercut banks) can have a negative effect on both fish and aquatic invertebrate habitat (MTO, 2009). Furthermore, alterations to channel morphology including altered substrate composition and interference with sediment transport can also result in aquatic habitat degradation.

Altered Hydrology

None of the alterations are expected to result in the diversion, redistribution, or realignment of the respective watercourse. That is, each alteration will be executed as a means of retrofitting the current or natural conditions to facilitate Project developments. Furthermore, several watercourses within the Assessment Area contain pre-existing crossings that have declined in efficiency since being installed. Therefore, some areas will see improved hydrology and fish passage with the upgraded crossings.

Road Upgrades

If determined to be required, five of the 15 forecasted alterations will be upgrades to pre-existing watercourse crossings and will take place during the road upgrading process. Four of these alterations would stem from retrofitting or replacing existing culverts to accommodate road widening and/or changes in carrying capacity. Project engineers will make this determination during the detailed design phase.

The remaining alteration (1) would stem from upgrading or replacing an existing clear-span bridge that crosses WC17. It is likely that the bridge will need to be replaced to accommodate transport of Project infrastructure. Should the bridge need to be replaced, another open-bottom structure will be utilized to ensure watercourse characteristics stay as true to pre-construction conditions as possible. Project engineers will make this determination during the detailed design phase.

Road Construction

The current Project layout and proposed areas for construction of new roads will require the installation of 10 new watercourse crossings. Each of these crossings will be designed to avoid any permanent diversion, restriction, or blockage of natural flow, such that the hydrologic function of the watercourse is maintained. Specific details of each crossing will be finalized during the detailed design phase and will be included in any necessary applications for alteration or notifications to NSECC.

A summary of the watercourses identified within the Assessment Area and how they are expected to interact with Project infrastructure is provided in Table 7.21.

Table 7.21: Watercourse Alteration Summary

Watercourse	Existing Alteration Present?	Forecasted Alteration
WC1	None observed.	Crossing to be installed with road construction.
WC2	None observed.	Crossing to be installed with road construction.
WC3	None observed.	Crossing to be installed with road construction.
WC4	None observed.	Crossing to be installed with road construction.
WC5	None observed.	Crossing to be installed with road construction.
WC6	None observed.	Crossing to be installed with road construction.
WC7	None observed.	Crossing to be installed with road construction.
WC8	None observed.	No alteration expected as watercourse can be avoided.

Watercourse	Existing Alteration Present?	Forecasted Alteration
WC9	None observed.	Crossing to be installed with road construction.
WC10	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC11	None observed.	Crossing to be installed with road construction.
WC12	None observed.	Crossing to be installed with road construction.
WC13	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC14	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC15	None observed.	No alteration expected as watercourse can be avoided.
WC16	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC17	Yes, open-bottom bridge structure for road crossing.	Open-bottom bridge structure to be assessed and potentially replaced with road upgrades.

Indirect Effects

Indirect effects such as erosion and sedimentation or changes in water quantity and quality can be farther reaching, extending outside of the LAA and into the greater RAA. These effects are often foreseeable, and research based, standardized BMPs can be implemented to mitigate the resulting outcomes, and the magnitude at which they are felt.

Erosion and Sedimentation

The mobilization of sediment within aquatic environments can cause shifts in ecological integrity, including changes to the plant species composition, the distribution of primary and secondary producers, and the habitat suitability for vulnerable species (Tilman et al., 1997). Erosion and sedimentation can occur throughout the lifecycle of the Project, including during construction efforts, routine road maintenance, and daily traffic. However, the highest potential for these effects is related to the construction and upgrading of access roads, and the installation or upgrading of crossing structures. The alteration or removal of riparian vegetation can also result in bank instability and erosion.

Changes in Surface Water Quantity

Changes to the amount of flow can alter channel morphology, increase flood potential, and disrupt habitat characteristics that support vulnerable species (MTO, 2009). These impacts could result from the alteration of bank or channel grades for road development, the compaction of soil from the heavy machinery required for turbine assembly, or the alteration of channel beds to facilitate the removal and replacement of preexisting infrastructure (e.g., rusted culverts).

Changes in Surface Water Quality

Changes in the quality of surface water can arise from alterations to the surrounding environment and can include an increase in water temperature from decreased shade, an increase in pollutants from machinery and infrastructure, and the mobilization of sediments (MTO, 2009). Given the dynamic nature of channeling water, effects upon water quality can quickly spread throughout different reaches of the respective watershed.

Mitigation

The primary mitigation measure to minimize potential effects on watercourses is the Project's use of existing roads. In addition, a site-specific EPP will be developed to further inform mitigation measures. This EPP will act as a "living document" that incorporates an adaptive management approach to environmental protection and mitigation. Further, the EPP will incorporate proven BMPs that have demonstrated success in mitigating such effects.

As required, all work completed under the provincial watercourse alteration notification process will be done in accordance with the Nova Scotia Watercourse Alterations Standards (2015c) and executed by a certified Watercourse Alteration Installer/Sizer. For work requiring an approval, specific and detailed mitigation will be developed and submitted to NSECC as part of the application process.

The following mitigative measures will be implemented to avoid and mitigate potential effects to watercourses:

Habitat Loss

- Educate Project personnel on the sensitivity of aquatic habitat.
- Ensure watercourses are clearly marked and avoid impacts to the watercourse and adjacent riparian habitat to the extent possible.
- Revegetate along the watercourse edge and above the ordinary high-water mark to stabilize the area.
- Redesign existing watercourse crossings to facilitate habitat upgrades, including unblocking culverts and making waterways more conducive to fish passage.
- Locate new crossings away from potential salmonid spawning areas, such as pools with a dominant substrate of small-to-medium sized gravel (DFO, 2022a).
- Conduct work between June 1 and September 30 to avoid sensitive periods in the life cycles of fish, to better control water flow, and to allow for a faster revegetation period (NSECC, 2015a).

Erosion and Sedimentation

- Develop a site-specific erosion and sedimentation plan during the detailed design phase.
    - The plan will target the disturbance to banks (as required) and adjacent land, and will address the type of control structures, proper installation techniques, grading, maintenance and inspection, timing of installation, and revegetation.
- Limit the area of exposed soil and the length of time soil is exposed without mitigation (e.g., mulching, seeding, rock cover).

- Limit the slope and gradient of disturbed areas to minimize the velocity of surface water runoff.

Changes in Surface Water Quantity

- Integrate water management systems including diversion and collection ditches, roadside drainage channels, vegetated swales, and stormwater retention ponds.
- Design any necessary alterations in a way that maintains the natural grade of the watercourse, to ensure the hydroperiod remains as it was pre-alteration.
- Fit any watercourse crossings with appropriately sized infrastructure, as prescribed by a certified Watercourse Alteration Installer/Sizer.

Changes in Surface Water Quality

- Leave riparian vegetation as intact as Project developments will allow.
- Integrate outlet protection features to dissipate flow velocities and decrease erosion at the outflow.
- Ensure that if concrete is to be used, it is pre-cast and cured for at least one week prior to use at a crossing site (NSECC, 2015a).
- Utilize untreated, rot-resistant timber (e.g., hemlock, tamarack, juniper, or cedar) below the ordinary highwater mark to avoid the leaching of toxic preservatives into waterways (NSECC, 2015a).
- Utilize rock material that is clean, coarse granular, non-ore-bearing, non-watercourse-derived, and non-toxic to aquatic life (NSECC, 2015a).

Monitoring

For crossings subject to provincial notification requirements, visual monitoring will be completed during the installation process to ensure the work is conducted in accordance with the Nova Scotia Watercourse Alteration Activity Standards (2015c). Monitoring requirements for crossings requiring an approval will be determined on a crossing-specific basis during the detail design phase.

A watercourse monitoring plan, if required as part of the permitting phase, will consist of detailed monitoring and general spot checks. Detailed monitoring will include hydrological, sediment, and stability assessments upstream, downstream, and at the crossing of the watercourse. Spot checks will involve a general overview of vegetative, hydrological, and substrate conditions, focusing on evidence of significant hydrologic alterations, sedimentation, and degradation of fish habitat. An example is included in Table 7.22.

Table 7.22: General Watercourse Monitoring Parameters and Methods of Assessment

Monitoring Parameter	Tasks	Method of Assessment	
		General Monitoring	Detailed Monitoring
Erosion and Sedimentation	Examine stability of watercourse banks both upstream and downstream of the crossing. Examine grade of slope at the crossing, taking note of any erosive channeling in substrate that would indicate the slope may be too steep.	Yes	Yes
	Inspect sediment control measures for effectiveness and look for evidence of sedimentation within the watercourse.	Yes	No
Water Quantity	Examine flow velocity, taking note of any undercutting or abrasive channeling, leftover construction debris, or obstruction to flow resulting from alteration activities.	No	Yes
	Preserve ability for fish passage by maintaining flow and adequate water levels.	No	Yes
	Examine water management systems (e.g., drainage channels) for effectiveness, taking note of any blockages, washouts, or unfavorable conditions.	Yes	No
Water Quality	Record basic water quality parameters and infer whether alteration activities have drastically disrupted natural conditions.	Yes	Yes
	Note the physical characteristics of watercourse, including colour, odour, cloudiness, or presence of algae.	Yes	Yes
Habitat Loss	Conduct stream assessments equivalent to those completed prior to alteration. Examine substrate, taking note of any obvious sediment mobilization, residual slash, or a build-up of fines/muck.	Yes	Yes
	Examine crossing for visual observance of fish, and/or any obvious signs of deteriorated fish habitat (e.g., desiccation of riparian vegetation, channel infill, etc.) or diversified fish habitat (e.g., pools, woody debris, etc.).	Yes	No

Conclusion

As previously mentioned, there are no identified Project-waterbody interactions.

The effects to watercourses are expected to be of moderate magnitude such that there will be a loss of aquatic habitat and altered hydrology that can be minimized through the implementation of effect-specific active management, mitigation measures, and monitoring programs. The timing and seasonality of effects is expected to be applicable, with a potential for the effects to be exasperated by high precipitation events in the spring and fall. Effects will be restricted to the LAA, be a short-term single event, and reversible. Therefore, effects to watercourses will not be significant.

7.3.2 Fish and Fish Habitat

7.3.2.1 Overview

The objective of the fish and fish habitat assessment was to inform the Project's design and collect the information necessary for the assessment of fish species and associated habitat within the Study Area. This was accomplished using the following approach:

- Identify potential fish habitat (waterbodies, watercourses, and wetlands) within the Study Area using desktop resources.
- Use the information collected to inform the Project design (e.g., avoid/minimize impacts to watercourses and water bodies) and determine an Assessment Area.
- Assess the quality of fish habitat within the Assessment Area via field surveys.
- Inventory and assess abundance and diversity of fish within the Assessment Area.
- Use the information collected to inform mitigation and management practices and further refine the Project Area.

7.3.2.2 Regulatory Context

For species designated as rare or at risk, said species and/or their dwellings are provided protection provincially under the NS *ESA* and *Biodiversity Act,* SNS 2021, c 3, and federally under *SARA*. Throughout this EA, SOCI are defined as follows:

- Species listed under *SARA* as "Endangered", "Threatened", or "Special Concern" (GOC, 2022).
- Species listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as "Endangered", "Threatened", or "Special Concern" (GOC, 2022).
- Species listed under NS *ESA* as "Endangered", "Threatened" or "Vulnerable" (Government of NS, 2022).
- Species having a subnational (provincial) rank (S-Rank) of "S1", "S2", or "S3" (ACCDC, 2022).

Federally, DFO is responsible for the protection of fish and fish habitat in accordance with the *Fisheries Act.* Section 34.4(1) of the *Fisheries Act* states that no person shall carry on any work, undertaking or activity, other than fishing, that results in the death of fish, and Section 35(1) of the *Fisheries Act* restricts any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish or fish habitat. The *Fisheries Act* provides additional protection to fish and fish habitat through means such as permitting, licensing, regulations, habitat restoration, marine refuge, and fish stocks.

Provincially, the potential for alterations/activities to impact fish and fish habitat is considered through the watercourse and/or wetland alteration application process, as appropriate.

7.3.2.3 Desktop Review

The desktop component included a review of the following resources and databases:

- Completed watercourse assessments (Section 7.3.1)
- Completed wetland assessments (Section 7.3.3)
- NS 10K Topographic Database – Hydrographic Network (NRCan, 2022a)
- WAM (NSNRR, 2012)
- Aquatic Species at Risk Map (DFO, 2022b)
- NS Significant Species and Habitats Database (NSNRR, 2018)
- Atlantic Canada Conservation Data Centre (ACCDC) Data Report (ACCDC, 2023)

Surface water mapping and associated information conducted for waterbodies, watercourses, and wetlands is found in Sections 7.3.1 and 7.3.3, respectively.

The Aquatic Species at Risk Map is a federal database showing the distribution of SAR and their associated critical habitat within Canadian waters (DFO, 2022). A review of this database determined that there are no water features within the Study Area that contain SAR. The nearest SAR water features are Eden Lake located 10 km to the southwest and Lochaber Lake located 13 km to the southeast. Both waterbodies are known to contain Brook floater (DFO, 2022).

The Nova Scotia Significant Species and Habitat Database (NSDNRR, 2018a) contains one unique record pertaining to fish and fish habitat within the Study Area. This record is for Brook floater present within the East River St. Mary's, which has tributaries that extend into the southern portion of the Study Area.

The Nova Scotia Significant Species and Habitat Database (NSNRR, 2018a) contains 15 unique species and/or habitat records pertaining to fish and fish habitat within a 100 km radius of the Study Area. These records include:

- Nine "Species at Risk" records relating to Triangle floater (*Alasmidonta undulata*) (5), and Brook floater (4).
- Six "Species of Concern" records relating to Triangle floater (4), Brook floater (1), and Ash gyro (*Gyraulus parvus*) (1).

The ACCDC database identified 16 fish and aquatic invertebrate SOCI within 100 km of the Study Area (Table 7.23).

Table 7.23: Fish and Aquatic Invertebrate SOCI within a 100 km Radius of the Study Area

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
Fish					
Alewife	*Alosa pseudoharengus*	---	---	---	S3B
American eel	*Anguilla rostrata*	Threatened	---	---	S3N
Atlantic salmon - Eastern Cape Breton pop.	*Salmo salar pop. 4*	Endangered	---	---	S1
Atlantic salmon - Gaspe - Southern Gulf of St. Lawrence pop.	*Salmo salar pop. 12*	Special Concern	---	---	S1
Atlantic salmon – inner Bay of Fundy pop.	*Salmo salar pop. 1*	Endangered	Endangered	---	S1
Atlantic salmon – Nova Scotia Southern Upland pop.	*Salmo salar pop. 6*	Endangered	Endangered	---	S1
Brook trout	*Salvelinus fontinalis*	---	---	---	S3
Lake trout	*Salvelinus namaycush*	---	---	---	S3
Striped bass	*Morone saxatilis*	Endangered Special Concern	---	---	S2S3B, S2S3N
Striped bass – Southern Gulf of St. Lawrence pop.	*Morone saxatilis pop. 1*	Special Concern	---	---	S2S3N
Aquatic Invertebrates					
Brook floater	*Alasmidonta varicosa*	Special Concern	Special Concern	Threatened	S3
Eastern pearlshell	*Margaritifera margaritifera*	---	---	---	S2
Triangle floater	*Alasmidonta undulata*	---	---	---	S2S3

Source: ACCDC, 2023
[1]Government of Canada, 2022; [2]Government of Canada, 2022; [3]Government of NS 2022; [4]ACCDC, 2022

In addition, the ACCDC Data Report identified five marine mammals within a 100 km radius of the Study Area – Atlantic white-sided dolphin (*Lagenorhynchus acutus*), Harbour porpoise (*Phocoena phocoena*), Humpback whale (*Megaptera novaeangliae*), Leatherback sea turtle (*Dermochelys coriacea*), and Long-finned pilot whale (*Globicephala melas*) (Appendix F). Based on the inland nature of the Project and distance from the coastline, impacts on marine species are not assessed further.

Of the 13 fish and aquatic invertebrate SOCI identified within a 100 km radius of the Study Area, the ACCDC Data Report identified Eastern pearlshell (*Margaritifera margaritifera*) as occurring within 5 km of the Study Area.

7.3.2.4 Field Assessment Methodology

Fish presence and existing habitat were documented as part of the watercourse surveys (Section 7.3.1). For each watercourse, notes on the visual observance of fish were recorded along with any habitat characteristics that may influence fish presence such as pool/riffle sequences, barriers to fish passage, and substrate composition. This information, along with the results of the desktop review, was then used to select ideal watercourses for detailed fish habitat assessments and qualitative electrofishing (Drawing 7.16). The locations selected also considered the position of the watercourse within the watershed and attempted to utilize notable, permanent features that offered a representation of the surficial hydrology across the entire Study Area.

Fish Habitat Assessment

The fish and fish habitat assessments were completed during summer 2022 and included several components: an analysis of in-situ water chemistry, a physical analysis of the watercourse including bank characteristics and substrate composition, and an assessment of fish habitat potential across various life stages (i.e., spawning, rearing, and overwintering). A description of assessment components is provided below:

- *Physical Makeup*

  ###### Substrate Percent

  Substrate composition was evaluated based on percent cover of bedrock, boulders, rubble, cobble, gravel, sand, and fines/muck. Habitat potential was assessed based on the presence/absence of suitable areas for various fish life stages, including spawning, rearing, and overwintering.

  ###### In-stream Habitat Types

  In-stream habitat diversity was assessed by presence of pools, riffles, runs, flat sections, rapids, or cascades. A diverse selection of in-stream habitat can cater to a diverse assemblage of species.

  ###### In-stream Cover

  Watercourses were assessed for physical characteristics that provide fish refuge, including boulders, overhanging and instream vegetation, woody debris, deep pools, and undercut banks. These parameters were ranked as being present in either trace, moderate, or abundant amounts.

  ###### Bank Characteristics

  Bank conditions were evaluated for evidence of siltation, erosion, stability, and undercutting. Conditions were ranked as being present in either trace, moderate, or abundant amounts.

  ###### Barriers to Fish Passage

  Watercourses were assessed for any potential barriers to fish passage. Barriers may include any physical structure or feature that hinders the ability of fish to navigate throughout the watercourse.

- *Water Chemistry*

Temperature

As most fish are considered ectotherms, water temperature is a crucial factor in habitat suitability. While the ideal temperature range is mostly species-specific, extreme temperature changes can have adverse effects on critical processes including metabolism, energy levels, behaviour, and nutrient uptake (Volkoff & Rønnestad, 2020).

Dissolved Oxygen

Dissolved oxygen (DO) fluctuates in response factors such as plant biomass, substrate, velocity, and temperature. Optimal DO concentrations should be >6.5-8 milligrams per litre (mg/L), with a subsequent saturation of around 80-120% (DataStream Initiative, 2021).

Conductivity

Conductivity is a measure of how easily water can conduct electricity, providing an indirect estimate of salinity. Conductivity is often categorized by the following hierarchy:

- Low conductivity (0-0.2 milliSiemens per centimetre [mS/cm]) is used as an indicator of pristine conditions.
- Medium conductivity (0.2-1 mS/cm) is the typical range of most major rivers.
- High conductivity (1-10 mS/cm) indicates saline conditions (Government of Northwest Territories, 2013).

pH

pH is a measure of acidity based on a 0-14 scale. Waterbodies of low pH (high acidity) typically register below 6 or 6.5. Waterbodies of high pH (low acidity), typically register above 9. Aquatic species typically have an optimum pH range, and fluctuation from this range can result in reduced hatching rates, poor health, or mortality (US EPA, 2022c).

Electrofishing Surveys

Electrofishing is a standard fish capture measure used to collect juvenile and adult fish in streams, rivers, and standing bodies of water (e.g., lakes). The process involves submerging an anode and cathode in the water and passing an electrical current through the water to attract and immobilize fish for capture.

Electrofishing was completed in tandem with fish habitat assessments and was conducted over 200 m stretches along each target watercourse. For the targeted watercourses, electrofishing assessments were completed at the 0 m, 100 m, and 200 m points (i.e., the downstream, crossing, and upstream locations, respectively), with notes, photos, and measurements taken for any fish caught during the completed surveys. As part of the assessment, field staff made note of any fish observed but not caught, along with any points of concern such as obstructions to fish passage (e.g., elevated culverts, waterfalls, etc.).

7.3.2.5 Field Assessment Results

Fish Habitat Assessment

Fish presence and existing habitat were documented as part of the watercourse surveys (Section 7.3.1). Notes on the visual observance of fish were recorded along with fish habitat characteristics such as pool/riffle sequences, substrate composition, and potential barriers to fish passage (e.g., elevated culverts). Detailed descriptions and characterization parameters for each watercourse are found in Appendix E.

Habitat assessments were also conducted during electrofishing surveys. Detailed results are in Appendix G, with a summary shown in Table 7.24.

Table 7.24: Fish and Fish Habitat Assessment Results

Watercourse	Surveyed Reach	Possible Barriers to Passage	Fish Seen	Habitat Characteristics			Ranking of Fish Presence
				Spawning[1]	Rearing[2]	Over-wintering[3]	
EF1/ Unnamed Watercourse	Downstream	No	Yes	Abundant	Moderate	Moderate	High
	Crossing	No	Yes	Abundant	Abundant	Moderate	High
	Upstream	No	Yes	Trace	Moderate	Moderate	High
EF2/ Unnamed Watercourse	Downstream	No	Yes	Moderate	Moderate	Trace	High
	Crossing	No	Yes	Trace	Trace	Trace	High
	Upstream	No	Yes	Trace	Trace	Trace	High
EF3/ Tributary of Black Brook	Downstream	No	Yes	Trace	Trace	Trace	High
	Crossing	No	Yes	Trace	Moderate	Trace	High
	Upstream	No	Yes	Trace	Trace	Trace	High

[1] Spawning Habitat = gravel to cobble dominant substrates
[2] Rearing Habitat = riffle-pool sequences
[3] Overwintering Habitat = contains deep pools

Electrofishing Surveys

Electrofishing was conducted during summer 2022. Qualitative electrofishing was conducted along two unnamed watercourses (EF1 & EF2) and a tributary of Black Brook (EF3) (Drawing 7.16). The electrofishing surveys resulted in 89 individual fish being caught across all three of the surveyed watercourses (Table 7.25).

Table 7.25: Electrofishing Survey Results

Watercourse	Count	Common Name	Scientific Name	COSEWIC Rank[1]	*SARA* Rank[2]	NS *ESA*[3]	S-Rank[4]
EF1/ Unnamed Watercourse	22	Atlantic salmon - Gaspe - Southern Gulf of St. Lawrence pop.	*Salmo salar pop. 12*	Special Concern	---	---	S1
	41	Brook trout	*Salvelinus fontinalis*	---	---	---	S3
EF2/ Unnamed Watercourse	14	Brook trout	*Salvelinus fontinalis*	---	---	---	S3
EF3/ Tributary of Black Brook	1	American eel	*Anguilla rostrata*	Threatened	---	---	S3N
	11	Brook trout	*Salvelinus fontinalis*	---	---	---	S3

[1]Government of Canada, 2021; [2] Government of Canada, 2021; [3] Government of NS, 2022; [4]ACCDC, 2023

The results of the qualitative electrofishing surveys saw three SOCI being observed – Atlantic salmon (*Salmo salar*) (presumed to be the Gaspe - Southern Gulf of St. Lawrence population given the location), Brook trout, and American eel (*Anguilla rostrata*). The Atlantic salmon ranged in size from roughly 2.5 cm to 11 cm, the Brook trout ranged in size from roughly 2.5 cm to 13 cm, and the American eel was roughly 17 cm. Each of the individual fish appeared to be in good health, exhibiting vigorous movement when captured and showing no obvious signs of illness, parasites, or injury. Further, each fish had a quick rebound from the stun delivered via the electrofisher, swimming quickly out of sight upon release back into their respective watercourse.

Note that a minor layout modification was made to the Project following the completion of the fish and fish habitat assessments, as further described in Section 7.3.3. As such, it is recommended that any aquatic environments (i.e., waterbodies, watercourses, and wetlands) identified within these areas be assessed for fish habitat and fish-bearing potential during the 2023 field season. Furthermore, a representative selection of the identified aquatic environments should undergo qualitative electrofishing surveys that align with the methodologies denoted above.

Priority Species

Based on the results of the field and desktop assessments, the following fish species were identified as priority species and are discussed in further detail:

- Atlantic salmon
- Brook trout
- Brook floater

Atlantic Salmon

The Atlantic salmon - Gaspé-Southern Gulf of St. Lawrence subspecies is listed as ‘Special

Concern' by COSEWIC and as "S1" by ACCDC (2023). This subspecies of Atlantic salmon is a genetically distinct population that encompasses rivers from the western Gaspé Peninsula, southward and eastward to the northern tip of Cape Breton (DFO, 2010). Most of this subspecies is said to spawn in the Miramichi River system in New Brunswick. However, the West River and the accompanying West River secondary watershed (1DR-5) have been listed as a priority area for the species in Nova Scotia (DFO, 2020).

In general, the freshwater habitat preference of Atlantic salmon includes clear, well-oxygenated waters in streams with bottoms of gravel, cobble, and boulder. Atlantic salmon prefer cool waters, with spawning typically observed in the 4.4 to 10° C range, and growth typically observed in the 5 to 19° C range (US Fish and Wildlife Service, 2021). As temperatures rise above 23° C, habitat potential decreases, and Atlantic salmon will search for cooler waters. Riffles, rapids, and pools are also necessary components for various life stages, with the preferred depth being in the 10 to 40 cm range (US Fish and Wildlife Service, 2021). Furthermore, Atlantic salmon prefers a circumneutral pH ranging from 6.5-7.5 (Maine Department of Environmental Protection, 2022).

Atlantic salmon smolts migrate seaward from rivers during May-July and adults return to the rivers in the late fall to spawn. This population has historically suffered from the construction and operation of dams in the area, which have resulted in rearing, spawning, and migration routes being blocked (COSEWIC, 2010).

The closest observation of Atlantic salmon - Gaspé-Southern Gulf of St. Lawrence subspecies is within the Assessment Area, where field staff recorded 22 individuals during electrofishing surveys.

The Atlantic salmon – Nova Scotia Southern Upland (NSSU) subspecies is listed as 'Endangered' by COSEWIC and as "S1" by ACCDC (2023). NSSU Atlantic salmon are a genetically distinct population of Atlantic salmon that occupy rivers in both the Eastern Shore and South Shore, draining into the Atlantic, as well as Bay of Fundy Rivers south of Cape Split (DFO, 2013). The exact number of rivers that contain NSSU Atlantic salmon is unknown; however, they have been historically considered present in 72 of the regions 585 watersheds. They are managed under Salmon Fishing Area 20, 21, and part of 22 (DFO, 2013). As the Bay of Fundy rivers interacting with the Project are located to the northeast of Cape Split, it is unlikely that the population would interact with the Project.

The closest observation of Atlantic salmon NSSU subspecies is 15.7 ± 0.0 km from the Study Area (ACCDC, 2023).

Brook Trout

Brook trout are not listed under federal (*SARA*) or provincial (NS *ESA*) legislation as SAR; however, are listed as 'S3' by ACCDC (2023). This species of trout is typically found in cold, clear, and well oxygenated rivers and lakes with plenty of shade and gravel substrate (US Fish and Wildlife Service, 2021). They prefer water temperatures that do not exceed 20° C, though

adult fish can tolerate temperatures of up to 25° C for short periods of time. Furthermore, despite being able to reproduce in waters with a pH as low as 4.5, they do best in a pH range of 5.0 to 7.5 (Maryland Department of Natural Resources, 2012).

Brook trout are a migratory species that migrate further inland to rivers and lakes during the fall months to spawn. Sea-run Brook trout may spend April to June in marine environments, but migration to marine habitat does not always occur year to year, with some Brook trout never entering marine environments (DFO, 1996). In Nova Scotia, Brook trout are considered the number one sportfish, with approximately two million trout stocked within the province on an annual basis (NS Department of Agriculture and Fisheries, 2005).

The closest observation of Brook trout is within the Assessment Area, where field staff recorded 66 individuals during electrofishing surveys.

Brook Floater

Brook floater is listed as 'Special Concern' under *SARA* and COSEWIC, 'Threatened' under NS *ESA*, and as 'S3' by ACCDC (2023). Brook floaters are medium sized freshwater mussels that are confined to only 15 watersheds in Nova Scotia and New Brunswick, including the Salmon/Debert watershed and the Phillip/Wallace watershed (COSEWIC, 2009), both watersheds which are located within the Study Area (further details supplied in Section 7.3.1). This species of mussel is typically found in shallow rivers or streams with moderate to high water flow, and substrate consisting of a rocky bottom with cobble and sand or fine gravel (DFO, 2016). Furthermore, Brook floaters prefer environments with DO levels above 6 mg/L, and a pH greater than 5.4 (DFO, 2016).

Brook floaters are considered long-term brooders, known to hold onto their larvae (called glochidia) for almost a year (US Fish and Wildlife Service, 2021). From there, larvae are released into the water column when temperatures rise above 14° C, where they attach to the body, gills, or fins of fish, remaining there through fall and winter until being released in the following spring (US Fish and Wildlife Service, 2021). After development on the host fish, juveniles burrow into the substrate of rivers where they grow into adults. As sessile organisms, Brook floaters require areas of flow refuge with stable substrate (US Fish and Wildlife Service, 2021) and in this life stage, like other mussels, Brook floaters feed on algae, bacteria, and other particles filtered from the water column (COSEWIC, 2009).

The closest ACCDC observation of Brook floater is 15.6 ± 0.0 km from the Study Area (ACCDC, 2023).

7.3.2.6 Effects Assessment

Project-Fish and Fish Habitat Interactions

Project activities, primarily those that involve watercourse crossing, earth moving, or vegetation removal, have the potential to impact fish and fish habitat (Table 7.26). These potential impacts could include habitat removal, disruptions to hydrology, and/or displacement of sediment.

Table 7.26: Potential Project-Fish and Fish Habitat Interactions

Valued Component	Site Preparation and Construction										Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Fish and Fish Habitat			X	X	X	X				X			X		X

Assessment Boundaries

The LAA for fish and fish habitat includes the Assessment Area. The RAA for fish and fish habitat includes the Study Area (Drawing 2.2).

Assessment Criteria

Assessment criteria provided in Section 4.6 apply for fish and fish habitat. The VC-specific definition for magnitude is as follows:

- Negligible – no loss of fish habitat or impact on fish behaviour expected.
- Low – small loss of fish habitat or impact on fish behaviour.
- Moderate – moderate loss of fish habitat or impacts to fish behaviour, but these impacts will only be experienced by individuals rather than entire populations and can be managed with routine measures.
- High – high loss of fish habitat and impacts to fish behaviour that will be experienced by entire populations and cannot be managed with routine measures; the population's life history is permanently altered.

Direct Effects

Direct effects to fish and fish habitat are likely to be most prominent during the construction phase. Effect-specific active management, mitigation, and monitoring are required to eliminate, mitigate, or otherwise manage the magnitude of these direct effects.

Habitat Loss

The Project design has been optimized to minimize interactions between the Project and watercourses and wetlands that may support fish and fish habitat. However, in areas where watercourse/wetland interactions are unavoidable, there is a potential for habitat loss.

Watercourse alterations required for the Project have the potential to impact fish and fish habitat. The removal of overhanging vegetation from stream banks decreases shade/cover for fish resulting in increased vulnerability to predators. Likewise, the removal of instream cover, such as

coarse woody debris or edge habitat (e.g., undercut banks) can have a negative effect on both fish and aquatic invertebrate habitat (MTO, 2009). Alterations to channel morphology and interference with sediment transport can also result in aquatic habitat degradation.

As detailed in Section 7.3.1, there is a potential for 15 watercourse alterations for the Project. These alterations include upgrades to existing roads and associated crossings (5), and the construction of new roads and accompanying crossings (10) (Table 7.28). Upgraded crossings will be designed to improve flow and aid in fish passage. Additionally, new crossings will be designed to avoid any permanent diversion, restriction, or blockage of natural flow, such that the hydrologic function of the watercourse is maintained. The specific details of each crossing will be finalized during the detailed design phase and will be included in any necessary applications for alteration or notifications to NSECC.

Wetland alterations required to facilitate Project developments also have the potential to impact fish and fish habitat. Wetlands that are contiguous with a watercourse or offer areas of open water may provide areas of fish feeding, spawning, and/or rearing. The dense macrophytic vegetation that often comes with these wetland environments can offer refuge to fish including shelter from predators, a substrate to which eggs can be adhered, and a source of food.

Based on the wetland assessments, there is a potential for two wetlands within the Assessment Area that may offer some form of fish habitat to be altered for Project developments. In these situations, should wetland alteration be required, habitat loss may be attributed to either partial or total infill, thus altering wetland functionality such as water cooling, sediment stabilization, or stream flow support. One of these wetlands (WL14) is contiguous with an identified and delineated watercourse (WC12). As such, any potential effects to fish and fish habitat stemming from Project-wetland interactions are addressed below and will be further addressed through the watercourse notification or alteration permitting process.

The second wetland (WL23) has a large area of open water formed by beaver activity. There was no obvious outflow channel, just an area of saturated ground extending to the east of the open water and continuing outside of the Assessment Area. As such, any alteration needed for Project developments will seek to avoid the lentic portion of the wetland, focusing efforts within the terrene portion to the east. Furthermore, a crossing structure will be installed with road construction to maintain hydrological connectivity and allow fish passage to neighboring wet areas.

Table 7.27: Summary of Alterations to Features that May Support Fish and Fish Habitat

Feature ID	Existing Alteration	Forecasted Alteration
Watercourses		
WC1	None observed.	Crossing to be installed with road construction.
WC2	None observed.	Crossing to be installed with road construction.

Feature ID	Existing Alteration	Forecasted Alteration
Watercourses		
WC3	None observed.	Crossing to be installed with road construction.
WC4	None observed.	Crossing to be installed with road construction.
WC5	None observed.	Crossing to be installed with road construction.
WC6	None observed.	Crossing to be installed with road construction.
WC7	None observed.	Crossing to be installed with road construction.
WC8	None observed.	Crossing to be installed with road construction.
WC9	None observed.	Crossing to be installed with road construction.
WC10	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC11	None observed.	Crossing to be installed with road construction.
WC12	None observed.	Crossing to be installed with road construction.
WC13	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC14	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC15	None observed.	No alteration expected as watercourse can be avoided.
WC16	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC17	Yes, open-bottom bridge structure for road crossing.	Open-bottom bridge structure to be assessed and potentially replaced with road upgrades.
Wetlands		
WL14	None observed.	Partial infill for road construction and installation of crossing structure for WC12.
WL23	None observed.	Partial infill for road construction.

Indirect Effects

The temporal and spatial extent of indirect effects such as erosion and sedimentation and changes in water quantity and quality can be farther reaching, but are often foreseeable, and research based, standardized BMPs can be implemented to mitigate the resulting outcomes.

Erosion and Sedimentation

The mobilization of sediment within aquatic environments can cause shifts in ecological integrity, including changes to the plant species composition, the distribution of primary and secondary producers, and the habitat suitability for vulnerable species (Tilman et al., 1997). Erosion and sedimentation can occur throughout the lifecycle of the Project, including during construction efforts, routine road maintenance, and daily traffic. However, the highest potential for these effects is related to the construction and upgrading of access roads and crossing structures. The alteration or removal of riparian vegetation can also result in bank instability and erosion, further exasperating these effects (MTO, 2009).

Changes in Surface Water Quantity

Changes to the amount of flow can alter channel morphology, increase flood potential, and disrupt habitat characteristics that support vulnerable species (MTO, 2009). These impacts could result from the alteration of catchment area grades for road development, the compaction of soil from the heavy machinery required for turbine assembly, or the alteration of channel beds to facilitate the removal and replacement of preexisting infrastructure (e.g., rusted culverts).

Changes in Surface Water Quality

Changes in the quality of surface water can arise from alterations to the surrounding environment and can include an increase in water temperature due to decreased shade, an increase in pollutants from machinery and infrastructure, and the mobilization of sediments (MTO, 2009). Given the dynamic nature of channeling water, effects upon water quality can quickly spread throughout different reaches of the respective watershed.

Mitigation

The primary mitigation measure to protect fish and fish habitat is the Project's use of existing roads. In addition, a site-specific EPP will be developed. This EPP will act as a "living document" that incorporates an adaptive management approach to environmental protection and mitigation.

As required, all work completed under the provincial watercourse alteration notification process will be done in accordance with the Nova Scotia Watercourse Alterations Standards (2015c) and executed by a certified Watercourse Alteration Installer/Sizer. For work requiring an approval, specific and detailed mitigation will be developed and submitted to NSECC as part of the application process.

In addition, the following mitigative measures will be implemented:

Habitat Loss

- Ensure watercourses and wetlands are clearly marked and avoid impacts to the area and adjacent riparian habitat to the extent possible.
- Ensure all crossings are installed by a certified Watercourse Alteration Installer/Sizer, and designed to avoid any permanent diversion, restriction, or blockage of natural flow, such that the hydrologic function of the watercourse is maintained.
- Revegetate along the watercourse edge and above the ordinary high-water mark to

facilitate the stabilization of the area, and restoration of fish habitat.
- Where possible, redesign existing watercourse crossings to facilitate habitat upgrades, including unblocking culverts and making waterways more conducive to fish passage.
- Avoid impacts to wetlands to the extent possible.
    - Where unavoidable, complete wetland alterations in accordance with the NS Wetland Conservation Policy and the wetland alteration process during the permitting stage, which includes a requirement to compensate for lost wetland habitat and functions.
    - Design wetland crossings to occur at the narrow part of the wetland or the wetland's edges, to the extent possible.
- Conduct work between June 1 and September 30 to avoid sensitive periods in the life cycles of fish, to facilitate a better control of water flow, and to allow for a faster revegetation period (NSECC, 2015a).

Erosion and Sedimentation

- Develop a site-specific erosion and sedimentation plan during the detailed design phase.
    - The plan will target the disturbance to banks and adjacent land, and will address the type of control structures, proper installation techniques, grading, maintenance and inspection, timing of installation, and revegetation.
- Limit the area of exposed soil and the length of time soil is exposed without mitigation (e.g., mulching, seeding, rock cover).
- Limit the slope and gradient of disturbed areas to minimize the velocity of surface water runoff.
- Ensure surface run-off containing suspended materials or other harmful substances is minimized.
- Direct run-off from construction activities away from wetlands.

Changes in Surface Water Quantity

- Integrate water management systems into the design, where appropriate, including diversion and collection ditches, roadside drainage channels, and vegetated swales.
- Design any necessary alterations in a way that maintains the natural grade of the watercourse, to ensure the hydroperiod remains as it was pre-alteration.
- Fit any watercourse crossings with appropriately sized infrastructure, as prescribed by a certified Watercourse Alteration Installer/Sizer.
- Avoid impacts to wetlands to the extent possible.
    - Where unavoidable, design wetland crossings to occur at the narrow part of the wetland or the wetland's edges, to the extent possible.

Changes in Surface Water Quality

- Leave riparian vegetation as intact as Project developments will allow.
- Integrate outlet protection features to dissipate flow velocities and decrease erosion at the outflow.
- Utilize vegetated swales for the phytoremediation of contaminated runoff.
- If concrete is to be utilized (e.g., for footings, culverts, wingwalls, etc.), ensure it is pre-

cast and cured for at least one week prior to use at a crossing site (NSECC, 2015a).
- Utilize untreated, rot-resistant timber (e.g., hemlock, tamarack, juniper, or cedar) below the ordinary highwater mark to avoid the leaching of toxic preservatives into waterways (NSECC, 2015a).
- Utilize rock material that is clean, coarse granular, non-ore-bearing, non-watercourse-derived, and non-toxic to aquatic life (NSECC, 2015a).

Monitoring

A site-specific monitoring plan will be developed and executed in tandem with watercourse and wetland monitoring during the construction phase. This will consist of detailed monitoring and general spot checks. Detailed monitoring will include hydrological, sediment, and stability assessments upstream, downstream, and at the crossing of the watercourse, as well as detailed vegetative, hydrological, and soil assessments within the wetland habitat adjacent to the infill site. Spot checks will involve a general overview of vegetative, hydrological, and substrate conditions, focusing on evidence of significant hydrologic alterations, sedimentation, and degradation of fish habitat (Table 7.28).

Table 7.28: General Fish Habitat Monitoring Parameters and Methods of Assessment

Monitoring Parameter	Tasks	Method of Assessment	
		General Monitoring	Detailed Monitoring
Hydrology	Examine flow velocity, taking note of any undercutting or abrasive channeling, leftover construction debris, or obstruction to flow resulting from alteration activities.	No	Yes
	Assess the general hydrologic condition and hydrologic connectivity of wetland habitat, including evidence of drier/wetter conditions, impeded water drainage, and upland flooding.	Yes	Yes
Vegetation	Vegetation assessments will be completed along the riparian zone and within remaining wetland habitat of partially infilled wetlands. An assessment of the potential changes in composition, species, health, and presence/absence of invasive plants will be evaluated.	No	Yes
Erosion & Sedimentation	Examine stability of watercourse banks both upstream and downstream of the crossing. Examine grade of slope at the crossing, taking note of any erosive channeling in substrate that would indicate the slope may be too steep.	Yes	Yes
	Assess potential changes in soil conditions throughout the remaining wetland habitat, including evidence of sedimentation and siltation.	Yes	Yes
	Inspect sediment control measures for effectiveness and look for evidence of sedimentation within the watercourse or wetland.	Yes	No
Habitat Loss	Conduct stream assessments equivalent to those completed prior to alteration. Examine substrate, taking note of any	Yes	Yes

Monitoring Parameter	Tasks	Method of Assessment	
		General Monitoring	Detailed Monitoring
	obvious sediment mobilization, residual slash, or a build-up of fines/muck.		
	Examine crossing for visual observance of fish, and/or any obvious signs of deteriorated fish habitat (e.g., desiccation of riparian vegetation, channel infill, etc.) or diversified fish habitat (e.g., pools, woody debris, etc.).	Yes	No

Conclusion

The effects to fish and fish habitat are expected to be of low magnitude such that there will be a small loss of fish habitat or impact to fish behaviours. Timing and seasonality of effects is expected to be applicable, with a potential for the effects to be exasperated by high precipitation events in the spring and fall, and an expectation to complete work during the period of June 1 to September 30. Effects will be restricted to the LAA, occurring as a short-term, single event during the construction phase, and are reversible. Therefore, effects to fish and fish habitat will not be significant.

7.3.3 Wetlands

7.3.3.1 Overview

Wetland assessments were conducted to identify and delineate wetland habitat so that impacts to wetland area and function could be avoided and minimized, to the extent possible. This was achieved by using the following approach:

- Identify wetland habitat in the Study Area using desktop resources.
- Use the findings of the desktop study to design the Project (e.g., avoid/minimize impacts to wetlands), and establish an Assessment Area, thus informing planning and logistics for field studies.
- Ground truth and delineate wetland habitat within the Assessment Area.
- Complete functional assessments for delineated wetlands identified within the Assessment Area.
- Identify the potential for, and confirm the presence of, Wetlands of Special Significance (WSS) within the Assessment Area.

7.3.3.2 Regulatory Context

The Nova Scotia Wetland Conservation Policy outlines a policy goal of no loss of WSS and no net loss in area and function for other wetlands (NSECC, 2019). Wetlands are considered WSS based on the wetland having significant species or species assemblages, high levels of biodiversity, significant hydrological value, or high social or cultural importance. Under this policy, the following are considered WSS:

- All salt marshes.
- Wetlands that are within or partially within a designated Ramsar site, Provincial Wildlife Management Area (Crown and Provincial lands only), Provincial Park, Nature Reserve, Wilderness Area or lands owned or legally protected by non-government charitable conservation land trusts.
- Intact or restored wetlands that are project sites under the North American Waterfowl Management Plan and secured for conservation through the Nova Scotia Eastern Habitat Joint Venture program.
- Wetlands known to support at-risk species as designated under *SARA* or the NS *ESA*.
- Wetlands in designated protected water areas as described within Section 106 of the *Environment Act,* SNS 1994-95, c 1.

As per Section 5 of the *Environment Act*, SNS 1994-95, c 1 approval from NSECC is required to alter a wetland. Nova Scotia considers a wetland alteration to be any activity that may affect wetland function and habitat. Such activities include, but are not limited to, excavating, flooding, infilling, or draining (NSECC, 2019).

7.3.3.3 Desktop Review

A desktop review for the location and extent of potential wetlands across the Study Area was completed using the following information sources:

- Wetlands Inventory (NSNRR, 2017)
- WSS Database (NSNRR, 2014)
- Nova Scotia Hydrographic Network (Open Data NS, 2022)
- Nova Scotia WAM Database (NSNRR, 2012)
- Nova Scotia Digital Elevation Model (DEM) (GeoNOVA, 2018)
- Provincial Landscape Viewer (NSNRR, 2017)
- Satellite and aerial imagery

The NSNNR Wetland Inventory (2021d) identified 55 wetland features within the Study Area. These were classified as either a swamp (42), marsh (9), bog or fen (3), and fen (1) ranging in size between 0.3 and 21 ha (Drawing 7.17). According to the WSS Database (2014), one WSS is located within the Study Area. The WSS is associated with Beaver Mountain Provincial Park, and the Project was designed to avoid interaction with this wetland.

The Nova Scotia Hydrographic Network (Open Data NS, 2022) was used in conjunction with the Nova Scotia WAM database and Nova Scotia DEM layer to further assess the distribution of confirmed and potential wetland habitat within the Study Area. These sources identified potential wet areas and predicted flow based on the assumed depth-to-water generated from digital elevation data (Drawing 7.14) (NSNRR, 2012). The depth-to-water ranged from 2.01 m to 10 m from the surface across the Study Area, with the majority of the Study Area being well to moderately-well drained.

The Provincial Landscape Viewer (NSNRR, 2017) was reviewed to confirm the presence of wetlands and WSS, as well as identify areas of interest including significant habitat, special management practice zones, and protected areas. The results show that the Study Area contains lands classified as a Mainland moose (*Alces alces americana*) concentration area (discussed in Section 7.4.3).

Satellite and aerial imagery were used as a quality assurance/quality control tool when reviewing desktop resources.

The results of the desktop review assisted in scoping field studies and were ultimately used to conduct a constraints analysis thus refining turbine/road siting locations to avoid known wetlands.

7.3.3.4 Field Assessment Methodology

General

Wetland field assessments were completed across the Assessment Area. This included high-level assessments for hydrology, complimented by in-depth wetland delineations and functional assessments. Wetland surveys were done in conjunction with watercourse assessment surveys. Field assessments aimed to minimize wetland alteration by establishing areas to be avoided during Project scoping for turbine siting and road placement. This approach resulted in several layout modifications as the Project Area was optimized to minimize interactions with wetlands. Although extensive wetland field assessments were completed throughout the entire Study Area, only wetlands within the current Assessment Area are discussed in the EA.

To accompany wetland field surveys, a list of SOCI known to occur within the general area of the Project was compiled to help with incidental identification. Throughout the wetland surveys all incidental observations of SOCI were noted; details of these observations are captured within the EA under their respective reporting sections, as applicable to the species observed.

Field Delineations

Field crews surveyed the Assessment Area, delineating and characterizing each wetland identified. Wetland boundaries were determined by confirming the following:

- Presence of hydrophytic (water loving) vegetation.
- Presence of hydrologic conditions which result in periods of flooding, ponding, or saturation during the growing season.
- Presence of hydric soils.

A positive indicator must typically be present for all three parameters to definitively identify any given site as a wetland (Environmental Laboratory, 1987). If the identified wetland extended outside of the Assessment Area, the extent of its boundary was estimated using aerial imagery and other desktop resources.

Identification of Hydrophytic Vegetation

Hydrophytic vegetation is defined as the sum of macrophytic plant life that occurs in areas where the frequency and duration of inundation or soil saturation produces permanent or periodically saturated soils of sufficient duration to exert a controlling influence on the plant species present (Environmental Laboratory, 1987). Hydrophytic vegetation should be the dominant plant type observed in wetland habitat (Environmental Laboratory, 1987).

Dominant plant species observed in each wetland were classified according to indicator status (probability of occurrence in wetlands), in accordance with the U.S. Fish and Wildlife Service National List of Vascular Plant Species that Occur in Wetlands: NE Region (Region 1) (Reed, 1988) (Table 7.29). These indicators are used as this region most closely resembles the flora and climate regime of Nova Scotia. Further relevant information was reviewed in Flora of Nova Scotia (Zinck, 1998).

Table 7.29: Classification of Wetland-Associated Plant Species[1]

Plant Species Classification	Abbreviation[2]	Probability of Occurring in Wetland
Obligate	OBL	>99%
Facultative Wetland	FACW	66-99%
Facultative	FAC	33-66%
Facultative Upland	FACU	1-33%
Upland	UPL	<1%
No indicator status	NI	Insufficient information to determine status
Plants That Are Not Listed (assumed upland species)	NL	Does not occur in wetlands in any region.

[1] Source: Reed, 1988
[2] A '+' or '-' symbol can be added to the classification to indicate greater or lesser probability, respectively, of occurrence in a wetland.

If the majority (greater than 50%) of the dominant vegetation at a data point is classified as obligate (OBL), facultative wetland (FACW), or facultative (FAC), then the location of the data point is considered to be dominated by hydrophytic vegetation.

Identification of Hydric Soils

A hydric soil is formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper layer (USDA-NRCS, 2010). Indicators of the presence of hydric soils include soil colour (gleyed soils and soils with bright mottles and/or low matrix chroma), aquic or preaquic moisture regimes, reducing soil conditions, sulfidic material (odour), soils listed on the hydric soils list, iron and manganese concretions, organic soils (histosols), histic epipedons, high organic content in the surface layer of sandy soils, and organic streaking in sandy soils.

During field surveys, soil pits were excavated to a maximum depth of 40 cm or until (auger) refusal. The soil in each pit was then examined for hydric soil indicators. The matrix colour and mottle colour (if present) of the soil were determined using Munsell Soil Colour Charts.

Determination of Wetland Hydrology

Wetland habitat, by definition, either periodically or permanently has a water table at, near, or above the land surface. To be classified as a wetland, a site should have at least one primary indicator or two secondary indicators of wetland hydrology (Table 7.30). Wetland habitat is assessed for signs of hydrology via visual observations across the area and through the assessment of soil pits.

Table 7.30: Indicators of Wetland Hydrology

Examples of Primary Indicators	Examples of Secondary Indicators
Surface Water	Oxidized Root Channels in the Upper 30 cm
Saturation	Local Soil Survey Data
Sediment Deposition	Dry Season Water Table
Drainage Patterns	Stunted or Stressed Plants
Water-stained Leaves	Drainage Patterns
Sparsely Vegetated Concave Surfaces	Surface Soil Cracks
Hydrogen Sulfide Odor	Moss Trim Lines

Functional Assessments

Field delineated wetlands were assessed for their functionality based on their geographic locations, as well as their variety in terms of landform, type, and characteristics. Aerial imagery and mapping data were used to visualize the wetland within the Study Area, including the position of the wetland within its respective tertiary watershed, and the estimated extent of its catchment area. Consideration was also given to the general ecological conditions of the wetland as observed during field delineations. Functional assessments were completed according to the Wetland Ecosystem Services Protocol – Atlantic Canada (WESP-AC) (Adamus, 2021).

WESP-AC is a standardized rapid assessment methodology for the important natural functions of all types of non-tidal wetlands in Atlantic Canada. Users complete a desktop review comprised of multiple-choice questions about the wetland by consulting aerial imagery and specific regulatory resources. Upon visiting the wetland, a field form is completed based on field observations, as well as a stressor data form relating to the degree to which a wetland or its catchment area has been altered or exposed to risk from factors capable of reducing its function (primarily anthropogenic in origin).

WESP-AC then generates scores (0 to 10) and ratings (lower, moderate, higher) for each of the wetland's functions and benefits. In addition, scores are provided for five grouped functions based on environmental similarities. Scoring is based on logic models programmed into the calculator spreadsheet. The spreadsheet contains rationale for use of each metric or indicator in every model, often with the citation of supporting scientific literature.

The most recent version of WESP-AC is available as a separate Excel file for each of the Atlantic provinces, and each calculator has been calibrated to a series of nontidal reference wetlands within their respective province. The calibrated wetlands were selected with minimal bias through

a statistical procedure intended to encompass as much variation as possible. WESP-AC scores are presented in their raw form and as a normalized score, relative to the calibrated wetlands.

7.3.3.5 Field Assessment Results

General

Field surveys completed during summer 2022 and spring 2023 identified 29 wetlands either partially or fully within the Assessment Area (Drawings 7.12A to 7.12Q). Detailed results are found in Appendix H.

Of the 29 identified wetlands, the most prominent wetland type was treed swamps (14). Treed swamps are characterized by an environment that is not as waterlogged as other wetland types, such as shrub swamps or marshes, and typically experience their highest hydroperiod during spring and fall precipitation events (Province of NS, 2018). As a result, treed swamps provide deciduous trees (e.g., red maple and yellow birch) and coniferous trees (e.g., black spruce and balsam fir) the opportunity to establish themselves and adapt to the inconsistent inundation periods (Province of NS, 2018). Typical species composition of treed swamps within the assessment area consisted of bunchberry (*Cornus canadensis*), twinflower (*Linnaea borealis*), cinnamon fern (*Osmundastrum cinnamomeum*), red maple (*Acer rubrum*), balsam fir (*Abies balsamea*), and black spruce (*Picea mariana*).

Four vernal pools were observed within the Assessment Area. These wetland features often lack a clear inlet or outlet and appear as an ephemeral pool that is typically less than 0.5 ha (Province of NS, 2018). Vernal pools serve as important habitat for herpetofauna such as the Red-spotted newt (*Notophthalmus viridescens viridescens*) and the Northern green frog (*Lithobates clamitans*). Typical species composition included sensitive fern (*Onoclea sensibilis*), royal fern (*Osmunda regalis*), balsam fir, red maple, and yellow birch (*Betula alleghaniensis*).

Three fens were identified within the Assessment Area. Fens typically exhibit more open water areas than bogs, often with a connection to a small watercourse or abutting a lakeshore. They may also receive hydrology from neighbouring uplands. Ultimately, this inundation of water from outside sources facilitates a transfer of nutrients that allow fens to support a wider variety of flora and fauna than bogs (Province of NS, 2018). Of the fens observed by field staff, typical species assemblages included fowl mana grass (*Glyceria striata*), sweet gale (*Myrica gale*), leather leaf (*Chamaedaphne calyculata*), and red maple.

Three floodplain wetlands were observed within the Assessment Area. These nutrient-rich wetlands form in areas prone to seasonal flooding, often resulting in graminoid-rich areas that are interspersed with marshy areas (Province of NS, 2018). Once the growing season begins, and flood waters subside, floodplain wetlands provide ideal growing conditions (Province of NS, 2018). However, the residence time of the species within these environments is directly correlated to the ability of the species to persist through future flooding events. Species composition included sensitive fern, marsh skullcap (*Scutellaria galericulata*), yellow birch,and balsam fir.

Three marshes were also observed throughout the Assessment Area. These wetlands often display more persistent surface water areas that tend to shrink as the growing season progresses. Furthermore, the lack of canopy cover and high-water table in marshes often facilitate vigorous growth of herbaceous vegetation (Province of NS, 2018). Such was the case for many of the marshes observed within the Assessment Area, with evidence of herbaceous encroachment along the edges of sparsely vegetated concave surfaces. Typical vegetation within marshes throughout the Assessment Area included common woolly bulrush (*Scirpus cyperinus*), fringed sedge (*Carex crinita*), fowl mana grass, and red maple.

Two shrub swamps were observed in the Assessment Area. Shrub swamps tend to form in permanently or seasonally flooded areas where the surface is moist from ground saturation. In many cases, shrub swamps eventually transition into treed swamps via succession (Province of NS, 2018). The typical species composition of shrub swamps identified within the Assessment Area included fringed sedge, cinnamon fern, meadowsweet (*Spirea alba*), balsam fir, and red maple. Surface water was more common than within treed swamps, though the temporal extent of the surficial hydroperiod seemed to be seasonal.

A minor layout modification was made to the Project following the 2022 field season, which included the following:

- The relocation of turbine 15 and the associated spur road to the southwest to avoid sound exceedances for nearby receptors at the original location.
- The relocation of the access road to the northeast, now entering the Project Area via Bouchard Road. This road will also act as a corridor for the placement of overhead collection circuits that will route electricity to the substation.

An out-of-season assessment was completed in these areas in April 2023, identifying 11 new wetlands. As such, delineation boundaries will be confirmed and functional assessments will be completed during the 2023 field season for each of the identified wetlands.

Functional Assessments

Functional assessments were completed during summer 2022 for 18 representative wetlands located within the Assessment Area. This selection of wetlands offers an overview of the ecological condition and inherent risk of wetland habitat within the Assessment Area. As the detailed design phase will see the refinement of the Project Area to avoid as much wetland habitat as possible, more in-depth analysis and functional assessments will be completed for any wetland deemed to require alteration. WESP-AC results are found in Appendix H and a summary is provided in Table 7.31.

None of the wetlands were determined to be WSS, as dictated by the Functional WSS Interpretation Results within the WESP-AC spreadsheet calculator. These results aligned with the desktop review results. Furthermore, these scores aligned with the results of other field surveys, including no at-risk lichen or plant species within field-delineated wetlands within the Assessment Area.

The results of the wetland field assessments were also cross-referenced with breeding bird survey results, specifically for avian SAR with wetland habitat requirements, with no at-risk bird species observed within field delineated wetlands within the Assessment Area.

The majority of wetlands were determined to be in high ecological condition, with 10 of 18 wetlands receiving this result. However, 14 of 18 were determined to be at a higher wetland risk, based on an average of their respective sensitivity and stressors. This is likely due to many of the wetlands being previously impacted by anthropogenic disturbance (i.e., road building, forestry activities, etc.) both directly and within the greater catchment area, resulting in a potential lack of intrinsic resistance and resilience to future stressors.

Table 7.31: Summary of WESP-AC Assessments for Wetlands within the Assessment Area

Wetland ID	Tertiary Watershed	Wetland Type(s)	WSS[1] (Yes/No)	Condition[2]	Risk[3]
WL8	1DR-5-E	Treed swamp	No	Higher	Higher
WL9	1DR-5-E	Shrub swamp	No	Higher	Higher
WL10	1DR-5-E	Treed swamp	No	Higher	Higher
WL11	1DR-5-E	Treed swamp	No	Lower	Higher
WL12	1DR-5-E	Vernal pool	No	Higher	Higher
WL13	1EO-1-H	Treed swamp	No	Lower	Higher
WL14	1EO-1-H	Marsh	No	Lower	Moderate
WL15	1EO-1-H	Treed swamp	No	Higher	Higher
WL16	1EO-1-H	Treed swamp	No	Moderate	Higher
WL17	1DR-5-E	Vernal pool	No	Moderate	Higher
WL18	1EO-1-H	Treed swamp	No	Higher	Higher
WL19	1EO-1-H	Marsh	No	Higher	Higher
WL20	1EO-1-H	Treed swamp	No	Higher	Higher
WL21	1EO-1-H	Fen	No	Higher	Higher
WL22	1EO-1-H	Vernal pool	No	Moderate	Moderate
WL23	1EO-1-H	Marsh	No	Higher	Higher
WL24	1EO-1-H	Fen	No	Lower	Moderate
WL25	1DQ-3-D	Floodplain	No	Lower	Moderate

[1] Wetlands of Special Significance.
[2] Wetland ecological condition, as compared to representative selection of calibration wetlands.
[3] Wetland risk is calculated as an average of the wetland sensitivity and stressors.

7.3.3.6 Effects Assessment

Project-Wetland Interactions

Project activities, primarily those that involve earth moving or vegetation removal, have the potential to impact wetlands through habitat removal, disruptions to hydrology, and/or displacement of sediment (Table 7.32).

Table 7.32: Potential Project-Wetland Interactions

Valued Component	Site Preparation and Construction										Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Wetlands				X	X	X				X			X		X

Assessment Boundaries

The LAA for wetlands is the Assessment Area. The RAA for wetlands includes the Study Area (Drawing 2.2).

Assessment Criteria

Assessment criteria provided in Section 4.6 apply for wetlands. The VC-specific definition for magnitude is as follows:

- Negligible – no direct loss of wetland habitat or alteration to wetland functions expected.
- Low – direct loss of wetland habitat, but overall wetland functions remain intact.
- Moderate – direct loss of wetland habitat and impact to wetland functions, but wetland area loss will not impact the hydrology of the wetland's watershed and/or the impacted wetland areas are not part of a WSS.
- High – direct loss of wetland habitat and impact to wetland functions; and wetland area loss will affect the hydrology of the wetland's watershed and/or the impacted wetland areas are part of a WSS.

Direct Effects

Direct effects on wetland habitat and functionality such as habitat loss and changes to hydrology can occur throughout the life of the Project but are likely to be most prominent during construction. Effect-specific active management, mitigation, and monitoring are required to eliminate, mitigate, or otherwise manage the magnitude of these direct effects.

Habitat Loss

Habitat loss can occur both directly (i.e., excavation or infilling) and indirectly (i.e., altered hydrology or canopy cover) as a result of the Project (Trombulak & Frissell, 2000). Loss of habitat can fragment wildlife corridors, potentially isolating species and lowering species richness. Habitat loss can also disrupt vital habitat characteristics that support vulnerable species. Further, the removal or infilling of wetland habitat can impact the hydroperiod of neighbouring wet areas, resulting in farther reaching impacts on habitat quality (Mitsch & Gosselink, 2001).

Hydrological Effects

The hydrology of a wetland is one of the most important aspects of its overall structure and function. Project infrastructure within or near a wetland can result in changes in the timing and quantity of flow, potentially impacting species composition, water treatment capabilities, and nutrient export (Mitsch & Gosselink, 2001). Further, disruption to the hydrology of one area may hinder the hydrological connectivity to other areas, thus resulting in impacts being felt in neighbouring wet areas.

A GIS suitability analysis was conducted to design a Project Area that would optimize the placement of Project infrastructure to avoid and minimize loss of wetland area and function, to the greatest extent possible. A summary of the wetlands identified within the Assessment Area and how they may be affected by the Project is provided in Table 7.33 and shown on Drawings 7.12A to 7.12Q.

Table 7.33: Habitat Alteration for Wetlands within the Assessment Area

ID	Wetland Type	Delineated Area (m^2)	Area of Potential Alteration[1] (m^2)	Activity
WL1	Treed swamp	322.78	316.11	Road construction
WL2	Treed swamp	1014.52	970.73	Road construction
WL3	Treed swamp	481.44	481.44	Road construction
WL4	Treed swamp	2968.72	2619.76	Road construction
WL 5	Fen	1595.79	1408.31	Road construction
WL6	Treed swamp	548.85	322.13	Road construction
WL7	Fen	784.14	780.60	Road construction
WL8	Treed swamp	896.40	776.07	Road construction
WL9	Treed swamp	2713.04	2353.05	Road construction
WL10	Treed swamp	3480.02	1618.84	Road construction
WL11	Treed swamp	375.87	373.74	Road upgrade
WL12	Vernal pool	236.01	0	No impact
WL13	Treed swamp	83.78	0	No impact
WL14	Marsh	8749.98	3354.48	Road construction
WL15	Treed swamp	16080.40	6569.25	Road construction
WL16	Treed swamp	138.80	0	No impact
WL17	Vernal pool	1327.18	0	No impact
WL18	Treed swamp	8891.37	4752.98	Road upgrade
WL19	Fen	34790.96	6620.11	Road upgrade
WL20	Treed swamp	71052.19	23667.02	Road upgrade
WL21	Fen	18607.04	2493.18	Road upgrade
WL22	Vernal pool	2231.12	0	No impact
WL23	Marsh	4127.30	2554.45	Road construction
WL24	Fen	667.93	0	No impact
WL25	Floodplain	1616.61	0	No impact
WL26	Fen	531.60	518.54	Road upgrade

ID	Wetland Type	Delineated Area (m^2)	Area of Potential Alteration[1] (m^2)	Activity
WL27	Floodplain	566.81	562.74	Road upgrade
WL28	Treed swamp	357.72	357.72	Road upgrade
WL29	Vernal pool	452.29	452.29	Road upgrade

[1] The area of potential alteration was calculated via GIS by assuming a conservative road disturbance width of 25 m. As the detailed design is completed, the actual area of alteration required to upgrade or construct a new road will be used to determine the precise area of alteration, which will be smaller than the estimates presented here.

Significant effort was made to maximize existing disturbed areas, with only 11.3 km of new road being constructed, and 13.3 km of previously existing road being utilized. As such, 9 of the potential 22 wetland alterations would be from upgrades to existing roads (if determined to be required during the detailed design phase). The remaining 13 potential alterations would be from the construction of new roads. The total area of potential alteration is 6.39 ha.

In areas where wetland alteration is unavoidable, the detailed design phase will refine the layout to have wetland crossings along wetland edges or narrow portions of the wetland to further minimize the impacts to wetland habitat and function. Furthermore, all necessary wetland crossings will be designed to avoid any permanent diversion, restriction, or blockage of natural flow, such that the hydrologic function of the wetland is maintained. The specific details of each crossing will be finalized during the detailed design phase and will be included in the application for alteration.

Provincial wetland data supplied by NSNRR was used to estimate the total amount of wetland habitat within the 3,920 ha RAA. An estimated 223 ha of wetland habitat was identified, which equates to approximately 5.69% of the RAA. As such, field delineated wetland habitat that may be directly impacted by the Project comprises approximately 0.16% of the total area within the RAA, approximately 2.87% of the potential wetland habitat within the RAA, and approximately 3.97% of the total area within the 161 ha LAA.

Indirect Effects

The temporal and spatial extent of indirect effects such as erosion and sedimentation, dust, invasive species, and compaction can be far reaching, but are often foreseeable, and research based, standardized BMPs can be implemented to mitigate the resulting outcomes.

Erosion and Sedimentation

Erosion and sedimentation can occur throughout the lifecycle of the Project, including during construction efforts, routine road maintenance, and daily traffic. The accumulation of sediment within wetland environments can cause shifts in ecological integrity, including the plant species composition and subsequent nutrient retention potential, hydrological storage capabilities, and habitat suitability for vulnerable species (Tilman et al., 1997).

Dust

The potential for dust deposition will likely be highest during the construction phase, though the risk will be present throughout the Project's lifecycle. Dust primarily impacts vegetative health,

with particle size influencing the scale of the impact (Farmer, 2003). Smaller particulate can result in clogged pores, hindering vital biochemical processes including photosynthesis, respiration, and transpiration; and larger particulate can result in lacerations in plant tissues, thus jeopardizing the health of the plant (Farmer, 2003).

Invasive Species

The colonization of invasive species can result in detrimental impacts on wetland environments, including alterations to evapotranspiration rates, infilling from reduced decomposition rates, and ultimately a reduction in the complexity of the wetland and its subsequent species richness (Zedler & Kercher, 2004). The creation of roadways can act as a vector for invasive species, with the potential for seed dispersal increasing with both vehicular and animal traffic. Further, with many invasive species being partial to disturbed soils, routine maintenance of roadways can provide ideal conditions for their establishment (Trombulak & Frissell, 2000).

Compaction

Compaction can hinder both the vegetative and hydrological structure of a wetland, with a loss of pore space restricting root growth and groundwater infiltration (Duiker, 2005). This impacts the absorption of moisture and nutrients, thus impacting the ecological integrity of the wetland and the ecosystem services it provides. Further, compaction can decrease percolation rates, resulting in prolonged periods of saturation, and increasing the potential for flooding (Duiker, 2005).

Mitigation Measures

The following specific mitigative measures will be implemented to avoid and mitigate any potential effects on wetlands. In addition, a site-specific EPP will be developed. This EPP will act as a "living document" that incorporates an adaptive management approach to environmental protection and mitigation.

Habitat Loss

- Flag wetlands to avoid interference with wetland habitat to the extent possible.
- Complete in-season wetland surveys for areas subject to minor layout modifications (refer to Section 7.3.3.5).
- Avoid impacts to wetlands to the extent possible.
    - Where unavoidable, complete wetland alterations in accordance with the NS Wetland Conservation Policy and the wetland alteration process during the permitting stage, which includes a requirement to compensate for lost wetland habitat and functions.
    - Design wetland crossings to occur at the narrow part of the wetland or the wetland's edges, to the extent possible.

Hydrology

- Design wetland crossings to avoid permanent diversion, restriction, or blockage of natural flow, such that hydrologic function of wetlands will be maintained.

Erosion and Sedimentation

- Develop a site-specific erosion and sedimentation plan during the detail design phase.
    - The plan will address the type of control structures, proper installation techniques, grading, maintenance and inspection, timing of installation, and revegetation.
- Limit the area of exposed soil and the length of time soil is exposed without mitigation (e.g., mulching, seeding, rock cover).
- Use the existing roads and access routes to the extent feasible.
- Avoid travel through wetlands. If travel through wetlands is required:
    - Use anti-rutting mitigation (e.g., mud mats), as appropriate.
    - Cross the wetland at the narrowest portion, where possible.
    - Time work to occur during frozen ground conditions, where possible.
- Avoid surface run-off containing suspended materials or other harmful substances.
- Direct run-off from construction activities away from wetlands.
- Maintain existing vegetation cover, where possible.

Dust Deposition

- Use water or an approved dust suppressant to control dust on roads, as required.
- Enforce site speed limits to minimize dust generation.

Invasive Species

- Use quarried, crushed materials for road construction to reduce the introduction of invasive vascular plant species, where possible.
- Prior to arrival on site equipment will be cleaned and inspected to prevent the introduction of invasive/non-native species.

Compaction

- Delineate and flag wetlands to avoid unnecessary compaction within wetlands.
- Train staff on the requirements for work in and around wetlands.
- Avoid travel through wetlands. If travel through wetlands is required:
    - Use anti-rutting mitigation (e.g., mud mats), as appropriate.
    - Cross the wetland at the narrowest portion, where possible.
    - Time work to occur during frozen ground conditions, where possible.

Monitoring

A site-specific post-construction wetland monitoring plan will be developed to facilitate adaptive management and contribute to the safeguarding of ecological integrity and environmental stability. The plan will be provided to NSECC as part of the permitting process and will consist of detailed monitoring and general spot checks. Detailed monitoring will include vegetative, hydrological, and soil assessments within the wetland habitat adjacent to the infill site. Spot checks will involve a general overview of vegetative, hydrological, and soil conditions, focusing on evidence of significant hydrologic alterations and sedimentation (Table 7.34).

Table 7.34: General Wetland Monitoring Parameters and Methods of Assessment

Monitoring Parameter	Tasks	Method of Assessment	
		General Monitoring	Detailed Monitoring
Hydrology	A shallow monitoring well will be installed within the remaining wetland habitat of the partially infilled wetland.	No	Yes
	Standing water depth measurements will be noted within the existing wetland (if applicable).	No	Yes
	Evidence of positive indicators of hydrology (e.g., drainage patterns, water-stained leaves, saturated surfaces, raised tree roots, development of a hydrogen sulfide odour in soils, water marks etc.) will be noted.	Yes	Yes
	An assessment of the general hydrologic condition and hydrologic connectivity will be made, including evidence of drier/wetter conditions, impeded water drainage, and upland flooding.	Yes	Yes
Vegetation	Vegetation assessments will be completed within plots along a vegetative transect throughout the remaining wetland habitat of the partially infilled wetlands. An assessment of the potential changes in composition, species, health, and presence/absence of invasive plants will be evaluated. Photographs will be taken of individual vegetation plots for comparison with future monitoring events.	No	Yes
	General assessment of the above variables throughout existing wetland habitat will be completed.	Yes	Yes
	Photographs will be taken of the existing wetland habitat from a fixed location for comparison with future monitoring events.	Yes	Yes
Soils	Assessment of surface soils within the remaining wetland habitat will be completed via hand digging of test pits. An assessment of potential shifts in soil characteristics will be evaluated.	Yes	Yes
	Assessment of potential changes in soil conditions throughout the remaining wetland habitat will be evaluated, including evidence of sedimentation and siltation.	Yes	Yes

Conclusion

Effects to wetland habitat and functionality are expected to be of low magnitude. The timing and seasonality of effects is expected to be applicable, with a potential for the effects to be exasperated by high precipitation events in the spring and fall. Effects will be restricted to the LAA, occurring as a short-term, single event during the construction phase, and are reversible. Therefore, effects to wetlands are considered not significant.

7.4 Terrestrial Environment

7.4.1 Terrestrial Habitat

7.4.1.1 Overview

The terrestrial habitat assessment focused on the identification of sensitive and important habitats through a combination of desktop review and field surveys, with the goal of designing the Project to avoid sensitive and important habitats. Wetland habitats are addressed in Section 7.3.3, and habitat assessment related to specific fish, fauna, bats, and bird species are addressed in Sections 7.3.2, and 7.4.3 to 7.4.5.

Historic and existing land use on Weavers Mountain includes forestry operations and recreation activities throughout the year. These activities have established an expansive road and trail network that allows for access to most locations within the Assessment Area.

To assess the terrestrial habitat within the Study Area, a desktop review was conducted prior to field surveys to identify different habitats and key areas of interest. The findings informed the design of field surveys with the goal of assessing all habitat types, including habitats in both their natural state and habitat that have been subject to anthropogenic disturbance. Results of the desktop and field studies informed the siting of wind turbines, laydown areas, spur roads, and other infrastructure components. This was an iterative process, with the layout being refined through ground truthing of Project component footprint impacts against sensitive and important habitats confirmed to be present through field studies. The results were also used to develop targeted mitigation and BMPs.

7.4.1.2 Regulatory Context

Applicable laws and regulations relevant to terrestrial habitat are within the *Environment Act*, SNS 1994-95, c 1 as well as the Old-Growth Forest Policy for Nova Scotia (NSNRR, 2022a) and the Nova Scotia Silvicultural Guide for the Ecological Matrix (SGEM) (McGrath et al., 2021).

The *Environment Act,* SNS 1994-95, c 1 supports and promotes the protection, enhancement, and use of the provincial environment while maintaining ecosystem integrity and sustainable development. The Old-Growth Forest Policy and SGEM regulate forestry and forest management practices on Crown land in Nova Scotia and inform best practices for management of forested areas on private lands. These policies provide requirements and/or guidance on how best to maintain ecological integrity and allow for the determination of whether old-growth forests exist. These requirements include no net loss of old-growth forests on Crown land, and guidance for avoiding development within 100 m of a confirmed old-growth stand.

A small portion (42 ha) of the Assessment Area lies within Crown land; however, most of the Assessment Area is on private land, and while no legal protection is granted to habitat on private land, the best practices described within the policies were still considered.

For species designated as rare or at risk, individual species and/or their dwellings are provided protection federally, under *SARA*, and provincially, under the NS *ESA* and *Biodiversity Act,* SNS 2021, c 3.

7.4.1.3 Desktop Review

To assess the terrestrial habitat, a desktop review was undertaken prior to any field activities using the following resources:

- Ecological Land Classification for Nova Scotia (Neily et al., 2017)
- Provincial Landscape Viewer (NSNRR, 2017)
- Nova Scotia Forest Inventory (Province of NS, 2021)
- Significant Species and Habitat Database (NSNRR, 2018a)
- Old-Growth Policy Layer (Province of NS, 2022)
- Nova Scotia Parks and Protected Areas Map (NSECC, 2022c)

The Study Area falls within the Nova Scotia Uplands Ecoregion, which covers 19.8% of the province, and is characterized by summits and plateaus, an abundance of river and streams, and uneven-aged forests exhibiting old-growth features (Neily et al., 2017). The Assessment Area lies within the Pictou Antigonish Highlands Ecodistrict (330), which comprises some of the province's highest elevations. This ecodistrict makes up 12.2% of the ecoregion and represents a division between the Northumberland Lowlands (530) and St. George's Bay Lowlands (520). The Pictou Antigonish Highlands contain large intact late successional Acadian forests of shade tolerant hardwood trees growing along hill crests and slopes, with common tree species including sugar maple (*Acer saccharum)*, American beech (*Fagus grandifolia*), yellow birch, white ash (*Fraxinus americana*), and ironwood (*Ostrya virginiana*). Additionally, the forests of this ecodistrict are generally defined by a large abundance and diversity of ferns and club mosses in the understory. Red maple and black spruce dominant stands are common in areas with imperfectly drained soils, while steep-sided ravines support mixed wood forests of eastern hemlock (*Tsuga canadensis*), white pine (*Pinus strobus)*, red spruce (*Picea rubens)*, yellow birch, sugar maple, and American beech. Wind exposure, snow, and ice storms can be a source of significant damage to trees at these high elevations, minimizing tree growth potential and causing blowdown and/or uprooting. A notable province-wide disturbance that has impacted this ecodistrict is the beech bark canker, which has reduced beech from a dominant overstory species to primarily understory. This shift in forest dynamics is reflected in the new status of beech as a SOCI in March 2022.

The Provincial Landscape Viewer was reviewed to identify the land cover within the Study Area (Table 7.35; Drawing 7.18). Land cover within the Study Area is varied, including built infrastructure, harvested areas, and a nearly equal distribution of hardwood and softwood forest. The majority of the Study Area is composed of untreated (i.e., not treated silviculturally) natural forest stands according to the Nova Scotia Forest Inventory Forest Groupings (54% cover) (Province of NS, 2021). A large percentage of the Study Area; however, is composed of plantations (25%). The Nova Scotia Forest Inventory is based on aerial imagery from 2007, and more recent imagery shows that many of these previously natural forest stands have since been

harvested and converted to additional plantations or remain bare. Therefore, the percentage of land cover made up of natural, untreated forest stands is likely much lower.

Table 7.35: Land Cover Types within the Study Area and their Respected Percent Cover as Determined by the Provincial Landscape Viewer and NSNRR Forest Inventory

Land Cover Type	Percent Cover (%)
Softwood	36.41
Hardwood	25.24
Mixed Wood	17.52
Harvests	15.11
Bog or Wetland	4.45
Blueberries or Barrens	0.47
Water	0.28
Old Field	0.21
Brush	0.17
Utility Corridor	0.04

The Old-Growth Policy layer (Province of NS, 2022) includes one forested area protected under the Old-Growth Policy, which is within the single Crown land parcel in the interior of the Study Area. This old-growth forest is located within 360 m of the Assessment Area. The closest old-growth forest to the Assessment Area is over 175 m away and located outside the Study Area. Neither of these areas will interact with the Project.

A review of the NSNRR Significant Species and Habitat Database (2018a) within 100 km of the Study Area identified 7 feature records:

- Six records classified as ‘Other Habitat’ which relate to one cove, one cave, three islands, and one lake.
- One record classified as ‘Species of Concern’ which relates to a cave.

All features are found over 20 km away from the Study Area and will not interact with the Project.

The Nova Scotia Parks and Protected Areas Map (NSECC, 2022c) was screened to identify any protected areas in/near the Study Area (Drawing 7.6), which include:

- Barneys River Nature Reserve
- Beaver Mountain Provincial Park

In December 2022, Barneys River Nature Reserve was approved as a protected nature reserve. This nature reserve is found outside the Study Area at the northwest border, and the nearest Project-related infrastructure is over 500 m away. Beaver Mountain Provincial Park is located outside the northwest border of the Study Area, adjacent to a proposed road.

7.4.1.4 Field Assessment Methodology

Terrestrial habitats investigated through field studies included those associated with watercourses, wetlands, mature/old-growth forests, caves/mine shafts, and habitat types known to support rare plants, lichens, and important lifecycle functions/stages for moose, birds, and bats.

Identification of sensitive or important terrestrial habitat features through field investigations were used to further refine siting of proposed Project infrastructure components (wind turbines and roads) with the objective of avoiding or minimizing interaction with these habitat features.

7.4.1.5 Field Assessment Results

Historic and ongoing forestry operations in the Study Area have resulted in modifications to the natural habitat conditions. Current habitat conditions included forests that have been subjected to clearcutting, selective cutting of both hardwood and softwood stands, reforestation using single species seedlings, and stands of naturally regenerating mixed wood forests. The Assessment Area is characterized by young, dense monocultural hardwood and softwood stands, regenerating roadside brush, and steep hardwood valleys.

Many of the hardwood stands encountered within the Study Area were young and even-aged, suggesting they are likely regenerating stands or plantations. A high proportion of the Study Area is composed of plantations, however early successional hardwood stands found growing after stand-level disturbances (i.e., harvesting) are common in this ecodistrict. Given the extent and intensity of forestry activities in the Assessment Area, there are very few areas that have gone untouched by industrial forestry operations. Natural, undisturbed areas were found to mainly exist along riparian areas where treed and shrub swamps were prominent, and river valleys with slopes vegetated by hardwood trees.

The native vegetation in and around the Assessment Area includes a variety late succession tree species, shrubs, and native grasses. Primary native tree species include red maple, yellow birch, sugar maple, American beech, red spruce, black spruce, and balsam fir. Yellow birch and sugar maple stands are found primarily on well drained slopes and ridges throughout the Assessment Area, and paper birch (*Betula papyrifera)* and red maple comprised many of the regenerating hardwood stands. The understory of most mature forests contained an abundance of shrub and fern species, a characteristic feature of this ecodisrict. Balsam fir and red spruce dominate poorly drained slopes, while black spruce, red maple, and yellow birch often dominate treed swamps and riparian zones around watercourses and wetlands. Alder thickets are mainly present in many of the areas of the site where higher levels of beaver activity have been observed. Through-flow wetlands dominated by alders are also present in many areas near the headwaters of the brooks and streams that flow in all directions from ridges and high points throughout the Assessment Area.

The province defines old-growth forest as “an area where 20% or more of the basal area is in trees greater than or equal to the reference age for that forest (ecosystem classification vegetation) type” (NSNRR, 2022a). As the Project occurs primarily on private land, with the only

Crown parcel occurring over 175 m from the Assessment Area, the Old-Growth Forest Policy (NSNRR, 2022a) is not enforceable and associated old-growth scoring was not undertaken. However, to support BMPs, potential locations for old-growth forest were considered during field surveys. Field biologists took note of characteristics such as uneven-aged tree composition, multiple canopy heights, evidence of a disturbance regime, high proportions of climax species within the forest stand, and the presence of dead standing trees (snags) or downed woody debris. Late successional hardwood and hemlock forests were encountered throughout the Study Area and in the northeastern portion of the Assessment Area, the majority of which were along ridges and in gullies.

Areas potentially supporting flora and fauna SOCI such as mature forests and wetlands were surveyed to determine the capacity for these areas to support SOCI and whether any SOCI were present. American beech was found in wetlands and various mixed wood and hardwood stands across the Study Area and was not limited to one specific habitat type or location. No additional habitat supporting SOCI was identified through terrestrial habitat field studies within the Assessment Area (wetlands are addressed separately in Section 7.3.3). Since the Assessment Area makes use of pre-existing roads and vegetation areas subject to historic and ongoing forestry activities, the interaction between Project infrastructure components and undisturbed/mature stands of naturally occurring vegetation is minimal.

7.4.1.6 Effects Assessment

Project-Terrestrial Habitat Interactions

Project activities, primarily those that involve earth moving or vegetation removal, have the potential to impact terrestrial habitat (Table 7.36). These activities could result in habitat removal or alteration.

Table 7.36: Potential Project-Terrestrial Habitat Interactions

Valued Component	Site Preparation and Construction										Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Terrestrial Habitat			X	X	X	X				X			X		X

Assessment Boundaries

The LAA for terrestrial habitat includes the Assessment Area, while the RAA includes the Study Area and all connected neighbouring habitat (Drawing 2.2).

Assessment Criteria

Assessment criteria provided in Section 4.6 apply for terrestrial habitat. The VC-specific definition for magnitude is as follows:

- Negligible – no loss of terrestrial habitat or alteration to habitat functions expected.
- Low – small loss of terrestrial habitat, but overall habitat functions remain intact.
- Moderate – small to moderate loss of sensitive terrestrial habitat or loss of key habitat functions.
- High – high loss of sensitive terrestrial habitat or key habitat functions.

Effects

Habitat Loss and Fragmentation

The loss or conversion of undisturbed habitat to construct roads, transmission line corridors, and turbine pads can impact the terrestrial habitat. Habitat to consider includes habitat for flora and fauna SOCI, old-growth forest, priority habitat features, areas of special concern for conservation or protection, and unfragmented, undisturbed areas.

No terrestrial habitat for SOCI was identified within the Assessment Area through the NSNRR Significant Species and Habitat Database (2018a) and field surveys, apart from American beech. No confirmed old-growth forest will be impacted by the Project. No conservation areas, nature reserves, or otherwise protected areas are found within the Assessment Area.

The majority of land cover within the Study Area is softwood and hardwood forests, including natural and treated stands, as determined by desktop review and confirmed through field surveys. The extent of treated and cleared areas were found to be greater than aerial imagery and Forest Inventory database designations suggested. The Project Area will consist of 11.3 km of new roads and 13.3 km of pre-existing roads. Therefore, impacts to undisturbed and unfragmented habitat will be low and although there will be small losses to terrestrial habitat associated with the Project, habitat functionality will remain intact relative to pre-construction conditions.

Habitat Creation

The terrestrial habitat within the Assessment Area will be modified. Although much of the Project Area consists of existing roads, these roads may require widening and additional infrastructure added in the rights-of-way (ditches, overhead collector lines). New gravel roadsides may become preferred nesting habitat for herpetofauna, and the new and widened roads may become basking habitat for snakes, wildlife corridors for terrestrial mammals, and the introduction of road salt may attract ungulates. New and widened road rights-of-way may become new habitat for nesting birds who prefer rocky or grassy surfaces to nest in. Roadside ditches and cleared

rights-of-way will be revegetated through mitigation measures and naturally over time. This process may lead to the creation of different habitat types than were previously present, including wetlands and early successional forests. Although succession will be induced by anthropogenic factors, the natural process will, in time, persist, and this new habitat will be used by a variety of species. Mitigation measures will be designed to ensure the process can proceed as naturally as possible, and that any new habitat created has a low magnitude of effects on the terrestrial environment.

Mitigation Measures

To address effects to terrestrial habitat, the following mitigation measures will be implemented:

Habitat Loss

- Minimize overall area to be cleared, fragmentation of habitats, and isolation of existing habitats by utilizing pre-existing roads and previously altered areas (i.e., clearcuts).
- Restore cleared areas where possible to reduce permanent habitat loss, primarily through revegetation of road rights-of-way.

Habitat Creation

- Revegetate disturbed areas, exposed soils, and cleared areas using native seed mixes.
- Minimize use of road salt to minimize attraction of ungulates to roadsides during the winter.

Monitoring

No monitoring programs specific to terrestrial habitat are recommended.

Conclusion

Effects to terrestrial habitat associated with the Project have been assessed, including habitat loss and habitat creation. Based on this assessment and through the implementation of proposed mitigation strategies, effects to terrestrial habitat are expected to occur within the LAA and be of low magnitude. Residual effects may occur as a single event and persist long-term until natural successional processes can occur. Furthermore, residual effects are expected to be reversible upon decommissioning of the Project and are not significant.

7.4.2 Terrestrial Flora

7.4.2.1 Overview

The terrestrial flora assessment included both desktop and field studies components. The objectives of the terrestrial flora assessment included the following:

- Classify habitat that supports terrestrial flora SOCI in the Study Area using available desktop resources (see Section 7.3.2.2 for definition of SOCI species).
- Identify important and sensitive habitat features that support terrestrial flora SOCI on/near the Project.
- Design field program efforts to document the diversity of terrestrial flora within the

Assessment Area, and to identify locations of terrestrial flora SOCI within the Assessment Area.
- Ground truth and collect information on terrestrial flora SOCI identified during desktop studies.
- Use the information collected through field studies to update the Project design to avoid or minimize interactions between Project infrastructure components and confirmed locations of terrestrial flora SOCI or the habitats that are known to support terrestrial flora SOCI.
- Apply mitigation, construction, and operational management practices to minimize effects to terrestrial flora (i.e., apply setbacks to lichen SOCI).

7.4.2.2 Regulatory Context

The following section describes terrestrial flora resources with the potential to occur in the Study Area, with a focus on vascular plant and lichen SOCI, that may be potentially impacted by Project activities. Plant and lichen SAR receive protection under *SARA* and/or NS *ESA* which prohibits their disturbance and destruction. Special management practices are required around occurrences of certain rare lichen, as prescribed in the At-Risk Lichens–Special Management Practices (NSNRR, 2018b). Additional regulations discussed in Section 7.4.1 aim to protect important habitat features, such as old-growth forests or wetlands, that support many plant and lichen SOCI in Nova Scotia.

7.4.2.3 Desktop Review

The desktop review included a review of the following databases for terrestrial flora:

- ACCDC Data Report (2023)
- Boreal Felt Lichen Habitat Layer (NSNRR, 2012)

ACCDC records (2023) identified 369 flora species within 100 km of the Study Area (Appendix F). Of the 369 species, 247 are vascular plants and 122 are non-vascular plants. A summary of plant and lichen SOCI identified by the ACCDC records as being known to occur within 5 km of the center of the Study Area is provided in Table 7.37 (Drawings 7.15C and 7.15D). All flora noted in Table 7.37 are found outside the Assessment Area.

Table 7.37: ACCDC Plant and Lichen SOCI Identified within 5 km of the centre of the Study Area

Common Name	Scientific Name	COSEWIC[1]	*SARA*[2]	NS *ESA*[3]	S-Rank[4]
Plants (Vascular)					
American beech	*Fagus grandifolia*	---	---	---	S3S4
Fragrant green orchid*	*Platanthera huronensis*	---	---	---	S1S2
Savin-leaved ground-cedar	*Diphasiastrum x sabinifolium*	---	---	---	S3?
Lichens (Non-vascular)					
Acadian jellyskin lichen	*Leptogium acadiense*	---	---	---	S3S4
Birdnest jellyskin lichen	*Scytinium tenuissimum*	---	---	---	S2S3

Common Name	Scientific Name	COSEWIC[1]	*SARA*[2]	NS *ESA*[3]	S-Rank[4]
Granular soil foam lichen	*Stereocaulon condensatum*	---	---	---	S2S3
Naked kidney lichen	*Nephroma bellum*	---	---	---	S3
Pompom-tipped shadow lichen	*Phaeophyscia pusilloides*	---	---	---	S3
Shelter shingle lichen	*Vahliella leucophaea*	---	---	---	S3S4
Shaggy fringed lichen	*Anaptychia palmulata*	---	---	---	S3S4

Source: ACCDC, 2023
[1]Government of Canada, 2022; [2]Government of Canada, 2022; [3]Government of NS, 2022; [4]ACCDC 2022
*Found within the Study Area boundary

The Boreal Felt Lichen Layer (provided to Strum by NSNRR) was reviewed to identify potential habitat for boreal felt lichen (*Erioderma pedicellatum*) within the Assessment Area. The habitat model is based on the known distribution of boreal felt lichen, which is known to grow on the trunks of balsam fir trees in peatland and in close proximity (<30 km) to the Atlantic Ocean (NSNRR, 2012). Boreal felt lichen – Atlantic population is a rare species listed as "Endangered" under Schedule 1 of *SARA* and NS *ESA* and is also listed as "S1" by ACCDC. The Boreal Felt Lichen Layer identified no suitable habitat across the Assessment Area.

7.4.2.4 Field Assessment Methodology

Plant and lichen surveys were completed across the Legacy Study Area on July 22, 23, and 24, 2020. Targeted transects were conducted by an expert botanist with extensive experience in Nova Scotia botany. The transects were spaced out through different habitats and positioned evenly throughout the Legacy Study Area to ensure survey coverage of all representative habitats was obtained. Habitat types surveyed included vernal pools, clear-cuts, river valleys, mature hardwood stands, regenerating softwood stands, and treed swamps. If important habitat types such as wetlands or fringe habitat were identified adjacent to transects, these areas were investigated (Drawing 7.21).

Field staff conducting wetland and watercourse surveys were briefed on a short list of plant SOCI prior to conducting surveys and used a plant guide to aid in incidental SOCI observations.

Concurrent with the plant surveys, lichen surveys were conducted by an expert lichenologist, as recognized by NSNRR. The presence of lichen species is dependent upon the vegetation in the area; therefore, vegetative cover was a criterion used to design lichen SOCI survey transects. Survey methods included predetermined transects in suitable vegetation habitats and investigating proposed road and turbine locations (the Assessment Area) that interacted with vegetation conditions known to support lichen SOCI.

7.4.2.5 Field Assessment Results

During the plant and lichen surveys, 177 flora species were identified, which included two plant SOCI and one lichen SOCI (Drawings 7.12A to 7.12Q). A complete list of plant species identified during targeted surveys and incidental observations is provided in Appendix I. All SOCI plants and lichens identified during field assessments are summarized in Table 7.38. Eleven non-native

plants were also encountered during field surveys (Table 7.39). Because some of the Assessment Area has not yet been surveyed during the growing season due to a minor layout modifications and additions (see Section 7.3.3), additional plant and lichen SOCI surveys are recommended during growing season before construction activities, including land clearing, are initiated.

Table 7.38: Flora SOCI Encountered during Flora Surveys

Common Name	Scientific Name	COSEWIC Status[1]	SARA Status[2]	NS *ESA* Status[3]	NS S-Rank[4]	Habitat
American beech	*Fagus grandifolia*	---	---	---	S3S4	Understory of hardwood and mixed wood stands throughout the Assessment Area
Acadian jellyskin lichen	*Leptogium acadiense*	---	---	---	S3S4	Mature hardwood trees, stands with no recent harvesting
Large purple fringed orchid	*Platanthera grandiflora*	---	---	---	S3	Wet area in hardwood stand

[1]Government of Canada 2022; [2]Government of Canada, 2022; [3]Government of NS, 2022; [4]ACCDC 2022a

Table 7.39: Non-Native Flora Encountered during Flora Surveys

Common Name	Scientific Name	Exotic Status[1]	S-Rank[2]
Autumn hawkbit	*Scorzoneroides autumnalis*	Widespread	SNA
Bitter dock	*Rumex obtusifolius*	Widespread	SNA
Common hawkweed	*Hieracium lachenalii*	Widespread	SNA
Common speedwell	*Veronica officinalis*	Widespread	SNA
Common St John's-wort	*Hypericum perforatum*	Widespread	SNA
Creeping buttercup	*Ranunculus repens*	Widespread	SNA
Helleborine	*Epipactis helleborine*	Fairly Common	SNA
Meadow hawkweed	*Pilosella caespitosa*	Widespread	SNA
Musk mallow	*Malva moschata*	Fairly Common	SNA
Norway spruce	*Picea abies*	Uncommon	SNA
Tall hawkweed	*Pilosella piloselloides*	Widespread	SNA

[1]NSECC 2012; [2]ACCDC 2022a

Two plant SOCI were observed during field surveys (Table 7.38, Drawings 7.12A to 7.12Q). American beech was assigned an S-Rank of 'S3S4' in March 2022, indicating that it is uncommon in the province and/or widespread, common, and apparently secure in the province (ACCDC, 2022). Although historically a common tree species in Nova Scotia, the quality and mass production of American beech trees have been devastated by beech scale disease. While still present across the province, the ecological role that this tree has played in tolerant hardwood forest has changed in recent years, shifting from an overstory tree to an intermediate

or understory species (NSNRR, 2021c). Because of the commonality of this species, locations of observations were not recorded.

The large purple fringed orchid (*Platanthera grandiflora*) is a wetland species, found in moist forests or fields, marshes, bogs, and swamps. This species was found in one location within the Study Area, in a wet area in a hardwood forest stand approximately 400 m south of the Assessment Area.

Many common species of lichen were observed throughout the Study Area but were not recorded due to their abundance. One lichen SOCI was observed during field surveys (Table 7.38, Drawings 7.12A to 7.12Q). Acadian jellyskin lichen (*Leptogium acadiense*) was found in one location outside of the Study Area, approximately 480 m south of the Assessment Area, within the Legacy Study Area. This lichen was found in a hardwood stand near the edge of a harvested area.

The results of flora studies have been incorporated into the design phase of the Project. Protection of flora SOCI will continue to be employed throughout operation and decommissioning phases through the use of targeted mitigation and BMPs.

7.4.2.6 Effects Assessment

Project-Terrestrial Flora Interactions

Project activities, primarily those that involve earth moving or vegetation removal, have the potential to impact terrestrial flora (Table 7.40). These activities could result in changes to, or loss of habitat used by SOCI, loss of plant or lichen SOCI, or introduction of non-native species that may become invasive in the environment.

Table 7.40: Potential Project-Flora Interactions

Valued Component	Site Preparation and Construction										Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Terrestrial Flora				X	X	X				X			X		X

Assessment Boundaries

The LAA for terrestrial flora includes the Assessment Area, while the RAA includes the Study Area and all connected neighbouring habitat (Drawing 2.2).

Assessment Criteria

Assessment criteria provided in Section 4.6 apply for terrestrial habitat. The VC-specific definition for magnitude is as follows:

- Negligible – no loss of terrestrial flora SOCI individuals or alteration to habitat supporting terrestrial flora SOCI expected.
- Low – small loss of habitat supporting terrestrial flora SOCI, but no terrestrial flora SOCI individuals lost.
- Moderate – small loss of terrestrial flora SOCI individuals (and associated habitat), but their populations remain largely intact.
- High – high loss of the habitat that supports terrestrial flora SOCI and/or loss of an entire population of terrestrial flora SOCI.

Effects

Loss of SOCI

Targeted plant surveys were conducted to identify locations of plant and lichen SOCI across the Study Area. The Project was designed to avoid areas where plant and lichen SOCI were found. Therefore, loss of plant and lichen SOCI is expected to be negligible to low.

Habitat Loss

Rare plants often become rare because they require specialized habitats (BCECC, 2018; CPC, 2020). Although much of the Project Area will utilize pre-existing roads (13.3 km of new roads will be required), road widening may be required and new roads will be constructed (11.3 km). A targeted approach was used when conducting field assessments for terrestrial flora to survey habitat that may host rare flora. For example, flora transects were targeted within hardwood forest areas because many rare lichen are found in mature hardwood forests. The Project design has avoided habitat that is known to support plant and lichen SOCI within the Study Area to the extent possible, and the design has also utilized previously disturbed habitat to minimize habitat loss. Effects to terrestrial flora from habitat loss are therefore expected to be negligible to low.

Invasive species

Terrestrial flora, particularly rare flora, may be at risk due to threats from invasive species (BCECC, 2018). Non-native species, often introduced into a landscape accidentally by humans, can become invasive when they cause harm to the environment, economy, or human health through rapid reproduction and out-competing native species (National Geographic, 2022). Industrial projects can lead to the introduction of invasive species in two main ways:

- Revegetation of cleared land with non-native seed mixes.
- Increased access to remote areas with equipment carrying seeds, spores, or other reproductive materials from non-native species.

Several non-native plants have already been found across the Study Area, and most areas would not be considered remote as access is already widespread. Therefore, the magnitude of effects is expected to be negligible to low.

Mitigation Measures

To address effects to terrestrial flora, the following mitigation measures will be implemented:

Loss of SOCI

- Complete in-season rare plant and lichen surveys for areas subject to minor layout modifications (further discussed in Section 7.3.3).
- Minimize overall area to be cleared by utilizing pre-existing roads and previously altered areas (i.e., clearcuts).
- Maintain avoidance of flora SOCI from areas with known occurrences during the design phase.
    - Desktop and field assessments identified important habitat features with terrestrial flora SOCI locations to be avoided during the design phase.
    - Additional surveys will be conducted to determine the presence (if any) of flora SOCI in the Assessment Area which have not yet been surveyed during the growing season.
- Educate Project personnel about the potential for plant or lichen SOCI during construction.
    - Guidance will be provided to Project personnel to raise awareness of terrestrial flora SOCI that are known to exist within the Study Area to increase the number of trained eyes looking for these species.
- Consult with NSNRR if an unexpected flora SOCI is encountered during construction activities. Potential mitigation measures based upon recognized practices to transplant or collect seeds can be used as a contingency if flora SOCI are unexpectedly encountered during construction activities. A transplantation plan will be developed along with a monitoring protocol through consultation with NSNRR should this be required during construction.

Habitat Loss

- Minimize overall area to be cleared by utilizing pre-existing roads and previously disturbed areas (i.e., clearcuts).
- Minimize (through avoidance) the loss of important habitat which supports terrestrial flora SOCI during the detailed design phase.
- Restore as much habitat as possible through revegetation (with native seed mix) to promote continued growth of terrestrial flora across the Study Area.

Invasive Species

- Use native seed mixes when revegetating cleared areas.
- Ensure equipment is as clean as possible to prevent the introduction of non-native species into previously untouched areas.
    - Because non-native species are already present within the Study Area, care will

be taken when travelling from developed areas to intact areas so that plant material is not transferred between locations.

Monitoring

Because all known locations of flora SOCI have been avoided during Project design, no monitoring of terrestrial flora will be necessary at this time.

Conclusion

Effects to terrestrial flora associated with the Project have been assessed, including loss of SOCI, habitat loss, and introduction of invasive species. Based on this assessment and through the implementation of proposed mitigation and monitoring strategies, effects to terrestrial flora are expected to occur within the LAA and be of low magnitude. Residual effects may occur as a single-event and persist long-term with no seasonal aspects applicable; however, effects are expected to be reversible upon decommissioning of the Project and are not significant.

7.4.3 Terrestrial Fauna

7.4.3.1 Overview

The fauna assessment was completed using a combination of desktop and field assessments to achieve the following objectives:

- Identify significant species and habitat supporting SOCI within/near the Legacy Study Area using desktop resources.
- Determine the likelihood of SOCI species occurring in the Legacy Study Area.
- Undertake targeted surveys for different groups of terrestrial fauna to document the presence of species within the Legacy Study Area, particularly SOCI.
- Use the information collected through field studies to update the Project design to avoid or minimize interactions between Project infrastructure components and confirmed locations of terrestrial fauna SOCI or the habitats that are known to support terrestrial fauna SOCI.
- Apply mitigation, construction, and operational management practices to minimize effects to terrestrial fauna.

7.4.3.2 Regulatory Context

Applicable laws and regulations relating to the protection of fauna (i.e., mammals, herpetofauna, butterflies, and Odonates [dragonflies and damselflies]) including the following:

- *SARA*
- NS *ESA*
- *Canada Wildlife Act*
- *Wildlife Act,* RSNS 1989, c 504
- *Biodiversity Act,* SNS 2021, c 3
- *CEPA*
- *Environment Act,* SNS 1994-95, c 1

The NS *ESA* and *SARA* prohibit harm to listed SAR along with their habitually occupied spaces and core/critical habitat (respectively). The *Canada Wildlife Act* provides a framework for the creation of protected wildlife areas, and the *Wildlife Act,* RSNS 1989, c 504 provides policies and programs for wildlife to maintain diversity of species at levels of abundance to meet specific management objectives. The *Wildlife Act,* RSNS 1989, c 504 includes a clause for the protection of den/habitation of a furbearer [48(3)]. The *Biodiversity Act,* SNS 2021, c 3 provides a framework for the creation of Biodiversity Management Zones used for conservation and sustainable biodiversity values. Lastly, *CEPA* and the *Environment Act,* SNS 1994-95, c 1 both provide measures for the protection of the environment and pollution prevention.

7.4.3.3 Desktop Review

The desktop component included a review of the NSNRR Significant Species and Habitat Database (2018a) and ACCDC data (2023) for mammal, herpetofauna, butterfly, and Odonates species recorded within a 100 km radius of the center of the Study Area. A comparison of habitat mapping data to known habitat requirements for species expected to occur within the area, and for all SOCI, was also completed. Specifically, habitat suitability modelling for Mainland moose was conducted to identify important moose habitat within the Study Area.

Mammals

The Nova Scotia Significant Species and Habitat Database (NSNRR, 2018) contains 55 unique species and/or habitat records pertaining to terrestrial mammals within a 100 km radius of the Study Area. These records include:

- 50 records of “Deer Wintering” related to White-tailed deer (*Odocoileus virginianus*)
- Two records of “Other Habitat” relating to American black bear (*Ursus americanus*)
- Three records of “Species at Risk” relating to moose

The closest record to the Study Area pertains to a deer wintering area 1 km away. The next closest record pertains to American black bear (20 km away) and the moose records are 54 km away.

The ACCDC database (2023) identifies four terrestrial mammal SOCI (excluding bats) that have been recorded within a 100 km radius of the center of the Study Area (Table 7.41). None of the identified SOCI have records within the Study Area.

Table 7.41: Mammal Species Recorded within a 100 km Radius of the Centre of the Study Area

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
Canada lynx	*Lynx canadensis*	Not at Risk	---	Endangered	S2S3
Fisher	*Pekania pennanti*	---	---	---	S3
American water shrew	*Sorex palustris*	---	---	---	S3S4
Mainland moose*	*Alces alces americanus*	---	---	Endangered	S1

Source: ACCDC, 2023
[1]Government of Canada, 2022; [2]Government of Canada, 2022; [3]Government of NS, 2022; [4]ACCDC, 2022
*Reported by ACCDC as ‘Moose – *Alces americanus*’, has been changed to reflect most up to date nomenclature

Mainland Moose Habitat Suitability Modelling

Mainland moose habitat suitability modelling was conducted by Strum using ArcGIS Pro software and the provincial Forest Inventory database (Province of NS, 2021). The data contained within this database were reclassified for the purposes of this analysis based on land cover groups (i.e., forest types and wet areas). Once different habitat types were determined, these locations were weighted according to which habitat is most preferred by moose (i.e., preferred habitats received higher weighted scores). This method was informed mainly by the Mainland Moose Recovery Plan (NSNRR, 2021g) and a variety of other sources to determine characteristics of high-quality moose habitat (NSEL, 2002; NSNRR, 2021d; NWF, n.d.).

Wetland environments were a required component in the creation of this model as Mainland moose use wetlands for thermal refuge in summer, and aquatic plants such as pondweed (*Potamogeton spp*.) and yellow pond lily (*Nuphar lutea*) provide important nutritional foraging options. Wetlands, particularly isolated areas surrounded by water, are also important calving areas as they provide protection and nutrients for calves and cows. For the purposes of the model, wetlands are defined as bog, fen, swamp, pond, or high-water table/flood prone regions based on the NSNRR Wetlands Inventory (2021e) and Forest Inventory (Province of NS, 2021)

Mixed wood forests were also a required component in this model due to the various benefits they provide to Mainland moose. Mixed wood forests provide winter cover, summer shelter, calving shelter, foraging opportunities in the forms of new growth and broad leaves, and satisfy winter diet requirements. Within the model, this habitat (i.e., mixed wood forest) was defined as a forest stand composed of 26-74% softwood by basal volume. Due to the wide range of species, mixed wood forests are ideal for a generalist species (such as moose) due to the diversity of ecosystems supported by both the deciduous and coniferous canopy. Common species found in the canopy of these mixed wood forests include yellow birch, paper birch, sugar maple, red spruce, balsam fir, and eastern hemlock. Because of the rich nutrient regime and fresh moisture regime common in mixed wood forests, there is also a high abundance of understory vegetation which provides moose with foraging opportunities. Most mixed wood areas also met the criteria provided in the Recovery Plan for each Mainland moose habitat component (i.e., summer forage area, winter forage area, summer cover, winter cover, calving area) (NSNRR, 2021g).

Mainland moose are considered a generalist species, which indicates that they can survive in a wide variety of habitats outside of their preferred habitat types. The Mainland Moose Recovery Plan (NSNRR, 2021g) defines suitable moose habitat as areas where a maximum distance of 200 m separates a mixed wood forest from a wetland. To account for generalist behaviours, and to showcase the connectivity of the habitat identified by the model, a 500 m buffer was used around any area defined as a wet area or mixed wood stand. Shorter distances between mixed wood forests and wetlands were given a higher score in the weighting scheme to account for the greater suitability of these areas (i.e., a distance of up to 100 m between mixed wood forest and wetland receives the highest score, whereas a distance of over 400 m, but no more than 500 m, between mixed wood forest and wetland receives the lowest score). An area with over 500 m between mixed wood forest and wetland was not considered suitable moose habitat in this model.

Upon running this model with the abovementioned criteria, the analysis displays the habitat of Mainland moose ranked from suitable to high quality, based on the weighted criteria (Table 7.42), in 5 ha hexagons spanning the RAA (as defined in Section 7.4.3.6).

Table 7.42: Moose Habitat Suitability Model Weighting Scheme

Score	Distance between wetland and mixed wood forest
110	Up to 100 m
90	Over 100 m but no more than 120 m
83	Over 120 m but no more than 140 m
76	Over 140 m but no more than 160 m
72	Over 160 m but no more than 180 m
66	Upper limit of 200 m specified in recovery plan (over 180 m but no more than 200 m)
59	Over 200 m but no more than 300m
50	Over 300 m but no more than 400m
11	Over 400 m but no more than 500 m (encompasses 200 – 250% of distance in recovery plan)

This model identified large areas of high-quality habitat across the Study Area. The areas surrounding the Assessment Area feature a gradient of habitat quality, indicating important areas that remain connected despite the presence of pre-existing roads. The model output has been submitted under separate cover to the appropriate regulators to reduce the risk of exploitation of these species. Potential impacts to this habitat and connectivity are discussed in Section 7.4.3.6.

Herpetofauna

The Nova Scotia Significant Species and Habitat Database (NSDNR, 2018) contains 60 unique species and/or habitat records pertaining to reptiles and amphibians within a 100 km radius of the Study Area. These records include:

- 60 records of “Species at Risk” relating to Wood turtle (59) and Snapping turtle (*Chelydra serpentina*) (1).

Two records pertaining to Wood turtle are within the Study Area, with six additional records pertaining to Wood turtle within 10 km of the Study Area. The Wood turtle records pertained to water features originating outside the Study Area (Eden Lake and Moose River) and in the Barneys River Watershed. These habitat features both end in the Study Area as small watercourses.

Data from the ACCDC (2022a) indicate that four herpetofauna SOCI have been recorded within a 100 km radius of the Study Area (Table 7.43).

Table 7.43: Herpetofauna Species Recorded by ACCDC within a 100 km Radius of the centre of the Study Area

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
Eastern painted turtle	*Chrysemys picta picta*	Special Concern	Special Concern	---	S4
Four-toed salamander	*Hemidactylium scutatum*	---	Not at Risk	---	S3
Snapping turtle	*Chelydra serpentina*	Vulnerable	Special Concern	Special Concern	S3
Wood turtle	*Glyptemys insculpta*	Threatened	Threatened	Threatened	S2

Source: ACCDC, 2023
[1]Government of Canada, 2022; [2]Government of Canada, 2022; [3]Government of NS, 2022; [4]ACCDC, 2022

None of the identified SOCI have records within the Study Area according to ACCDC. The closest Wood turtle record was 5.6 km from a central point within the Study Area.

Butterflies and Odonates

The Nova Scotia Significant Species and Habitats (NSDNR, 2018) database identifies four significant habitat features relating to butterflies and Odonates within a 100 km radius of the Study Area. These records include:

- Four records of "Species of Concern" relating to Northern bluet (*Enallagma cyathigerum*), Little bluet (*Enallagma minusculum*), Sphagnum sprite (*Nehalennia gracilis*), and Black meadowhawk (*Sympetrum danae*).

None of the aforementioned habitat records for butterflies and Odonates are located within the Study Area, and the nearest record is the Northern bluet, found 43 km from the Study Area.

The ACCDC database contains records of 39 unique butterfly and Odonate SOCI within a 100 km radius of the Study Area (Table 7.44), none of which have been recorded within the Study Area.

Table 7.44: Unique Butterfly and Odonate Species Recorded within a 100 km Radius of the Study Area

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
Acadian hairstreak	*Satyrium acadica*	---	---	---	S2
Aphrodite fritillary	*Speyeria aphrodite*	---	---	---	S3S4
Arctic fritillary	*Boloria chariclea*	---	---	---	S1S2
Banded hairstreak	*Satyrium calanus*	---	---	---	S3
Black meadowhawk	*Sympetrum danae*	---	---	---	S3S4
Bog elfin	*Callophrys lanoraieensis*	---	---	---	S3
Broad-tailed shadowdragon	*Neurocordulia michaeli*	---	---	---	S2

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
Brook snaketail	*Ophiogomphus aspersus*	---	---	---	S3
Compton tortoiseshell	*Nymphalis l-album*	---	---	---	S2S3
Delicate emerald	*Somatochlora franklini*	---	---	---	S3S4
Dorcas copper	*Tharsalea dorcas*	---	---	---	S2
Eastern red damsel	*Amphiagrion saucium*	---	---	---	S3S4
Eastern tailed blue	*Cupido comyntas*	---	---	---	S3S4
Elfin skimmer	*Nannothemis bella*	---	---	---	S3S4
Forcipate emerald	*Somatochlora forcipata*	---	---	---	S3
Green comma	*Polygonia faunus*	---	---	---	S3S4
Greenish blue	*Icaricia saepiolus*	---	---	---	SH
Gray hairstreak	*Strymon melinus*	---	---	---	S3
Harlequin darner	*Gomphaeschna furcillata*	---	---	---	S3S4
Harpoon clubtail	*Phanogomphus descriptus*	---	---	---	S3
Hoary comma	*Polygonia gracilis*	---	---	---	SH
Jutta arctic	*Oeneis jutta*	---	---	---	S3S4
Kennedy's emerald	*Somatochlora kennedyi*	---	---	---	S2S3
Lance-tipped darner	*Aeshna constricta*	---	---	---	S3S4
Maine snaketail	*Ophiogomphus mainensis*	---	---	---	S3
Maritime copper	*Tharsalea dospassosi*	---	---	---	S2
Milbert's tortoiseshell	*Aglais milberti*	---	---	---	S2S3
Monarch	*Danaus plexippus*	Endangered	Endangered	Special Concern	S2?B, S3M
Mottled darner	*Aeshna clepsydra*	---	---	---	S3S4
Northern cloudywing	*Cecropterus pylades*	---	---	---	S3S4
Ocellated darner	*Boyeria grafiana*	---	---	---	S3S4
Pepper and salt skipper	*Amblyscirtes hegon*	---	---	---	S3S4
Question mark	*Polygonia interrogationis*	---	---	---	S3B
Rusty snaketail	*Ophiogomphus rupinsulensis*	---	---	---	S3
Satyr comma	*Polygonia satyrus*	---	---	---	S1?
Spot-winged glider	*Pantala hymenaea*	---	---	---	S2?B
Southern pygmy clubtail	*Lanthus vernalis*	---	---	---	S2S3
Taiga bluet	*Coenagrion resolutum*	---	---	---	S2
Vernal bluet	*Enallagma vernale*	---	---	---	S3

Source: ACCDC, 2023
[1]Government of Canada, 2022; [2]Government of Canada, 2022; [3]Government of NS, 2022; [4]ACCDC 2022

7.4.3.1 Field Assessment Methodology

Mammals

Winter tracking and pellet surveys were conducted to assess the presence and distribution of mammals across the Legacy Study Area, and trail cameras were also placed across the Legacy Study Area to capture the presence of wildlife without any interference from human disturbance (Drawing 7.19; Table 7.45). The goal of the surveys was to cover all relevant habitat types present across the Legacy Study Area, including roadways, wetlands, various forested habitats, riparian areas along watercourses and waterbodies, and previously disturbed areas (i.e., clearcuts). These surveys provided a broader perspective of terrestrial mammal activity within and around the Study Area, with the objective of informing a discussion of the potential impacts to terrestrial mammals in the RAA.

Table 7.45: Mammal Assessment Survey Information

Survey Type	Dates	Transect Number/Location	Transect Length (km)
Winter Tracking	02/07/2022	2	3.00
		4	4.50
		5	3.00
		11	3.00
		3	1.10
		6	3.00
		8	3.50
	02/10/2022	1	3.00
		10	3.00
	03/09/2022	9	2.44
		2	3.05
		8	3.12
		10	3.34
		5	2.82
	03/10/2022	7	3.04
		3	1.10
		6	2.60
		1	3.91
Pellet Surveys	04/26/2022	9	2.44
		2	4.85
		10	3.34
		3	3.07
		6	4.70
		8	3.60
		5	8.00
	04/27/2022	4	7.83
		7	3.10

Survey Type	Dates	Transect Number/Location	Transect Length (km)
Trail Camera Deployment	05/2022-10/2022	Central Road	N/A
	01/2022-05/2022	Hardwood Stand Dead End	N/A
	05/2022-11/2022	Indian Lake Outflow	N/A
	01/2022-05/2022	Lake Edge Game Trail	N/A
	09/2022-11/2022	Mixed Wood Stand	N/A
	07/2022- 11/2022	Clearcut	N/A
	12/2021-05/2022	Softwood Stand	N/A

Methods were adapted from those recommended by the NSNRR Wildlife Division (2012, 2022). Winter wildlife tracking surveys were completed in February and March 2022, within seven days of the most recent snowfall of 10 cm or more, and when possible, within two to three days of the most recent snowfall. This timeline allowed sufficient time for animals to leave their tracks, and limited opportunities for tracks to deteriorate or disappear as a result of excessive snowfall, melting, or rain. Care was also taken to ensure surveys were not completed during rain or snow events. Recent, intact tracks in fresh snow allow for the most accurate track identification. Pellet surveys were completed in April 2022 after the snow had melted completely, revealing animal droppings that had been preserved in the snow over the winter.

Surveys were conducted along pre-determined transects covering a range of representative habitats within the Legacy Study Area, with priority given to habitat where Mainland moose were expected to be active, if present. Transect lengths and locations were slightly altered between winter tracking and pellet surveys to account for information gained during winter tracking and ensure as many habitat types as possible could be covered across surveys. Sections of trails and roads were also surveyed opportunistically, and any incidental observations were recorded. All survey tracks were recorded using GPS devices, and any changes to transects were made such that the new course was similar in length to the planned transect and covered similar or improved habitat types.

Transects were travelled either by all-terrain vehicles (ATVs) (along roads/trails) or by foot. While slowly travelling along a transect, a 4 m area centred on the transect line was scanned for any sign of animal activity, including tracks, pellets/scat, browse, dens, or animal sightings. When suspected Mainland moose activity was observed, detailed notes and photos were recorded. If activity from other, non-SOCI animals was observed, the observation was also recorded. All observations were recorded and georeferenced in the field using an ArcGIS Survey123 form. Additional notes relating to habitat, weather, and animal activity were recorded in a wildlife tracking spreadsheet. If incidental observations of mammalian activity were made during other survey types, these observations were also recorded.

Concurrently, and in addition to wildlife surveys, trail cameras were deployed at various locations across the Legacy Study Area from December 2021 to November 2022. Locations were selected to include various habitat types, and to capture more information from locations previously found to have signs of wildlife (Drawing 7.20). Trail cameras were targeted to areas that provide natural corridors for wildlife movement throughout the landscape. Many large mammals commonly use

old roads, trails, or natural corridors such as riparian zones to travel throughout a landscape, and thus cameras were placed in these areas to capture their movements. Riparian areas are often preferred by these mammals as this habitat represents some of the only remaining intact forest within the Assessment Area. Trail cameras were visited regularly to replace storage cards and batteries, and occasionally the trail camera itself was removed from one location and relocated to increase site coverage. All photos/videos were then assessed for signs of wildlife.

Herpetofauna

Targeted Wood turtle surveys were conducted on May 24 and 25 and June 6 and 7, 2022. A desktop review of the Study Area was undertaken before conducting field surveys to identify areas of preferred turtle habitat. There were eight records of Wood turtles within 10 km of the Study Area identified, two of which were within the Study Area. Watercourses that overlap with the Assessment Area and areas with ideal turtle habitat were targeted for surveying. Generally, habitat types targeted included clear, meandering watercourses with a moderate flow; sandy or sand-gravel areas; and artificial nesting sites which may include gravel pits, road shoulders, and residential sites (Flanagan et al., 2013; McLean, 2018). Also considered was the habitat surrounding watercourses, which may be riparian or forested areas, or open areas such as flood plains, meadows, agricultural fields, river oxbows, and beaver ponds (McLean, 2018).

In addition to desktop data, previously collected wetland and watercourse survey information was used to support selecting Wood turtle survey locations. Areas 200 m upstream and downstream of any proposed new or upgraded infrastructure on watercourses were prioritized during surveys to best understand the impacts of this development on turtle activity.

Transect lines were walked at a width of 10 m along both sides of a watercourse, surveyed simultaneously by two field biologists (Drawing 7.19). The transect line served as a center point, and surveyors scanned 10 m on either side for a total search area of 20 m on both sides of the watercourse. Search efforts focused on bank areas with high sun exposure or other adequate basking areas such as instream rocks or logs. Turtles may also be found under or near deadfall, grasses, leaf litter, or woody shrubs, particularly alder trees, and so these areas were searched with greater intensity as they may be more inconspicuous.

Surveys occurred in early summer with an ambient air temperature higher than the water temperature (at least 10 °C) but not higher than 25 °C. Any observation of one of the four native turtles to Nova Scotia, snakes, or salamanders were recorded and georeferenced in the field using an ArcGIS Survey123 form. Any additional incidental observations of herpetofauna made during wetland or watercourse surveys, as well as observations of suitable turtle habitat, were also recorded.

Butterflies and Odonates

Targeted surveys for butterfly and Odonate species were not conducted; however, any incidental observations of butterfly and Odonate SOCI during other field surveys were documented.

7.4.3.2 Field Assessment Results

Mammals

Eleven species were identified during field assessments (including incidental observations) conducted within the Legacy Study Area (Table 7.46).

Table 7.46: Summary Results of the Mammal Field Assessments

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
American black bear	*Ursus americanus*	---	---	---	S5
Mainland moose	*Acles alces americanus*	---	---	Endangered	S1
American porcupine	*Erethizon dorsatum*	---	---	---	S5
Bobcat	*Lynx rufus*	---	---	---	S5
Eastern coyote	*Canis latrans*	---	---	---	S5
Raccoon	*Procyon lotor*	---	---	---	S5
Red squirrel	*Tamiasciurus hudsonicus*	---	---	---	S5
Eastern chipmunk	*Tamias striatus*	---	---	---	S5
Snowshoe hare	*Lepus americanus*	---	---	---	S5
American mink	*Neovison vison*	---	---	---	S5
Unknown rodent	*N/A*	N/A	N/A	N/A	N/A
White-tailed deer	*Odocoileus virginianus*	---	---	---	S5

[1]Government of Canada, 2022; [2]Government of Canada, 2022; [3]Government of NS, 2022; [4]ACCDC 2022

Nine mammals were recorded by trail cameras (Table 7.47, Photo log provided in Appendix J).

Table 7.47: Summary of Trail Camera Results

Trail Camera Location	Animals Observed	Number of Observations*
Central Road	White-tail deer	23
	American black bear	8
	Porcupine	15
	Mainland moose	1
	Eastern coyote	11
	Bobcat	1
	Raccoon	2
	Snowshoe hare	15
Hardwood Stand Dead End	White-tail deer	32
	American black bear	1
	Fisher	1

Trail Camera Location	Animals Observed	Number of Observations*
	Eastern coyote	2
	Bobcat	2
Indian Lake Outflow	N/A	
Lake Edge Game Trail	N/A	
Mixed Wood Stand	N/A	
Clearcut	White-tail deer	10
Softwood Stand	American Porcupine	3
	Eastern coyote	2
	Bobcat	2

*Number of observations adjusted based on likelihood of photos belonging to the same animal; a general rule of one hour between photos was applied to consider photos of the same species to be separate observations.

Terrestrial mammals that have been recorded within a 100 km radius of the Study Area were screened against the criteria outlined in the Guide to Addressing Wildlife Species and Habitat in an EA Registration Document (NSECC, 2009) to develop a list of priority species. These priority species include:

- Mainland moose – Endangered (NS *ESA),* S1 (S-Rank)
- Fisher (*Pekania pennanti*) – S3 (S-Rank)

Mainland moose are a SOCI listed as “Endangered” under the NS *ESA* with a subnational ranking of S1 (highest priority) (ACCDC, 2022). In 2021, NSNRR published a recovery plan for Moose in mainland Nova Scotia, thereby assigning the common name ‘Mainland moose’. Threats to Mainland moose include habitat loss and fragmentation, particularly resulting from industrial activities; and loss of habitat connectivity due to the increased placement and density of roads (NSNRR, 2021g). The Study Area has previously been and continues to be subject to the abovementioned threats as a result of historical and current land-uses, including forestry activities and recreation. Renewable energy projects were described as medium level threat, as the nature of wind projects usually requires the construction or expansion of road networks and loss of forested habitat.

Evidence of Mainland moose was observed during winter tracking surveys, pellet surveys, wetland surveys, and Wood turtle surveys throughout 2022. Evidence was observed within the Legacy Study Area and within the Assessment Area in the form of tracks, pellets, and one photograph taken by a trail camera (Tables 7.46, 7.47). All moose activity occurred in areas that were deemed as high-quality habitat during habitat suitability modelling.

Most moose evidence was observed outside the current Study Area, as winter tracking and pellet surveys transects were more centrally and southernly located in the Legacy Study Area. Both the Legacy Study Area and Study Area contain similar habitat types, including mature hardwood forests, various wetland types, mixed-age mixed wood forests, clear-cuts, and

regenerating softwood stands. The highly fragmented nature of the Study Area's landscape has resulted in a habitat patchwork that is able to provide for the varied requirements of Mainland moose. Although the majority of moose evidence occurred outside of the Study Area, based on habitat availability and search effort it is likely that moose are utilizing similar habitat in the Study Area as well.

Fishers prefer dense, mature to old-growth forests with continuous overhead cover (Allen 1983; Ellis, 1999). Generally considered forest-interior species (OMNR, 2000), Fishers require large tracts of well-connected habitat (Ellis, 1999; Meyer, 2007). Fishers are distributed throughout mainland Nova Scotia, and trapping data suggests the population is concentrated in Cumberland, Colchester, and Pictou counties. A total of 120 fishers have been harvested from Pictou County since 2012, representing 9.4% of the provincial total during that time. In Antigonish County, where only a small portion of the Study Area lies, 42 Fishers have been harvested since 2012, representing 3.3% of the provincial total during that time. One Fisher was captured by a trail camera positioned in a large, mature hardwood stand near a dead-end road. Mature forest stands may provide suitable canopy closure and coarse woody debris of sufficient diameter for Fishers on site.

Herpetofauna

No herpetofauna SOCI were identified in the Study Area during 2022 field studies. Additional non-SOCI species such as frogs and snakes were observed across the Study Area in various habitats. Ideal turtle habitat was noted along various watercourses through the Study Area, characterized by sandy/gravelly shores, clear, flowing water, and adequate sun exposure; however, these areas do not overlap the Assessment Area. Although significant habitat for Wood turtles was noted during the desktop review, this habitat was searched during ideal conditions and no turtles were observed. Additionally, all ACCDC records for Wood turtles occurred outside the Study Area.

Based on field and desktop results, no herpetofauna species were identified as priority species. Mitigations to protect herpetofauna habitat will be discussed in Section 7.4.3.3.

Butterflies and Odonates

There were no incidental observances of SOCI butterfly and Odonate species during the field assessments. Additionally, there were no records of butterfly or Odonate SOCI within the Study Area identified during desktop studies. Therefore, no priority species have been identified.

7.4.3.3 Effects Assessment

Project-Terrestrial Fauna Interactions

Project activities, primarily those that involve earth moving or vegetation removal, have the potential to impact terrestrial fauna (Table 7.48). These activities could result in habitat removal, alterations to wildlife corridors, and reductions in food availability. Other Project-related activities, including during construction and operation, may impact terrestrial fauna behaviours, such as increased traffic and noise.

Table 7.48: Potential Project-Terrestrial Fauna Interactions

Valued Component	Site Preparation and Construction											Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Terrestrial Fauna			X	X	X	X	X					X	X		X

Assessment Boundaries

For the purposes of this assessment, the LAA for terrestrial fauna includes the Assessment Area. The RAA for terrestrial fauna includes surrounding regions that may fall within the habitat range of each species, bounded by pre-existing infrastructure and roads or other large crossing areas (Drawing 7.19).

Assessment Criteria

The assessment criteria provided below apply for terrestrial fauna. The VC-specific definition for magnitude is as follows:

- Negligible – no loss of fauna habitat or impact to fauna behaviours expected.
- Low – small loss of habitat supporting fauna, but no impacts to fauna behaviours expected.
- Moderate – moderate loss of fauna habitat or moderate impacts to fauna behaviours, but these impacts will only be experienced by individuals rather than entire populations.
- High – high loss of fauna habitat or high impact to fauna behaviours on a population scale.

Effects

Mainland Moose

Habitat Loss

The Mainland Moose Recovery Plan identifies three localized groups of Mainland moose within the province, one of which being the Pictou/Antigonish/Guysborough group (NSNRR, 2021g). The Recovery Plan has defined Core Habitat of each group through habitat suitability modelling and found that the Pictou/Antigonish/Guysborough group requires an area of ~6,300 km^2 of Core Habitat to meet recovery objectives. Mainland moose Core Habitat is dependent on several biophysical parameters to satisfy different habitat requirements, including but not limited to:

- Summer foraging area composed of either regenerating forest that is within close proximity of winter or summer cover, or mature mixed or hardwood stands.
- Winter foraging area composed of either regenerating forest; mixed or hardwood forest within close proximity of winter cover; or mixed wood forest dominated by softwood trees.
- Winter cover area composed of mature softwood stands or mature mixed wood stands dominated by softwood trees.
- Summer cover area composed of mature hardwood, mixed wood, or softwood stands.
- Calving area with open water or wetlands in close proximity to both foraging and cover areas.

Road construction is defined as one of the main activities likely to result in destruction of important moose habitat (NSNRR, 2021g). Renewable energy is included as a potential threat to Mainland moose in the Recovery Plan due to potential habitat loss, conversion, and degradation caused by vegetation clearing for infrastructure associated with wind farms. Current and historical land-use in the Study Area (i.e., forestry activities and recreational off-road vehicle use) has altered the landscape within the Study Area to its current state, where road networks are abundant and forested habitat has been altered and degraded. The Project Area will utilize these pre-existing disturbed areas to the greatest extent possible to reduce habitat loss.

Habitat loss and reduced habitat quality may result in behavioural changes, including from reduced opportunities for thermoregulation, loss of overwintering areas, loss of adequate sources of food, reduced space for mating, and reduced protection for calves.

A Mainland moose habitat analysis was developed to assess the quality of Mainland moose habitat within the RAA. Of the 28.750.80 ha of habitat determined to be suitable for Mainland moose within the RAA, 150.85 ha lie within the Assessment Area (XX%). Furthermore, 13.3 km of existing roads have been incorporated into the Project design, while 11.3 km of new road construction will be required. The creation of wider road rights-of-way will increase the space for early successional vegetation, creating new foraging opportunities for moose adjacent to this built infrastructure that may eventually become suitable habitat.

The Mainland moose habitat analysis also indicates that the majority of suitable habitat within the RAA is considered high quality. All Mainland moose sightings observed during field surveys occurred within habitat deemed suitable through this habitat analysis. This overlap indicates the relative accuracy of this model in identifying suitable habitat on site. The average habitat score within the RAA is 69.87, while the average score within the LAA is 75.99. The Project Area will therefore be located in areas of statistically above average quality for moose habitat, as the Project design has maximized the use of pre-existing roads and otherwise previously disturbed areas. Therefore, the availability of and connectivity to alternative areas of high-quality habitat will remain high.

Although some area considered to be high quality Mainland moose habitat will require alteration or removal to construct the Project, the design has maximized the use of existing infrastructure

and disturbed areas such that the overall area of habitat loss is small and the direct impacts to moose habitat are expected to be low.

Habitat Fragmentation

The Recovery Plan identifies habitat fragmentation as another key threat to Mainland moose (NSNRR, 2021g). Habitat fragmentation is directly related to habitat connectivity which is a major concern for the longevity of Mainland moose in Nova Scotia, where communities are already highly localized to three areas of the province. Road placement and road density are the main drivers of reduced habitat connectivity. Wildlife corridors are often cited as a mitigation strategy for improving habitat connectivity; however, effective maintenance of these corridors requires an understanding of natural wildlife corridors and Mainland moose movement patterns on the landscape.

Much of the Project Area will utilize pre-existing roads, thus minimizing habitat fragmentation with 11.3 km of new roads needing to be constructed (while the remaining 13.3 km of roadways will utilize existing road. Due to the construction of new roads, the Project may have a small interaction with habitat fragmentation in the RAA. Additionally, the size of habitat gaps may increase for roads requiring widening. Areas requiring upgrading to facilitate developments (e.g., the widening of a turn to accommodate a radius sufficient for turbine blade transport) are likely to see more impact, whereas areas with roadways large enough to accommodate forestry equipment will remain as true to their current state as Project developments will allow.

There is an abundance of high-quality moose habitat (i.e., habitat with a mean distance of less than 200 m between mixed wood forest and wetland) that will remain unfragmented due to the limited construction of new roads. The Mainland moose habitat analysis also identifies high-quality habitat surrounding all pre-existing roads. During field surveys, Mainland moose were observed along pre-existing roadways, as well as in intact habitat that will not be impacted further. These findings indicate that despite the presence of linear gaps in high-quality habitat, connectivity between habitat patches has persisted and is expected to continue to persist, such that moose activity has and will continue to occur across the Study Area. From the results of field surveys and desktop analyses, the magnitude in which habitat fragmentation will affect Mainland moose within the LAA and RAA is low.

Disruption of Life History

Direct effects to Mainland moose from wind farms may include sensory disturbance and stress from anthropogenic light sources or human presence resulting in behavioural changes. Mitigation strategies to avoid direct impacts resulting in behavioural changes during sensitive windows and in important habitat are described below. Indirect effects may include removal of adequate calving habitat through conversion of the landscape to support new project-related infrastructure and reducing areas with enough seclusion or cover to protect calves from predators. Mainland moose breeding season takes place between September and October, with calving generally occurring in late May to early June, where one to two calves are born. Cows may require specific habitat types for calving, such as secluded islands, peninsulas, and shorelines. Seclusion is an important factor for protecting calves from predators. The cow and

calf/calves remain together for one year until the calf/calves become mature enough for independence (NSNRR, 2021g).

With no desktop data supporting Mainland moose activity within the Study Area and only one direct observation of Mainland moose during field surveys (Table 7.47, Appendix J), neither age nor sex diversity can be confirmed within the Study Area. Although 29 wetlands were delineated within the Assessment Area, no specific habitat types required for calving were observed. An analysis of Mainland moose habitat quality within the RAA has shown that large areas of suitable habitat exist around the Assessment Area that will not be directly impacted by the Project. Mitigation measures will be implemented to minimize impacts; however, the amount of high-quality habitat remaining within the RAA and the extent of pre-existing linear features across the landscape indicate that the magnitude of Project-related impacts to Mainland moose life history will be low.

Disease

Problematic native species have been identified as a pervasive threat to Mainland moose due to their potential to spread debilitating disease. Specifically, White-tailed deer are hosts for Brainworm (*Parelaphostrongylus tenuis*) and Winter tick (*Dermacentor albipictus*), both of which cause mortality in moose and are thought to be regulators of population abundance and distribution (NSNRR, 2021g). A possible concern associated with developments is their potential to cause indirect effects on Mainland moose by increasing access to the site by White-tailed deer and therefore, increasing the chances of disease spreading to Mainland moose.

There is a known deer over-wintering area 1 km east of the Study Area; however, it is unlikely that the new and upgraded roads will increase access for White-tailed deer as they already have existing access to the Study Area. As such, effects to Mainland moose from disease are expected to be negligible.

Poaching

Poaching has been identified as a potential threat facing Mainland moose in the Recovery Plan (NSNRR, 2021g). Increased human access may increase the risk of poaching for rare, sought-after animals. The Project Area is already highly accessible to the public, including local hunters and recreational users. Due to the pre-existing access to the Study Area and no issues associated with poaching to date, poaching is not expected to affect Mainland moose within the LAA or RAA as a result of this Project. Furthermore, an increased presence of staff within the Project may act as a deterrent to moose poaching.

Climate Change

Climate change has been identified as a potential threat facing Mainland moose in the Recovery Plan; however, the details of how moose will be impacted by climate change are not yet well understood (NSNRR, 2021g). The development of windfarms is one of the province's strategies to transition to renewable energy to reduce provincial emissions. It is expected that this Project will have a net positive impact on climate change (for further details see Section 7.1.2), thus this potential threat is not expected to negatively affect Mainland moose within the LAA or RAA.

Fisher

Habitat Loss

Fishers show preference for a variety of habitat types depending on location; however, they generally prefer dense, mature forests with continuous canopy cover. Generally considered to be forest interior species, Fishers require large tracts of intact forest and tend to prefer hardwood stands for their superior prey availability compared to softwood stands. Other important factors associated with Fisher habitat include the presence of slopes, low elevation, nearby water or riparian areas, and shallow snow cover. Denning habitat is often restricted to downed woody debris, tree snags, or standing living trees (Meyer, 2007).

Within the LAA, several steep slopes leading to brook valleys can be found, and areas of mature hardwood forest with a large amount of large woody debris suitable for denning. Evidence of fisher activity was found in the latter habitat type outside the Study Area; however, there is over 1 km of continuous cover of hardwood forest between the Fisher observation and the nearest proposed Project-related infrastructure that will remain undisturbed by the Project. No other desktop or field data indicates the presence of Fisher habitat within the Study Area.

Habitat Fragmentation

Fishers have large home ranges, and can move long distances; however, they may exhibit sensitivity to habitat fragmentation. When suitable habitat is bisected by a large tract (10 to 20 km) of unsuitable habitat, Fishers may be unable to cross this distance and therefore be excluded from this neighbouring habitat. Unsuitable habitat generally refers to open or clear-cut forests which are avoided by Fishers. The degree of habitat connectivity may also influence genetic dispersal, as large distances between populations may reduce chances of dispersal (Meyer, 2007). Because the Project Area will maximize the use pre-existing roads, and infrastructure to be constructed in intact habitats will be no wider than 25 m (for roads) or 200 m (for turbine pads), effects of habitat fragmentation for fishers resulting from the Project are expected to be low.

General Effects to Terrestrial Mammals

Road Traffic

The Project will result in increased roads within the LAA. Both small and large terrestrial mammals are known to use the roadways within the Study Area, as evidenced by trail camera footage and winter tracking/pellet survey results. An increase in road traffic will increase the chances of collision and mortality for those animals using the roadways. Most roads within the Study Area are currently used for recreation by ATV, snowmobile, and dirt bike users and for forestry activities. Outside of the construction phase, the Project will only require a small number of technicians to access the site to perform regular maintenance/equipment checks. Considering the pre-existing traffic load and the minimal traffic to be associated with the Project, road traffic is expected to have a negligible to low effect on terrestrial mammals in the LAA.

Habitat Loss and Fragmentation

Other non-priority species were observed within the Study Area and make use of various habitat types across this area. The footprint of the Project, particularly the area that will impact intact habitat, is relatively small compared to other developments in the natural resource sector. 11.3 km of new road will be constructed within the Study Area, and upgrades to pre-existing roads will be limited to removing small areas of habitat in areas that have already been disturbed. Patterns of movement/migration across the landscape may be disrupted by habitat alteration and fragmentation. Evidence of animals using these roads through wildlife surveys and trail camera photos indicate that the creation of additional roads may in fact be creating usable habitat. These linear features allow for easier access across the Study Area, and terrestrial fauna will continue to use these roads post-construction. Direct habitat loss and fragmentation within the LAA will therefore be small and can be mitigated through various strategies to reduce the effects of habitat loss.

Sensory Disturbance

Reproduction and survival strategies of terrestrial mammals may be directly or indirectly impacted by sensory disturbances caused by Project construction and operation. Many species have sensitive windows for breeding and birthing, and any small disruption to these activities may reduce reproductive success in the population. Sensory disruptions may result from sound/vibration or excess light. Lovich and Ennen (2013) stress the importance of turbine siting relative to the needs of wildlife to minimize effects. The iterative Project design process has prioritized avoidance and minimization of interactions with important wildlife habitat such as wetlands and mature forest, which will minimize sensory disturbances in these areas. Project-related noise may impact habitat use, patterns of activity, stress levels, immune response, reproductive success, risk of predation, communication with conspecifics and antipredator predator behaviours, and hearing damage (Rabin et al., 2006; Lovich & Ennen, 2013). The extent that noise associated with wind farms may impact terrestrial mammals is not well studied, and results have been inconclusive thus far (Lovich & Ennen, 2013). The Study Area is, however, already subject to noise from forestry activities and recreation vehicles (snowmobiles, ATVs) and despite the pre-existing noise, different mammal species were still observed across the Study Area so impacts from sensory disruptions caused by the Project within the LAA are anticipated to be low.

Herpetofauna

Road Traffic

Increased road traffic may affect herpetofauna within the LAA due to the potential for an increase in risk of traffic collisions with herpetofauna species. Turtles, salamanders, and snakes may cross roads daily in search of food, or seasonally during migration to find nesting habitat or to escape uninhabitable climatic conditions (Wills, 2021). As stated previously, the pre-existing traffic load and the minimal traffic to be associated with the Project both indicate that road traffic is not expected to have a significant effect on terrestrial herpetofauna in the LAA.

Habitat Loss

Terrestrial habitat utilized by herpetofauna includes riparian areas along wetlands and watercourses, forested areas near watercourses, and rocky or gravelly areas such as roadsides. These different habitat types support different biological needs of species and relate directly to life history strategies. The Project layout aims to reduce impacts to intact habitat and has been specifically designed to minimize interactions with riparian areas and intact forest. With approximately 11.3 km of new road being constructed, a small area of new habitat may be created in the form of gravel roadsides and this new habitat may serve as a potential benefit to herpetofauna species. Because the Project has avoided areas of known or ideal Wood turtle habitat and no additional herpetofauna SOCI were identified within the Assessment Area during desktop review and field surveys, no direct impacts resulting from habitat loss within the LAA are expected.

Habitat Fragmentation

Terrestrial herpetofauna utilize the terrestrial environment to move across the landscape, particularly between wetlands and watercourses. The alteration of these habitats and conversion of intact forest to roads may result in a fragmented landscape, preventing natural patterns of movement across the landscape. Habitat fragmentation has been minimized through the Project design, which prioritized the use of pre-existing roads or otherwise disturbed habitats. No herpetofauna SOCI were observed within the Study Area during field surveys; however, mitigation measures will be taken to maintain connectivity in watercourses and wetlands (see Sections 7.3.2 and 7.3.4). Therefore, minimal effects to herpetofauna related to habitat fragmentation are expected within the LAA or RAA.

Disruption of Life History

Sensitive windows for herpetofauna may relate to migration or nesting periods, and interference with these animals' activities during these windows may disrupt their natural life history. Interference may be both temporal and spatial. Project related activities occurring during sensitive windows may impact migratory or breeding behaviours, and habitat removal or fragmentation may create a physical barrier to herpetofauna species from reaching important habitat. Limited impacts to fragmentation and life history are expected due to the small Project footprint and minimized interactions with important habitat features such as wetlands and watercourses.

Sensory Disturbance

Given the pre-existing traffic load and the minimal traffic to be associated with the Project, sound and light impacts are expected to be low.

Butterflies and Odonates

Turbine Collision-Induced Mortality

Swarming and migrating insects, including butterflies and Odonates, are susceptible to mortality from collisions with wind turbines. There are several hypotheses as to whether, or why, these insects are attracted to wind turbines (Long et al., 2011; Rydell et al., 2010; Jansson et al.,

2020). Questions remain in the literature concerning how this potential attraction affects mortality rates; whether insect fatalities at wind turbines are contributing to population declines; and how these fatalities are impacting ecological functions (Voigt, 2021). No significant effects to butterfly and Odonate SOCI are expected as a result of this Project based on current insect population and ecology research.

Mitigation Measures

To address the abovementioned effects to terrestrial fauna, the following mitigation measures will be implemented where possible:

Habitat Loss

- Minimize overall area to be cleared by utilizing pre-existing roads and previously altered areas (i.e., clearcuts).
- Continue to review habitat modelling results, field survey results, and guidance from NSNRR through the detail design phase.
- Revegetate roadsides and cleared areas to minimize lost habitat as much as possible.
    - Reclaim small roads leading to turbines to minimize long-lasting effects of habitat loss.

Habitat Fragmentation

- Minimize fragmentation and habitat isolation by utilizing pre-existing roads and previously altered areas during the design phase.
- Augment connectivity by maintaining semi-artificial pathways such as wildlife corridors, greenbelts, and vegetated buffers around wetlands and watercourses, where possible.
- Revegetate as much cleared area as possible to limit the effects of fragmentation.

Road Traffic

- Design the Project footprint to minimize road density and utilize pre-existing roads to the greatest extent possible.
- Install traffic signs to alert road users of speed limits and the presence of wildlife in the area.
    - Inform all Project-related staff working on the site of dangers to wildlife and create awareness around wildlife hotspots on the site.
- Minimize Project-related traffic to reduce chances of wildlife collisions and traffic-related stress to wildlife.
- Impose restrictions on site access if deemed necessary due to a substantial increase in wildlife collisions and mortality.

Disease

- Use seed mixes that do not contain clover to avoid attracting deer (which carry ticks) to the area when revegetating road rights-of-way and other cleared areas requiring revegetation.

Disruption of Life History

- Avoid removal of vegetation/habitat alteration in key habitat areas during sensitive windows for priority species, where possible, including:
    - Mainland moose – late May to early June (birthing season) and September to October (breeding season)
    - Fisher – March to April
- Minimize loss of important habitat required by priority species for reproduction events, including:
    - Mainland moose – wetlands and isolated islands/peninsulas
    - Fisher – large diameter snags, large woody debris, or live standing trees in mature, intact forests
- Minimize overall area to be cleared to maintain refugia and cover for protection from predators.
- Maintain all equipment and machinery on site to reduce noise and vibration emissions associated with malfunctions. Where practical, install vehicles and machinery with noise muffling equipment to limit disturbance.
- Restrict on-site lighting, especially at night, to limit disturbance.
- Prohibit harassment and feeding of wildlife by Project personnel.

Monitoring

A site-specific post-construction Wildlife Management Plan may be developed in consultation with NSECC, NSNRR, the Mi'kmaq of Nova Scotia (including the First Nations development partner, Glooscap First Nation, and all other relevant parties. The management plan will inform monitoring activities that will take place to ensure continued protection of known SOCI in the LAA and RAA.

Conclusion

While effects to mammals, herpetofauna, and insects differ, the effects considered to be of greatest concern include habitat loss, habitat fragmentation, and associated disruption of the life history of populations within these groups. Based on this assessment and through the implementation of proposed mitigation and monitoring activities, effects on terrestrial fauna are expected to be of low magnitude and within the RAA. Residual effects are expected to be long-term for habitat loss but negligible for individual SOCI; continuous but differ seasonally as the needs of animals change; reversible; and not significant.

7.4.4 Bats

7.4.4.1 Overview

A desktop review and field studies were undertaken to gather information on bat species and associated habitat in the Study Area. Objectives were as follows:

- Assess observations, species diversity and habitat utilization of bats within the Study Area during the active bat periods (spring to fall).
- Assess nearby hibernacula for bat activity.

- Assess for summer roosting activity in the suitable areas of the Study Area (e.g., mature hardwood forests).
- Use the information collected to inform and refine the Project design (i.e., avoid impacts to SOCI and their habitats).
- Use the information collected to inform mitigation and management practices.

7.4.4.2 Regulatory Context

There are six species of bats in Nova Scotia, of which three are resident species that reside in the province year-round and three are migratory species that overwinter in the southern United States. Resident species include the Little brown myotis (*Myotis lucifugus*), Northern myotis (*Myotis septentrionalis*), and Tri-colored bat (*Perimyotis subflavus*). Migratory species include the Eastern red bat (*Lasiurus borealis*), Hoary bat (*Lasiurus cinereus*), and Silver-haired bat (*Lasionycteris noctivagans*).

All three resident species are protected at both the federal and provincial level under *SARA* and the NS *ESA*. The Little brown myotis, Northern myotis, and Tri-colored bat were added to the NS *ESA* list as “Endangered” species on July 11, 2013 and were declared as “Endangered” under Schedule 1 of *SARA* on November 26, 2014. In Nova Scotia, a 90% population decline of resident bat species has been attributed to a disease called White-nose syndrome, caused by the fungus *Geomyces destructans*, which was first detected in Canada in 2010. White-nose syndrome is lethal and affects bat species that congregate in caves and abandoned mines during winter hibernation (COSEWIC, 2013).

All three migratory bat species underwent COSEWIC status updates in May 2023 and are now listed as “Endangered” by COSEWIC (COSEWIC, 2023).

7.4.4.3 Desktop Review

Databases and online resources referenced as part of this desktop review include:

- Terrestrial Habitat Mapping (Section 7.4.1)
- Locations of Known Bat Hibernacula in NS (Moseley, 2007)
- Nova Scotia Geoscience Atlas - Abandoned Mine Openings (NSNRR, 2021e)
- Nova Scotia Significant Species and Habitats Database (NSNRR, 2018a)
- ACCDC Data Report (ACCDC, 2023)

Terrestrial Habitat Mapping

Terrestrial habitat mapping from Section 7.4.1 was used to identify locations of ideal bat foraging and over-day habitat (i.e., day roosts) within the Study Area. Ideal habitats for bat foraging and over-day habitat include lakes, wetlands, watercourses, forest edges, cliffs, rock outcrops, talus slopes, and mature hardwood forests. The results of this review were subsequently used to guide field surveys for bats/bat habitat.

There are three habitat features considered to be significant for bats: hibernacula for overwintering, maternity roosts for birthing and raising young, and migratory stopovers for rest

periods during spring/fall migration. Hibernacula are overwintering sites that are typically located in abandoned mines or caves and can support hundreds of bats.

Maternity colonies are poorly documented in Nova Scotia, with limited desktop information regarding these sites' location and use (ECCC, 2015; NSNRR, 2020). As a result, information on potential maternity roosts near the Project was supplemented through field studies.

Migration is one of the most poorly understood components of bat biology, at both a regional (<200 km) and long distance (>1000 km) scale. Migratory stopovers utilized for short term rest or sanctuary are thought to be located on islands or shorelines of large bodies of water and along geographic features such as riparian zones or mountain ranges (McGuire et al., 2011). During terrestrial habitat mapping, riparian and shoreline habitats were identified and used to guide field studies.

Locations of Known Bat Hibernacula

Moseley (2007) provides an overview of the known and recorded bat hibernacula located within Nova Scotia. This research indicates six known hibernacula within a 100 km radius of the Study Area (Table 7.49).

Table 7.49: Known Bat Hibernacula within 100 km of the Study Area

Hibernaculum	Approximate Distance to Study Area*	Direction
McLellan's Brook Cave	26 km	W
Hirschefield Galena Prospect	27 km	S
New Laing Adit #1	45 km	W
New Laing Adit #2	45 km	W
Black Brook	97 km	SW
Lake Charlotte Gold Mine	97 km	SW

*Distance measured to the nearest point of the Study Area.
Source: Moseley, 2007

No known hibernacula are located within 25 km of the Study Area as per the recommended buffer provided in the Guide to Preparing an EA Registration Document for Wind Power Projects in Nova Scotia (NSECC, 2021).

McLellan's Brook Cave, the nearest hibernacula to the Project (just outside the 25 km buffer), is a minor hibernaculum located in a dissolution stream cave that is suspected of supporting less than 10 overwintering bats (Moseley, 2007). Myotis species have been observed near the hibernaculum in late summer, but there have been no underground recordings of bats (Moseley, 2007).

The Hirschefield Galena Prospect (also just outside the 25 km buffer from the Project) is a hibernaculum located in an abandoned mine adit, approximately 215 m in length. This hibernaculum is thought to support approximately 200 to 300+ overwintering bats, in which species composition has not been determined but is suspected to consist primarily of Little brown myotis.

It should be noted that the number of overwintering bats in these hibernacula were assessed prior to the onset of white-nose syndrome in Nova Scotia, and therefore, populations are likely less than originally estimated (Moseley, 2007).

Abandoned Mine Openings

There is one recorded abandoned mine opening (a gold shaft) located within the Study Area (Drawing 7.21). Outside of the Study Area, there are few sporadic mine openings documented including one copper shaft 5 km east of the Study Area and a copper adit 6 km east of the Study Area (NSNRR, 2021e).

Significant Species and Habitat Records

The NSNRR Significant Species and Habitats Database (2018a) contains eight unique species/habitat records pertaining to bats and associated habitat within 100 km radius of the Study Area. These records include:

- One “Species of Concern” record relating to a cave.
- One “Other Habitat” record relating to a cave.
- Six “Species at Risk” records which relate to five Little brown myotis and one Northern myotis.

ACCDC Records

The ACCDC Data Report (2023) completed for this Project indicated three bat species of concern recorded within 100 km of the centre of the Study Area (Table 7.50).

Table 7.50: Bat Species Recorded within a 100 km radius of the Study Area

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
Bat species	*Vespertilionidae sp.*	Not Listed	Not Listed	Not Listed	S1S2
Little brown myotis	*Myotis lucifugus*	Endangered	Endangered	Endangered	S1
Northern myotis	*Myotis septentrionalis*	Endangered	Endangered	Endangered	S1

Source: ACCDC, 2023
[1]Government of Canada, 2022; [2]Government of Canada, 2022; [3]Government of NS, 2022; [4]ACCDC, 2022.

According the ACCDC Report (2023), a “bat hibernaculum or bat species occurrence” is not known to exist within the Study Area.

Bat species that have been recorded within a 100 km radius of the Study Area were screened against the criteria outlined in the document Guide to Addressing Wildlife Species and Habitat in an EA Registration Document (NSECC, 2009) to develop a list of priority species. These priority species include:

- Little brown myotis
- Northern myotis
- Tri-colored bat

The Little brown myotis is the most common species in Nova Scotia and is likely ubiquitous in the province (Broders et al., 2003). During the day, the Little brown myotis will roost in buildings, trees, under rocks, in wood piles, and in caves, congregating in tight spaces to roost at night (Fenton & Barclay, 1980). As a non-migratory species, Little brown myotis hibernates from September to early or mid-May in abandoned mines or caves (Fenton & Barclay, 1980; Mosely, 2007). ACCDC data indicates that there are no records of Little brown myotis in the Study Area; the closest observation is 11.0 ± 0.0 km from the centre of the Study Area (ACCDC, 2023).

The Northern myotis, once considered uncommon throughout Nova Scotia (Moseley, 2007), is likely ubiquitous in the forested regions of the province (Broders et al., 2003). This species is widely distributed in the eastern United States and Canada and is commonly encountered during swarming and hibernation (Caceres & Barclay, 2000). During the day, Northern myotis show a preference for roosting in trees; however, the habitat preferences of females may vary according to their reproductive status (Garroway & Broders, 2008). Females appear to prefer shade tolerant deciduous trees over coniferous trees, whereas males roost alone in coniferous or mixed-stands in mid-decay stages (Broders & Forbes, 2004). Northern myotis are also non-migratory and are typically associated with the Little brown myotis during hibernation, being found in caves or abandoned mines also inhabited by this species (Moseley, 2007). Hibernation of the Northern myotis is thought to begin as early as September and can last until May (Caceres & Barclay, 2000). ACCDC data indicates that there are no records of Northern myotis within the Study Area; the closest observation is 62.5 ± 0.0 km from the centre of the Study Area (ACCDC, 2023).

The Tri-colored bat (also known as the Eastern pipistrelle) only has approximately 10% of its range in Canada and is considered rare in Nova Scotia (COSEWIC, 2013). Documented observations of the Tri-colored bat predominantly occur in the southwest region of the province, especially during the summer months (Broders et al., 2003). The Tri-colored bat can be found in a variety of habitats, foraging in covered riparian areas and around open bodies of water. Hibernation for this species begins in September and extends to early or mid-May in abandoned mines or caves with high humidity and above freezing temperatures (COSEWIC, 2013). ACCDC data indicates that there are no records of Tri-colored bat within 100 km of the centre of the Study Area (ACCDC, 2023).

7.4.4.4 Field Assessment Methodology

Field surveys and monitoring conducted within the Study Area include the following:

- Incidental Observations (2022)
- Passive Bat Assessment (2022)

Incidental Observations

Incidental observations of significant bat habitat features were recorded throughout the 2022 field assessments. Features of note that qualified field biologists searched for include:

- Snags and downed trees
- Living trees or trees in early stages of decay with cavities and peeling bark (candidate species include white pine, oak, ash, aspen, and maple)
- Rock outcrops and cliffs
- Wetlands
- Old-growth forests
- Clusters of snags (≥25 diameter breast height and >10 snags per ha) for potential maternity colony habitat (as per OMNR, 2022)
- Caves and abandoned mines (for potential hibernacula/overwintering habitat)

Several ideal habitat features for bats (i.e., wetlands and old growth) are assessed in other biophysical sections, and therefore, are not considered further here.

Passive Bat Assessment

Passive acoustic monitoring was conducted within the Study Area across various representative habitats such as clear cuts, riparian river valleys, and forest edges (Drawing 7.21). Monitoring stations were chosen based on habitat mapping and accumulated knowledge from field studies to represent various habitat types present along with ideal bat habitat for bat species present in Nova Scotia. The passive acoustic bat monitoring program was conducted using Song Meter SM4BAT/Mini's from Wildlife Acoustics. The detectors were programed to monitor between 30 mins before sunset to 30 mins after sunrise to correspond with peak times of bat activity. GPS points and supplementary information (i.e., habitat descriptions) of each monitor location and detector set up were recorded.

Acoustic monitoring data (i.e., sonograms) was processed using Kaleidoscope software from Wildlife Acoustics, complementary to the detectors used. Sonograms were processed for potential bat generated ultrasonic vocalizations and speciated where possible. Identification codes for Nova Scotia bat species are listed below:

- MYOT Myotis species (Little brown myotis & Northern myotis)
- PESU Tri-colored bat
- LACI Hoary bat
- LABO Eastern red bat
- LANO Silver-haired bat
- UNKW Unknown

Due to their similarity, calls of Nova Scotia's two resident Myotis species (Little brown myotis and Northern myotis) can be difficult to reliably distinguish from one another (O'Farrell et al., 1999), so these calls are typically not identified to species. Bat generated calls were identified as Unknown (UNKW) if the recording was within the correct frequency range for bats (20-40 kHz for low frequency bats and 40-120 kHz for high frequency bats) but was unable to be speciated based on the quality or length of the recording.

Passive acoustic bat monitoring was conducted for 155 consecutive days within the Study Area between the dates of May 31 and November 1, 2022, encompassing the spring, summer, and fall active bat seasons. Four detectors were deployed in habitats representative of the Study Area and in areas expected to provide suitable foraging habitat for bats (i.e., forest edges, waterbodies, watercourses, and wetlands). Detector BM1 was deployed along the western shoreline of Indian Lake where a tributary intersects the lake. Detector BM2 was deployed in a treed swamp in the western portion of the Study Area. Detector BM3 was set up in the riparian area of Duck Ponds. Lastly, Detector BM4 was deployed at the location of the radar tower (Drawing 7.21 and Table 7.51).

Table 7.51: Monitoring Periods for Each Detector

ID	Detector Location	Habitat Description	Monitoring Duration (2022)	Consecutive Days	# Of Recordings
BM1	Indian Lake	Riparian area (wetland) where tributary intersects Indian Lake	May 31 – November 1	155	2435
BM2	Wetland	Treed swamp (mixed wood)	May 31 – November 1	155	6897
BM3	Duck Ponds	Riparian area (softwood dominant) where tributary meets Duck Ponds	May 31 – November 1	155	4837
BM4	Radar Monitoring Location	Open, cleared, and graded area	May 31 – November 1	155	609

In addition to the 2022 passive acoustic bat monitoring discussed above, WSP completed passive acoustic monitoring for a 15-day period in 2021 at four locations in the Legacy Study Area. During the monitoring period, eight bat calls were recorded, of which six were identified as Myotis species and two were undermined. For further details, the WSP Bat Survey Report can be found in Appendix K.

7.4.4.5 Field Assessment Results

Incidental Observations

Bat habitat features such as snags, downed trees, and living trees in the early stages of decay were found across the Study Area; especially in bogs, treed swamps, and riparian areas where waterlogged sediments resulted in the decay of large diameter trees. These freshwater habitats (e.g., waterbodies, wetlands, etc.) encountered during field studies were all considered potential over-day habitat and/or potential feeding grounds for various bat species. Individual data points for each bat habitat feature (i.e., each snag) within these freshwater habitats were not recorded because they are delineated, and the significance of these areas is captured in Section 7.3.1 and 7.3.3 (see Drawings 7.12A to 7.12Q for wetland/watercourse locations). Further, these freshwater habitats were avoided to the greatest extent possible. Similarly, information and importance of old-growth forests are discussed in 7.4.1 and these areas were avoided.

No areas of significant bat habitat (i.e., hibernacula, maternity colonies, or migratory stopovers) were identified/incidentally observed during the 2022 field assessments.

Passive Bat Assessment

A total of 14,778 files were recorded by the acoustic detectors during the monitoring period, of which 1781 were determined to be bat generated ultrasound using complementary software. The remaining files were determined to be caused by extraneous noise from sources such as vegetation, wind, or precipitation. The following species were recorded during the acoustic survey: Myotis, Eastern red bat, Hoary bat, Silver-haired bat, and Tri-colored bat (Table 7.52).

Table 7.52: Results of the Passive Acoustic Bat Survey (2022)

Detector	MYOT	LABO	LACI	LANO	PESU	UKWN	Calls per Detector
BM1 Indian Lake	1156	114	42	10	4	2	**1328**
BM2 Wetland	3	0	87	0	0	1	**91**
BM3 Duck Ponds	44	14	219	0	0	0	**277**
BM4 Radar Tower	25	6	53	0	0	1	**85**
Calls per Species	**1227**	**134**	**401**	**10**	**4**	**4**	**Survey Total 1781**

The detector located along the shoreline of Indian Lake recorded significantly higher call counts compared to the other detectors. Open water sources are important foraging grounds for bats as a result of high insect activity, which may explain the concentrated number of bat calls associated with Indian Lake. In addition, the detectors position adjacent to open water may experience reduced background noise associated with vegetation and increased detection range, resulting in a higher number of recorded and identifiable bat calls.

Across the entire Study Area (including all monitors), 1781 bat calls were detected over a 155-day period resulting in an average of 11.49 bat calls/day. Recorded bat calls may belong to the same or a different individual bat; for example, a bat foraging near a detector may be recorded several times throughout the night and/or over multiple nights. Average bat calls per day for each detector are as follows:

- BM1 Indian Lake 8.57 bat calls/day
- BM2 Wetland 0.59 bat calls/day
- BM3 Duck Ponds 1.79 bat calls/day
- BM4 Radar Tower 0.55 bat calls/day

Bat calls were also assessed hourly throughout the night (Figure 7.3). Peak hourly bat activity was observed after dusk (21:00), at midnight (0:00), and a few hours before sunrise (3:00-4:00). These findings are relatively consistent with the most current and available literature on bat species and nightly activity in Nova Scotia (NSNRR, 2020).

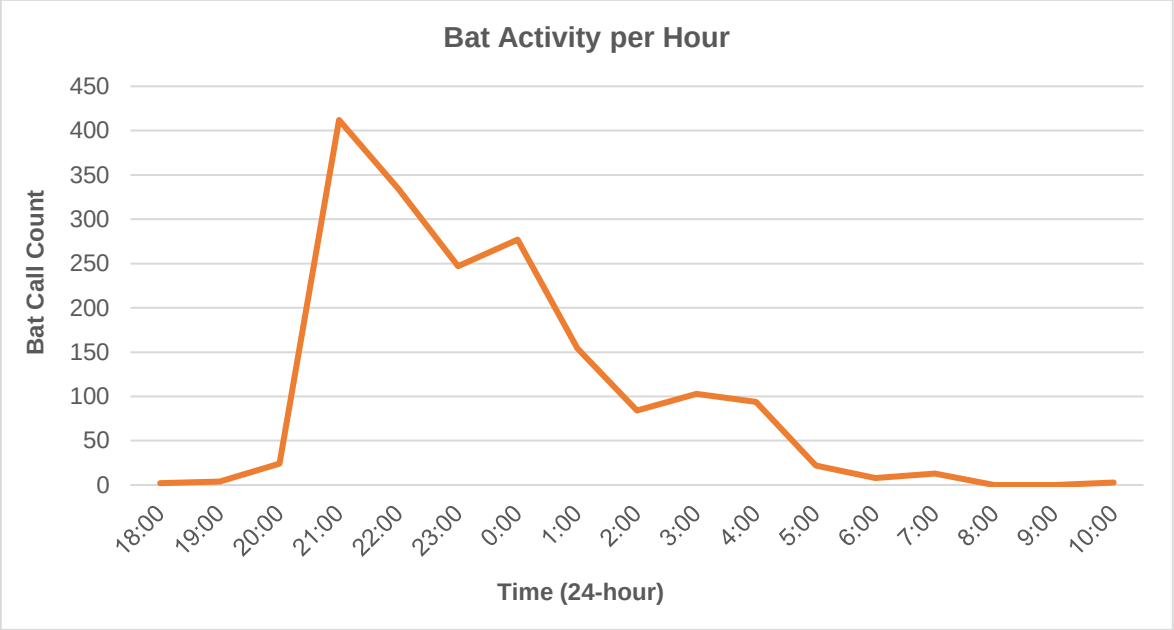

Figure 7.3: Bat Activity Per Hour Observed During the Passive Acoustic Survey (2022)

There is limited literature and research available for species specific levels of bat activity throughout the night. Factors that may influence the distribution of bat activity throughout the night include environmental conditions, foraging location, time of year, competition/resource partitioning, and/or diet (as cited in Fern et al., 2018).

The majority of bat calls recorded during the acoustic survey occurred during the month of June and again in late July to August. During the spring months (May-June), bats emerge from overwintering sites (i.e., hibernacula) and begin migrating to summer maternity habitat where they birth and raise young. Little bat activity was recorded during the early summer season (July); however, this significantly increased later into July/August. Decreased acoustic activity observed during the fall months (September-November) is likely a result of migratory bats beginning to migrate south for the winter and resident species congregating near hibernacula for over-wintering (Figure 7.4).

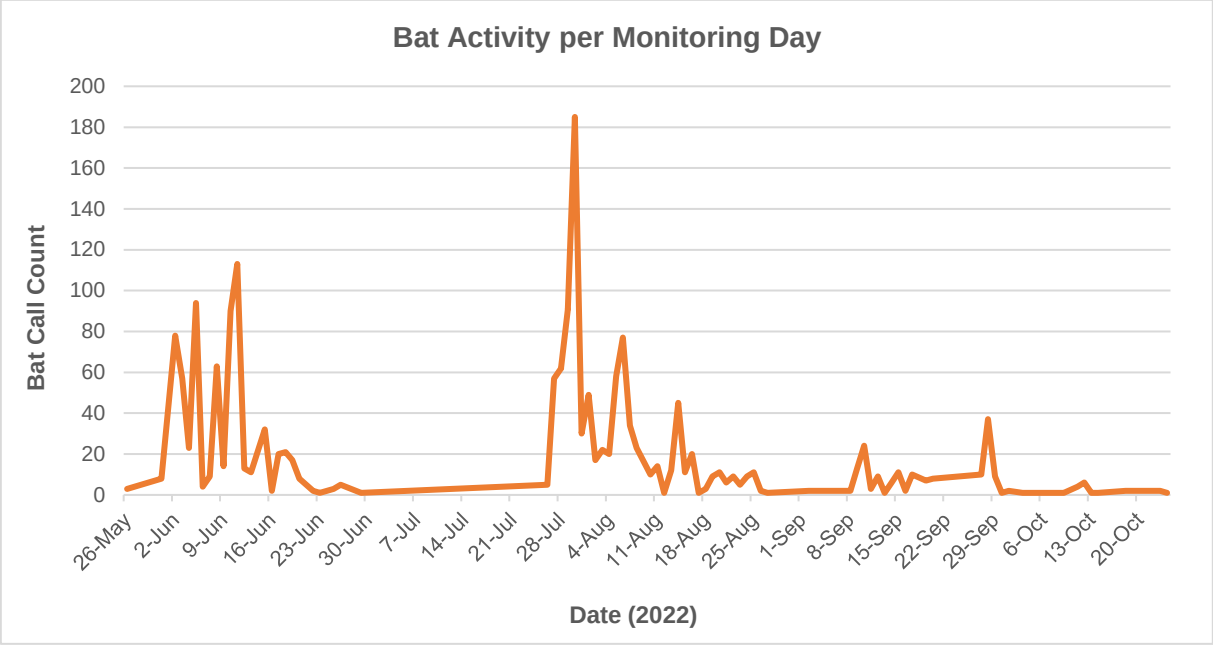

Figure 7.4: Bat Activity Per Monitoring Day Observed During the Passive Acoustic Survey (2022)

7.4.4.6 Effects Assessment

Project-Bat Interactions

Project activities, primarily those involving vegetation removal and turbine operation, have the potential to impact bat and bat habitat (Table 7.53). These activities could result in habitat removal along with accidental injury/mortality. Other Project activities during construction and operation may impact bat behaviors such as increased noise and lighting.

Table 7.53: Potential Project-Bat Interactions

Valued Component	Site Preparation and Construction										Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Bats				X	X	X						X			

Assessment Boundaries

The LAA for bats includes the Assessment Area, while the RAA includes the Study Area (Drawing 2.2).

Assessment Criteria

The assessment criteria provided in Section 4.6 applies for bats. The VC-specific definition for magnitude is as follows:

- Negligible – no loss of bat habitat or impact on bat behaviour expected.
- Low – small loss of habitat supporting bats, but loss of individuals is not expected.
- Moderate – minimal loss of individuals or impacts to bat behaviour, but these impacts will only be experienced by individuals rather than entire populations.
- High – high loss of habitat that supports bats and/or loss of individuals or impacts on bat behaviour on a population scale.

Effects

Potential impacts to bat species from the Project's construction and operation include:

- Habitat fragmentation and/or removal.
- Injury/mortality from barotrauma or collision with turbine blades.
- Sensory disturbance (i.e., lighting, noise, human activity, etc.).

Habitat Fragmentation and Removal

There is extremely limited research and knowledge on how wind farm developments impact habitat suitability and populations of bat species (Segers & Broders, 2014). Vegetation clearing required for wind turbine construction can result in the removal of ideal bat habitat (snags, wetlands, etc.) or disrupt corridors between important habitat features (foraging grounds, birthing areas, etc.) (Segers & Broders, 2014). In addition, the construction of roads can potentially impede movement, foraging, flight activity, and habitat use (GOC, 2015). One study by Segers & Broders (2014) found that different species of bats respond differently to landscape alteration for wind farm development. Suitable habitat for the Little brown myotis increased after wind turbine installation, which is likely associated with the increase in open areas and forested edges as these areas are preferred foraging habitats for the species (Segers & Broders, 2014). Alternatively, suitable habitat for Northern myotis bats decreased, likely due to this species' preference to forage in forested areas and around canopy covered streams (Segers & Broders, 2014). Pregnant and lactating female bats have also been shown to be sensitive to habitat degradation as their foraging ranges are more constricted due to decreased energy and caring for young (Henry et al., 2002; Segers & Broders, 2014).

During the field surveys, it was observed that the Assessment Area is already significantly fragmented and disturbed from previous developments primarily active/previous forestry and recreational activity. There were no identified areas of mature hardwood forests with the necessary density or clusters of snags (at ≥10 snags per hectare) required to support maternity colonies (OMNR, 2022). It is unlikely that the bat habitat observed during the survey supports

maternity colonies; however, the identified snags may provide adequate day-roosting habitat for a variety of bat species. Other significant habitat features, including caves and abandoned mines, that could serve as hibernacula or over-wintering sites were also not observed during the survey.

Impacts to bats as a result of habitat fragmentation and removal are anticipated to be minimal based on the widespread existing disturbance/fragmentation in the Study Area along with the Project's maximized use of existing roadways. Habitat fragmentation and removal will be associated with newly constructed roads (totaling approximately 11.3 km in length) and clearing for turbine pads within the Project Area. Areas where new roads and turbine pads are proposed do not contain significant bat habitat. In addition, an existing roadway along Indian Lake was utilized, minimizing clearing requirements in an area documented to contain concentrated bat activity (as per the assessment results above).

Injury/Morality

Wind project related bat injuries/mortalities are increasingly becoming a concern as some researchers have highlighted that turbines could have a greater impact on bats than birds. Bats have a slower life cycle than birds resulting in impacts to population dynamics when mortalities occur, especially where populations are already small (Wellig et al., 2018). Bat injuries/ mortalities can result either from a direct collision with a turbine blade or from barotrauma which is caused by the sudden decrease in air pressure following rotating blades (GOC, 2015). Reasons for bats colliding with blades include the inability for bats to detect or avoid blades due to high speeds, which can be up to 300 km/h at the tip of the blade (Wellig et al., 2018). In addition, research suggests that bats are attracted to wind turbines because the tall structures dominate landscapes which may attract insects or be perceived as potential mating sites or roost trees (Wellig et al., 2018). A study completed by Horn et al. (2008) found that bats actively forage within turbine locations during operation. Through the investigation, researchers observed bats approaching non-rotating and rotating blades, repeatedly investigating turbine elements, following or trapped by blade-tip vortices, and bats colliding with turbine blades (Horn et al., 2008).

Long distance migrating bats including the Eastern red bat, Hoary bat, and Silver-haired bat comprise most of the reported mortalities from wind turbines due to their higher flight elevations and long migration distances (Parisé & Walker, 2017; GOC, 2015). Alternatively, Myotis species of bats have lower fatality rates due to lower flight elevation and short migrating distances (GOC, 2015). In the Recovery Strategy for Little Brown Myotis, Northern Myotis, and Tri-colored Bat (ECCC, 2015), collisions and barotrauma from wind turbines were listed as a high level of concern in areas impacted by white-nose syndrome (like Nova Scotia), with localized seasonal impacts in the summer, fall, and spring.

Bat activity and use of habitat within the Study Area was assessed through incidental observations and passive acoustic monitoring. Five bat species were identified through the acoustic assessment which included both resident species (Myotis and Tri-colored bat) and migratory species (Eastern red bat, Hoary bat, and Silver-haired bats). A total of 1781 bat calls were recorded, of which, several were classified as unknown as they were not able to be

speciated due to poor quality recordings or too short of calls to accurately identify (representing only 0.2% of the total recorded calls).

Myotis species (i.e., Little brown myotis and/or Northern myotis) were the most frequently detected bats within the Study Area representing 68.9% of recorded bat calls. Another resident species, the Tri-colored bat, was also recorded during the survey but only represented 0.2% of identified calls. Tri-colored bats are typically restricted to southwest Nova Scotia which likely explains its low detection rate during the survey. Both Myotis and Tri-colored bats are resident species which reside in Nova Scotia year-round through the use of hibernacula during the winter months. As discussed above, resident species have been found to be at a lower risk for wind turbine related injuries and mortalities as a result of lower flight patterns and shorter migration routes. Migratory bat species, which are at a higher risk due to higher flight patterns and longer migration routes, comprised 30.6% of calls identified: Hoary bats (22.5%), Silver-haired bats (0.6%), and Eastern red bats (7.5%).

The Study Area has demonstrated bat activity and therefore has the potential to impact bat species individuals as a result of injury/mortality during Project activities (primarily vegetation clearing and turbine operation). Impacts to bat SOCI populations at a regional scale or population level are not anticipated based on the low flight patterns of resident SOCI (GOC, 2015). In addition, Strum Consulting has completed numerous post-construction bat mortality surveys for wind turbine developments and have identified minimal/negligible levels of bat mortality across the Province of Nova Scotia. These post-construction bat monitoring reports/results are client-confidential, but copies were submitted to and are accessible by NSECC (as per requirements for approval of past wind turbine developments).

Sensory Disturbance

Sensory disturbance generated primarily by lighting and noise during both construction and operation phases of the Project may also impact bat behaviours and/or impede movement, foraging, flight activity, and habitat use. Based on the pre-existing traffic loads, forestry, and recreational activity within the Study Area, along with the minimal traffic to be associated with the Project, effects on bat behaviours are not anticipated within the LAA. In addition, turbine lighting will be restricted to minimums required for safety and potential impacts bat behavior and movements are negligible/low.

Mitigation

To address the abovementioned effects to bat and bat habitat, the following mitigation measures will be implemented where possible:

Habitat Fragmentation & Removal

- Minimize overall area to be cleared by utilizing pre-existing roads and previously altered areas (i.e., clearcuts).
- Complete clearing during winter months when bats are overwintering in caves (end of September to late April).
- Maintain avoidance of important bat habitat (i.e., Lear Shaft, caves, and abandoned mines) to the greatest extent possible.

- Avoid/minimize the removal of large diameter (≥25 cm) snags and hollow trees (bat over-day roosting habitat) within the Project Area during the detail design phase, to the greatest extent possible.
- Minimize fragmentation and habitat isolation during the design phase.
- Revegetate roadsides and cleared areas to minimize lost habitat as much as possible.

Injury/Mortality

The primary mitigation measure to prevent injury/mortality of bats is avoidance of important habitat (i.e., hibernacula, migration routes, and migratory stopovers) along with placement of turbines away from freshwater habitats demonstrated to have bat activity, which has been incorporated into the Project's design/development.

Sensory Disturbance

- Continue to prioritize the use of existing roads to the extent possible to minimize increases in the road density.
- Restrict lighting to minimums required for safety considerations.
- Utilize noise controls (e.g., mufflers) on machinery, equipment, etc. during construction of the Project.

Monitoring

A detailed Post Construction Bat Monitoring Plan will be developed and submitted to NSECC and NSNRR for review. Monitoring activities may include:

- Passive acoustic monitoring.
- Post-construction bat mortality monitoring (up to two years).
- Adaptive management/contingency plan if post-construction monitoring identifies significant bat mortality, which would include consultation with NSNRR.

Conclusion

Results are characterized as moderate magnitude, within the LAA, medium duration, intermittent, reversible, and not significant.

7.4.5 Avifauna

7.4.5.1 Overview

A desktop review, field program, and habitat modelling were undertaken to gather information on avian species and associated habitat in the Study Area. Objectives were as follows:

- Assess observations, species diversity and habitat utilization of avian species within the Study Area during all seasons.
- Use the information collected to inform and refine the Project design (i.e., avoid impacts to SOCI and their habitats).
- Assess migratory bird activity and assess the risk that the Project poses to migratory birds.
- Use the information collected to inform mitigation and management practices.

7.4.5.2 Regulatory Context

Applicable laws and regulations relating to the protection of avian species include the following:

- *MBCA*
- NS *ESA*
- *SARA*

The *MBCA* protects all migratory birds while they are present in Canadian Jurisdiction, including on land, in the air, and on the water. The NS *ESA* and *SARA* prohibit harm to listed SAR along with their habitually occupied spaces and core/critical habitat.

7.4.5.3 Desktop Review

Desktop information was utilized to gain insight into protected avifauna habitats, species utilization of the area, and to identify SOCI potentially occurring at or within the Assessment Area using the following sources:

- Terrestrial Habitat Mapping (Section 7.4.1)
- IBAs (Bird Studies Canada & Nature Canada, 2022)
- Maritimes Breeding Bird Atlas (MBBA) (Bird Studies Canada, 2016)
- Nova Scotia Significant Species and Habitats Database (NSNRR, 2018)
- ACCDC Data Report (ACCDC, 2023)

The Study Area features softwood stands, with hardwood dominated slopes, and some mixed wood stands scattered throughout. Much of the forested area is managed for silviculture and has been subject to clear-cutting or thinning activities within the past decade. The diversity of habitat types, in particular the prevalence of edge/transitional habitat, provides for the foraging, breeding, and roosting requirements of a variety of resident and migratory bird species.

The closest IBA in Nova Scotia (IBA Canada, 2016) is the Pomquet Beach Region, Northumberland Strait, approximately 30 km northeast of the Project (Drawing 7.22). At low tide, sand flats and salt marshes are exposed, and this ecosystem supports breeding Piping Plovers (*Charadrius melodus*), a nationally endangered and globally vulnerable species (IBA Canada, 2016). This IBA is far enough from the Project Area that there are no interactions with the Project expected.

The majority of the Assessment Area is contained within the map square 20NR64 of the MBBA. The Study Area also intersects squares 20NR54 and 20NR63 (MBBA 2012). In the most recent edition of the MBBA (2006-2010), 91 species were identified as being possible, probable, or confirmed breeders in square 20NR64, including 25 SOCI:

- American Kestrel (*Falco sparverius*) – “S3B” (ACCDC)
- American Robin (*Turdus migratorius*) – “S3N” (ACCDC)
- Barn Swallow (*Hirundo rustica*) – “Threatened” (*SARA*), “Special Concern” (COSEWIC), “Endangered” (NS *ESA*), “S3B” (ACCDC)

- Black-backed Woodpecker (*Picoides arcticus*) – "S3S4" (ACCDC)
- Black-billed Cuckoo (*Coccyzus erythropthalmus*) – "S3B" (ACCDC)
- Bobolink (*Dolichonyx oryzivorus*) – "Threatened" (*SARA* and COSEWIC), "Vulnerable" (NS *ESA*), "S3B" (ACCDC)
- Boreal Chickadee (*Poecile hudsonicus*) – "S3" (ACCDC)
- Canada Warbler (*Cardellina canadensis*) – "Threatened" (*SARA*), "Special Concern" (COSEWIC), "Endangered" (NS *ESA*), "S3B" (ACCDC)
- Chimney Swift (*Chaetura pelagica*) – "Threatened" (*SARA* and COSEWIC). "Endangered" (NS *ESA*), "S2S3B, S1M" (ACCDC)
- Cliff Swallow (*Petrochelidon pyrrhonota*) – "S2S3B" (ACCDC)
- Common Nighthawk (*Chordeiles minor*) – "Threatened" (*SARA* and NS *ESA*), "Special Concern" (COSEWIC), "S3B" (ACCDC)
- Eastern Kingbird (*Tyrannus tyrannus*) – "S3B" (ACCDC)
- Eastern Wood-Pewee (*Contopus virens*) – "Special Concern" (*SARA* and COSEWIC), "Vulnerable" (NS *ESA*), "S3S4B" (ACCDC)
- Evening Grosbeak (*Coccothraustes vespertinus*) – "Special Concern" (*SARA* and COSEWIC), "Vulnerable" (NS *ESA*), "S3S4B, S3N" (ACCDC)
- Gray Jay (*Perisoreus canadensis*) – "S3" (ACCDC)
- Hairy Woodpecker (*Picoides villosus*) – "SU" (ACCDC)
- Mourning Warbler (*Oporornis philadelphia*) – "SU" (ACCDC)
- Nashville Warbler (*Vermivora ruficapilla*) – "SU" (ACCDC
- Northern Parula (*Parula americana*) – "SU" (ACCDC)
- Northern Waterthrush (*Seiurus noveboracensis*) – "S2S3" (ACCDC)
- Olive-sided Flycatcher (*Contopus cooperi*) – "Threatened" (*SARA*), "Special Concern" (COSEWIC), "Threatened" (NS *ESA*), "S2B" (ACCDC)
- Pine Grosbeak (*Pinicola enucleator*) – "S3B" (ACCDC)
- Pine Siskin (*Spinus pinus*) – "S3" (ACCDC)
- Rusty Blackbird (*Euphagus carolinus*) – "Special Concern" (*SARA* and COSEWIC), "Endangered" (NS *ESA*), "S2B" (ACCDC)
- Spotted Sandpiper (*Actitis macularius*) – "S3S4B" (ACCDC)

The NS Significant Species and Habitats database contains 24 unique records pertaining to birds and/or bird habitat within a 10 km radius of the Project. These records include but are not limited to:

- Three records classified in the database as "Other Habitat", all of which relate to Bald Eagle (*Haliaeetus leucocephalus*).
- One record classified as "Species of Concern" which relates to Common Loon (*Gavia immer*).
- 20 records classified as "Species at Risk" which relate to 10 Pine Siskin, one Black-backed Woodpecker, two Eastern Wood-Pewee, two Boreal Chickadee, two Olive-sided Flycatcher, two Rose-breasted Grosbeak (*Pheucticus leudovicianus*), and one Killdeer (*Charadrius vociferus*).

The NS Significant Species and Habitats database contains 1182 unique records pertaining to birds and/or bird habitat within a 100 km radius of the Project. These records include but are not limited to:

- 211 records classified in the database as “Other Habitat”, most of which relate to Bald Eagle (193).
- 155 records classified in the database as “Migratory Bird”, many of which relate to Double-crested Cormorant (*Phalacrocorax auritus*) (30), Willet (*Tringa semipalmata*) (37), and Common Eider (*Somateria mollissima*) (21).
- 188 records classified as “Species of Concern” many of which relate to Unclassified Tern (67).
- 628 records classified as “Species at Risk” many of which relate to Yellow-bellied Flycatcher (*Empidonax flaviventris*) (61), Swainson’s Thrush (*Cathartus ustulatus*) (39), Ruby-crowned Kinglet (*Regulus calendula*) (103), Piping Plover (48), Gray Jay (32), and Common Loon (25).

The ACCDC database contains records of 107 bird species within a 100 km radius of the Study Area (Table 7.5.4).

Table 7.54: Bird Species Recorded within a 100 km Radius of the Study Area

Common Name	Scientific Name	*SARA* Status[1]	NS *ESA* Status[2]	COSEWIC Status[3]	NS S-Rank[4]
American Bittern	*Botaurus lentiginosus*	---	---	---	S3S4B,S4S5M
American Coot	*Fulica americana*	---	---	Not At Risk	S1B
American Golden-Plover	*Pluvialis dominica*	---	---	---	S2S3M
American Kestrel	*Falco sparverius*	---	---	---	S3B,S4S5M
American Three-toed Woodpecker	*Picoides dorsalis*	---	---	---	S1?
American Water Shrew	*Sorex palustris*	---	---	---	S3S4
Arctic Tern	*Sterna paradisaea*	---	---	---	S3B
Atlantic Puffin	*Fratercula arctica*	---	---	---	S2B
Baltimore Oriole	*Icterus galbula*	---	---	---	S2S3B,SUM
Bank Swallow	*Riparia riparia*	Threatened	Endangered	Threatened	S2B
Barn Swallow	*Hirundo rustica*	Threatened	Endangered	Special Concern	S3B
Barrow's Goldeneye	*Bucephala islandica*	Special Concern	---	Special Concern	S1N,SUM
Bay-breasted Warbler	*Setophaga castanea*	---	---	---	S3S4B,S4S5M
Black Tern	*Chlidonias niger*	---	---	Not At Risk	S1B

Common Name	Scientific Name	*SARA* Status[1]	NS *ESA* Status[2]	COSEWIC Status[3]	NS S-Rank[4]
Black-backed Woodpecker	*Picoides arcticus*	---	---	---	S3S4
Black-bellied Plover	*Pluvialis squatarola*	---	---	---	S3M
Black-billed Cuckoo	*Coccyzus erythropthalmus*	---	---	---	S3B
Black-crowned Night-heron	*Nycticorax nycticorax*	---	---	---	S1B
Black-headed Gull	*Chroicocephalus ridibundus*	---	---	---	S3N
Black-legged Kittiwake	*Rissa tridactyla*	---	---	---	S2S3B
Blackpoll Warbler	*Setophaga striata*	---	---	---	S3B,S5M
Blue-winged Teal	*Spatula discors*	---	---	---	S3B
Bobolink	*Dolichonyx oryzivorus*	Threatened	Vulnerable	Special Concern	S3B
Boreal Chickadee	*Poecile hudsonicus*	---	---	---	S3
Boreal Owl	*Aegolius funereus*	---	---	Not At Risk	S2?B,SUM
Brant	*Branta bernicla*	---	---	---	S3M
Brown Thrasher	*Toxostoma rufum*	---	---	---	S1B
Brown-headed Cowbird	*Molothrus ater*	---	---	---	S2B
Canada Jay	*Perisoreus canadensis*	---	---	---	S3
Canada Warbler	*Cardellina canadensis*	Threatened	Endangered	Special Concern	S3B
Cape May Warbler	*Setophaga tigrina*	---	---	---	S3B,SUM
Chimney Swift	*Chaetura pelagica*	Threatened	Endangered	Threatened	S2S3B,S1M
Cliff Swallow	*Petrochelidon pyrrhonota*	---	---	---	S2S3B
Common Eider	*Somateria mollissima*	---	---	---	S3B,S3M,S3N
Common Gallinule	*Gallinula galeata*	---	---	---	S1B
Common Goldeneye	*Bucephala clangula*	---	---	---	S2S3B,S5N,S5M
Common Nighthawk	*Chordeiles minor*	Threatened	Threatened	Special Concern	S3B
Common Tern	*Sterna hirundo*	---	---	Not At Risk	S3B
Cooper's Hawk	*Accipiter cooperii*	---	---	Not At Risk	S1?B,SUN,SUM
Eastern Bluebird	*Sialia sialis*	---	---	Not At Risk	S3B
Eastern Kingbird	*Tyrannus tyrannus*	---	---	---	S3B
Eastern Meadowlark	*Sturnella magna*	Threatened	---	Threatened	SHB

Common Name	Scientific Name	*SARA* Status[1]	NS *ESA* Status[2]	COSEWIC Status[3]	NS S-Rank[4]
Eastern Whip-Poor-Will	*Antrostomus vociferus*	Threatened	Threatened	Special Concern	S1?B
Eastern Wood-Pewee	*Contopus virens*	Special Concern	Vulnerable	Special Concern	S3S4B
Evening Grosbeak	*Coccothraustes vespertinus*	Special Concern	Vulnerable	Special Concern	S3B,S3N,S3M
Fox Sparrow	*Passerella iliaca*	---	---	---	S3S4B,S5M
Gadwall	*Mareca strepera*	---	---	---	S2B,SUM
Great Cormorant	*Phalacrocorax carbo*	---	---	---	S2S3B,S2S3N
Great Crested Flycatcher	*Myiarchus crinitus*	---	---	---	S1B
Greater Yellowlegs	*Tringa melanoleuca*	---	---	---	S3B,S4M
Harlequin Duck - Eastern population	*Histrionicus histrionicus pop. 1*	Special Concern	Endangered	Special Concern	S2S3N,SUM
Horned Grebe	*Podiceps auritus*	Special Concern	---	Special Concern	S3N,SUM
Horned Lark	*Eremophila alpestris*	---	---	---	SHB,S4S5N,S5M
Hudsonian Godwit	*Limosa haemastica*	---	---	Threatened	S2S3M
Indigo Bunting	*Passerina cyanea*	---	---	---	S1?B,SUM
Ipswich Sparrow	*Passerculus sandwichensis princeps*	Special Concern	---	Special Concern	S1B
Killdeer	*Charadrius vociferus*	---	---	---	S3B
Lapland Longspur	*Calcarius lapponicus*	---	---	---	S3?N,SUM
Laughing Gull	*Leucophaeus atricilla*	---	---	---	SHB
Leach's Storm-Petrel	*Hydrobates leucorhous*	---	---	Threatened	S3B
Least Sandpiper	*Calidris minutilla*	---	---	---	S1B,S4M
Lesser Yellowlegs	*Tringa flavipes*	---	---	Threatened	S3M
Long-eared Owl	*Asio otus*	---	---	---	S2S3
Nelson's Sparrow	*Ammospiza nelsoni*	---	---	Not At Risk	S3S4B
Northern Gannet	*Morus bassanus*	---	---	---	SHB
Northern Goshawk	*Accipiter gentilis*	---	---	Not At Risk	S3S4
Northern Mockingbird	*Mimus polyglottos*	---	---	---	S1B
Northern Pintail	*Anas acuta*	---	---	---	S1B,SUM

Common Name	Scientific Name	*SARA* Status[1]	NS *ESA* Status[2]	COSEWIC Status[3]	NS S-Rank[4]
Northern Shoveler	*Spatula clypeata*	---	---	---	S2B,SUM
Northern Shrike	*Lanius borealis*	---	---	---	S3S4N
Olive-sided Flycatcher	*Contopus cooperi*	Threatened	Threatened	Special Concern	S3B
Pectoral Sandpiper	*Calidris melanotos*	---	---	---	S3M
Peregrine Falcon - anatum/tundrius	*Falco peregrinus pop. 1*	Special Concern	Vulnerable	Not At Risk	S1B,SUM
Philadelphia Vireo	*Vireo philadelphicus*	---	---	---	S2?B,SUM
Pine Grosbeak	*Pinicola enucleator*	---	---	---	S3B,S5N,S5M
Pine Siskin	*Spinus pinus*	---	---	---	S3
Pine Warbler	*Setophaga pinus*	---	---	---	S2S3B,S4S5M
Piping Plover melodus subspecies	*Charadrius melodus melodus*	Endangered	Endangered	Endangered	S1B
Purple Martin	*Progne subis*	---	---	---	SHB
Purple Sandpiper	*Calidris maritima*	---	---	---	S3S4N
Red Crossbill	*Loxia curvirostra*	---	---	---	S3S4
Red Knot rufa subspecies	*Calidris canutus rufa*	Endangered	Endangered	E,SC	S2M
Red-breasted Merganser	*Mergus serrator*	---	---	---	S3S4B,S5M,S5N
Roseate Tern	*Sterna dougallii*	Endangered	Endangered	Endangered	S1B
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	---	---	---	S3B
Rough-legged Hawk	*Buteo lagopus*	---	---	Not At Risk	S3N
Ruddy Duck	*Oxyura jamaicensis*	---	---	---	S1B
Ruddy Turnstone	*Arenaria interpres*	---	---	---	S3M
Rusty Blackbird	*Euphagus carolinus*	Special Concern	Endangered	Special Concern	S2B
Sanderling	*Calidris alba*	---	---	---	S2N,S3M
Scarlet Tanager	*Piranga olivacea*	---	---	---	S2B,SUM
Semipalmated Plover	*Charadrius semipalmatus*	---	---	---	S1B,S4M
Semipalmated Sandpiper	*Calidris pusilla*	---	---	---	S3M
Short-billed Dowitcher	*Limnodromus griseus*	---	---	---	S3M
Short-eared Owl	*Asio flammeus*	Special Concern	---	Threatened	S1B
Spotted Sandpiper	*Actitis macularius*	---	---	---	S3S4B,S5M

Common Name	Scientific Name	*SARA* Status[1]	NS *ESA* Status[2]	COSEWIC Status[3]	NS S-Rank[4]
Tennessee Warbler	*Leiothlypis peregrina*	---	---	---	S3S4B,S5M
Turkey Vulture	*Cathartes aura*	---	---	---	S2S3B,S4S5M
Vesper Sparrow	*Pooecetes gramineus*	---	---	---	S1S2B,SUM
Virginia Rail	*Rallus limicola*	---	---	---	S2S3B
Warbling Vireo	*Vireo gilvus*	---	---	---	S1B,SUM
Whimbrel	*Numenius phaeopus hudsonicus*	---	---	---	S2S3M
Willet	*Tringa semipalmata*	---	---	---	S3B
Willow Flycatcher	*Empidonax traillii*	---	---	---	S2B
Wilson's Snipe	*Gallinago delicata*	---	---	---	S3B,S5M
Wilson's Warbler	*Cardellina pusilla*	---	---	---	S3B,S5M
Wood Thrush	*Hylocichla mustelina*	Threatened	---	Threatened	SUB

Source: ACCDC, 2023

[1]Government of Canada, 2022; [2] Government of NS, 2022; [3]Government of Canada, 2022; [4]ACCDC, 2023

7.4.5.4 Field Survey Methodology

Several types of survey methods were employed to assess the avian species using the Study Area throughout the year. Survey methods were based on the protocols recommended in the document Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds (CWS, 2007), unless otherwise stated.

Point Counts

Point count surveys were used as the primary means of identifying species in the Study Area through all seasons. Point counts were 10 mins in duration and were completed at predetermined locations. All visual and auditory observations of birds were recorded for each point count location, along with relevant behavioral information (such as breeding evidence). Point count locations were determined using terrestrial habitat resources (Section 7.4.1) and in consultation with an expert birder, with the objective of representing the diversity of habitat within the Study Area. The estimated distance to target, direction, and number of species is recorded, while the observer remains still and silent for the duration of the survey interval. Surveys were completed from ½ hour before, through 4 hours after dawn in any given season to observe the most active time of day for passerine species. Survey opportunities were maximized for clear weather and minimal wind within the appropriate timeframe. Target species of point counts are primarily passerines, identified audibly.

Nocturnal Counts

Nocturnal counts were 10 mins in duration and completed at predetermined locations throughout

the Study Area. As the target species, all nightjars (nighthawks, etc.) and owls heard or observed were recorded with information on direction, behavior (if applicable) and distance from the observer. Surveys were conducted from dusk until 2 hours after dusk on clear nights with minimal wind and no precipitation.

Diurnal Watch Surveys

Watch surveys were completed to assess the movement of birds within the Study Area during the day. These surveys were completed for 120 mins, usually in the late morning. Observations on the movement of birds were recorded, including bearing from the observer, distance to the target, the direction that the target was moving, its passing height, and any other behavioral notes.

Fall Migration Season Bird Surveys (2021 and 2022)

Fall migration surveys were used in tandem with spring migration surveys to determine the migratory species that are moving through or over the Study Area, though at a different time of year. In Nova Scotia, the fall migration period lasts from late August through late October for most species. These surveys included point counts and diurnal watches.

Winter Bird Surveys (2021-2022)

Winter bird surveys were completed to establish the species and distribution of resident birds through the winter season. These surveys were conducted from mid-December through March and included point counts.

Spring Migration Season Bird Surveys (2022)

Spring migration surveys were completed to inventory species migrating through or over the Study Area. The spring migratory period runs from early April through mid-June, and surveys included point counts, and diurnal watch surveys.

Breeding Bird Surveys (2022)

Breeding bird surveys were completed to inventory avian species and assess their breeding activity within the Study Area during the breeding season. In Nova Scotia, the core breeding season for migratory species runs from mid-June to late July. Breeding bird surveys were conducted using point counts. Two rounds of point count surveys were completed, and any evidence of breeding as outlined by the MBBA was recorded.

Nocturnal Bird Surveys (2022)

Nocturnal bird surveys were completed during the breeding season to gain an understanding of resident and migratory species.

7.4.5.5 Habitat Modelling Methodology

Habitat modelling for SAR observed during the 2022 breeding bird and nocturnal surveys (i.e., priority species that may be breeding within the Study Area) was completed. Breeding habitat preferences for these species were incorporated into a GIS model, which was used to estimate the quality and quantity of breeding habitat for each species. The model criterion for each species is summarized below.

Canada Warbler

The land cover classification was queried based on bogs, wetlands, or brush to account for the species preferred habitat of treed conifer swamps, extensive mid-story growth (e.g., holly, alders). Forest data was queried to include the FORNON code of 39 which is an area where in part alders compose 75% or more of the Crown closure. The leading species (SP1) attribute of BF (balsam fir), and BS (black spruce) were used. Furthermore, to account for smaller scale wetland features, the NSNRR wetland data was filtered to include those classified as bog, bog or fen, fen, and swamp.

Chimney Swift

Habitat characteristics that are preferred for Chimney Swift are mainly urban areas that have access to chimneys, grain towers, or other forms of cavity. Rural forested areas are atypical; however, cavities are mainly found in dead trees/forest and windthrow areas which can be habitable by Chimney Swifts. There were no such areas identified in the Nova Scotia forestry and landcover datasets within the Study Area. Chimney swifts are also known to inhabit cavities in trees that have a diameter above 50 cm. All treed stands in the Study Area have an average total diameter (AVDI) below 50 cm and therefore were not included as a parameter in the analysis. Due to the observation of Chimney Swift in the Study Area, areas of dead stands were mapped for reference. Areas within 300 m of wetlands were also mapped because 3/5 main insect orders consumed by the Chimney Swift are associated with wetlands (NSNRR, 2007, ECCC, 2007).

Common Nighthawk

Forestry inventory data was filtered to identify areas with bare ground, including clear cuts, ditched areas (confirmed by DEM), roadsides, laydown areas, and other corridors where vegetation has been removed or is kept cut. This habitat is primarily suitable for nesting, not breeding nor foraging.

Eastern Wood-Pewee

Using the forest inventory, the data was filtered based on 10-45% crown closure of the treed stands in both the first story and the second story to survey the area for any open woodland type of forest. All tree species were included due to the lack of hardwood or hardwood dominated stands in the Study Area. In addition, the land cover classification was queried based on hardwood (regardless of crown closure), with all hardwood included due to the minimal (0.8%) coverage in the Study Area.

Evening Grosbeak

Using the forest inventory, the data was filtered based on the classified softwood forests and harvests in the land cover dataset. This accounted for mature coniferous and second growth coniferous forests, mixed wood forests. In addition, the Evening Grosbeak was observed in forests with aspen stands. Therefore, the forest inventory was used where the leading species (SP1) matched the attribute of TA (large tooth aspen and trembling aspen).

Olive-sided Flycatcher

Using the forest inventory, forest data was queried to include the leading species (SP1) attribute of BS (black spruce), RS (red spruce), WS (white spruce), SP (scots pine), RP (red pine), JP (jack pine), and EH (eastern hemlock), if present. To account for all softwood forests, the land cover dataset was filtered based on the softwood classification (may result in an overestimation of habitat).

7.4.5.6 Remote Sensing Methodology

Avian Radar Assessment

Avian radar assessments were undertaken during the spring and fall 2022 migratory periods. The objective of the avian radar assessment was to assess migratory bird activity in the airspace above the Study Area. The avian radar systems (ARS) were deployed from April 25 to May 31, and from June 26 to November 28, 2022. During both migratory periods, one Simrad Halo 20+ pulse compression marine surveillance radar was used and was angled diagonally at 45° above the horizon. The diagonal orientation allowed for a 180° scan of the airspace above the radar, while the 180° below the radar is blanked. The diagonal orientation also allows for the calculation of the height of targets. A second year of avian radar monitoring commenced in April 2023.

An off grid 12V system was designed for optimal active monitoring and specificity in deployment. It was designed to charge and store energy using solar panels and a battery bank, while also powering the radar and associated equipment for data collection and remote communications. The system in its entirety was designed to be mobile, so the movement of the radar throughout the Study Area was possible, if desired.

A central location within the Study Area was chosen, which also provided a good line of site (relatively few trees in the immediate area) into the airspace above the Study Area, a southern exposure for solar charging, sufficient cellular and satellite coverage for remote communications, and accessibility for spot checks. The radar was mounted off the ground (approximately 2 m) to minimize ground noise interference and lessen the impacts of local microtopography on data collection and clarity.

Avian radar assessment results were processed using the radR platform (Taylor et al., 2010) – an open-source platform designed for the processing of radar data for biological applications – and outputs were analyzed using Microsoft Excel. Standard settings for the identification of biological targets (BT), such as birds, and bats were used. Targets reflected by the radar generate blips in the image of the radar scan. radR helps filter sequential images of radar scans to identify blips that occur in the same area over at least four out of five scans. Should these constraints be met, a target is generated. BTs are most likely generated by birds, but could also be bats and insects, or even drones and planes. Fog, rain, low cloud cover, cause interference with the radar (similarly to weather radar), which lowers the effectiveness of the system, and reduces the reliability of the system's ability to detect birds. As such, any data collected when the nearest weather station (in this case, ECCC's Collegeville Auto Weather Station) indicates a minimum hourly rainfall of 0.5 mm was excluded from the analysis.

Avian Acoustic Assessment

Wildlife Acoustics SM4 Acoustic monitors were deployed within the Study Area in tandem with the radar system during the spring of 2022 (April 25 to May 23, 2022), and the fall of 2022 (August 30 to November 1, 2022). These monitors were programmed to record throughout the night during the monitoring periods with the intention of recording the acoustic activity of migratory songbirds for analysis.

The acoustic data was initially processed using Wildlife Acoustics' Kaleidoscope's cluster analysis capabilities. The dataset was restricted to only assess data between 9 pm and 4 am in the spring, and between 8 pm and 5 am in the fall (when nights are longer). The goal was to observe night flight calls (NFCs). The cluster analysis was done using bait files in conjunction with the raw acoustic data. The bait files included sample audio from 91 SOCI bird species (Table 7.55) for Kaleidoscope to create clusters around avian acoustics.

Table 7.55: Species Used as Bait Files for NFC Recognition Using Kaleidoscope

Common Name	Scientific Name
American Coot	*Fulica americana*
American Kestrel	*Falco sparverius*
American Robin	*Turdus migratorius*
American Three-toed Woodpecker	*Picoides dorsalis*
Arctic Tern	*Sterna paradisaea*
Atlantic Puffin	*Fratercula arctica*
Bank Swallow	*Riparia riparia*
Barn Swallow	*Hirundo rustica*
Bay-breasted Warbler	*Setophaga castanea*
Bicknell's Thrush	*Catharus bicknelli*
Black-backed Woodpecker	*Picoides arcticus*
Black-billed Cuckoo	*Coccyzus erythropthalmus*
Black-crowned Night-heron	*Nycticorax nycticorax*
Black-headed Gull	*Chroicocephalus ridibundus*
Blacklegged Kittiwake	*Rissa tridactyla*
Blackpoll Warbler	*Setophaga striata*
Black Tern	*Chlidonias niger*
Blue-winged Teal	*Spatula discors*
Bobolink	*Dolichonyx oryzivorus*
Boreal Chickadee	*Poecile hudsonicus*
Boreal Owl	*Aegolius funereus*
Brown-headed Cowbird	*Molothrus ater*
Brown Thrasher	*Toxostoma rufum*
Canada Jay	*Perisoreus canadensis*
Canada Warbler	*Wilsonia canadensis*
Cape May Warbler	*Setophaga tigrina*
Chimney Swift	*Chaetura pelagica*
Cliff Swallow	*Petrochelidon pyrrhonota*
Common Eider	*Somateria mollissima*
Common Gallinule	*Gallinula galeata*

Common Name	Scientific Name
Common Goldeneye	*Bucephala clangula*
Common Murre	*Uria aalge*
Common Nighthawk	*Chordeiles minor*
Common Tern	*Sterna hirundo*
Cooper's Hawk	*Accipiter cooperii*
Eastern Bluebird	*Sialia sialis*
Eastern Kingbird	*Tyrannus tyrannus*
Eastern Whip-Poor-Will	*Antrostomus vociferus*
Eastern Wood-Pewee	*Contopus virens*
Evening Grosbeak	*Coccothraustes vespertinus*
Fox Sparrow	*Passerella iliaca*
Gadwall	*Mareca strepera*
Great Cormorant	*Phalacrocorax carbo*
Great Crested Flycatcher	*Myiarchus crinitus*
Greater Yellowlegs	*Tringa melanoleuca*
Harlequin Duck	*Histrionicus histrionicus*
Indigo Bunting	*Passerina cyanea*
Killdeer	*Charadrius vociferus*
Lapland Longspur	*Calcarius lapponicus*
Leach's Storm-Petrel	*Hydrobates leucorhous*
Least Sandpiper	*Calidris minutilla*
Lesser Yellowlegs	*Tringa flavipes*
Long-eared Owl	*Asio otus*
Manx Shearwater	*Puffinus puffinus*
Marsh Wren	*Cistothorus palustris*
Nelson's Sparrow	*Ammospiza nelson*
Northern Goshawk	*Accipiter gentilis*
Northern Mockingbird	*Mimus polyglottos*
Northern Pintail	*Anas acuta*
Northern Shoveler	*Spatula clypeata*
Olive-sided Flycatcher	*Contopus cooperi*
Peregrine Falcon	*Falco peregrinus*
Philadelphia Vireo	*Vireo philadelphicus*
Pine Grosbeak	*Pinicola enucleator*
Pine Siskin	*Spinus pinus*
Pine Warbler	*Setophaga pinus*
Piping Plover	*Charadrius melodus*
Purple Finch	*Haemorhous purpureus*
Razorbill	*Alca torda*
Red-breasted Merganser	*Mergus serrator*
Red Crossbill	*Loxia curvirostra*
Roseate Tern	*Sterna dougallii*
Rose-breasted Grosbeak	*Pheucticus ludovicianus*
Rough-legged Hawk	*Buteo lagopus*
Ruddy Duck	*Oxyura jamaicensis*
Rusty Blackbird	*Euphagus carolinus*

Common Name	Scientific Name
Scarlet Tanager	*Piranga olivacea*
Semipalmated Plover	*Charadrius semipalmatus*
Semipalmated Sandpiper	*Calidris pusilla*
Short-eared Owl	*Asio flammeus*
Solitary Sandpiper	*Tringa solitari*
Spotted Sandpiper	*Actitis macularius*
Tennessee Warbler	*Leiothlypis peregrina*
Turkey Vulture	*Cathartes aura*
Vesper Sparrow	*Pooecetes gramineus*
Virginia Rail	*Rallus limicola*
Warbling Vireo	*Vireo gilvus*
Willet	*Tringa semipalmata*
Willow Flycatcher	*Empidonax traillii*
Wilson's Snipe	*Gallinago delicata*
Wilson's Warbler	*Cardellina pusilla*

The signal parameters used for this analysis included:

- 250 – 22000 Hz frequency range
- 0.1 – 7.5 s length of detection
- 0.35 s maximum inter-syllable gap

The cluster analysis parameters for this analysis included:

- 2.0 maximum distance from cluster centre to include outputs in cluster.csv
- 10.67 ms FFT window
- 12 maximum states
- 0.5 maximum distance to cluster centre for building clusters
- 500 maximum clusters

Once the clusters were generated by Kaleidoscope, the output was vetted for the presence of avian acoustics. Every cluster was manually scanned to a minimum of 5% of its contents to determine whether it contained avian calls, singing, or noise, including non-avian sounds. If the cluster was found to be 90% noise, the entire cluster was considered noise. If the cluster scan achieved less than 90% noise, the entire cluster was investigated for avian acoustics. Any NFCs recorded during these scans were included in the analysis regardless of whether the cluster itself was considered noise.

7.4.5.7 Field Survey Results

2021 Fall Migration Surveys

Fall migration surveys were completed on September 30, and October 11, 13, 22, and 26, 2021. The surveys included 81 10-minute point counts and four 120-minute diurnal watches.

A total of 44 species, comprising 1269 individual birds, were observed during the fall migration point count surveys (Table 7.56; Tables 1/2, Appendix L). Surveys were completed across a wide range of habitats, spatially distributed throughout the Legacy Study Area on September 30, and October 11, 13, 22, and 26, 2021 (Drawing 7.23). Golden-crowned Kinglet (*Regulus satrapa*), Purple Finch (*Carpodacus purpureus*), and White-winged Crossbill (*Loxia leucoptera*) were the most abundant and frequently observed species. Passerines accounted for 95.7% of the individual birds, and 75% of the diversity in species observed.

Table 7.56: Total Observations by Bird Group – 2021 Fall Migration Point Count Surveys

Bird Group	Group #	# Individuals	# Species
Waterfowl	1	5	2
Shorebirds	2	4	2
Other Waterbirds	3	0	0
Diurnal Raptors	4	5	1
Nocturnal Raptors	5	0	0
Passerines	6	1215*	33*
Other Landbirds	7	39**	6**
Total		**1269**	**44**

*10 unidentified passerine observations could not be identified to the species level
**1 unidentified woodpecker observation could not be identified to the species level

SOCI observed during the fall migratory point count surveys include Boreal Chickadee, Canada Goose (*Branta canadensis*), Evening Grosbeak, Fox Sparrow (*Passerella iliaca*), Gray Jay, Hairy Woodpecker, Northern Parula, Red Crossbill (*Loxia curvivostra*), Rusty Blackbird, and Spruce Grouse (*Falcipennis canadensis*).

A total of 15 species, comprising 149 individual birds, were observed during fall migration diurnal watch surveys (Table 7.57; Tables 3/4, Appendix L). The four 120-minute diurnal watch surveys were conducted on October 11, 22, and 26, 2021, from elevated locations covering a wide range of habitats within the Legacy Study Area (Drawing 7.24). Common Raven (*Corvus corax*) and Purple Finch were the most abundantly observed species, however, a pair of flocks (15+ individuals) of finches were observed, though they were not able to be identified to the species level. Migrant passerines accounted for 85.9% of the individual birds, and 58.3% of the species observed.

Table 7.57: Total Observations by Bird Group – 2021 Fall Migration Diurnal Watch Surveys

Bird Group	Group #	# Individuals	# Species
Waterfowl	1	0	0
Shorebirds	2	0	0
Other Waterbirds	3	0	0
Diurnal Raptors	4	20*	4*
Nocturnal Raptors	5	0	0
Passerines	6	128	7
Other Landbirds	7	1	1
Total		**149**	**12**

*1 accipiter observation could not be identified to the species level
**71 unidentified passerine specimens were observed, including those flocks mentioned above

SOCI observed during the fall migratory diurnal watch surveys include American Robin, Gray Jay, Hairy Woodpecker, Red Crossbill, and Turkey Vulture (*Cathartes aura*).

No large high-flying migratory flocks were observed during diurnal watch surveys. Most observations consisted of passerine species flying in small groups just above the tree line. Observations of raptors mostly consisted of individual birds.

2021 – 2022 Winter Surveys

Winter surveys were completed on December 16, and 26, 2021; January 24, 25, and 27, 2022; and March 5, 6, 14, and 16, 2022. The surveys included 137 10-minute point counts across 58 locations (Drawing 7.23). A total of 25 species, comprising 1498 individual birds, were observed (Table 7.58; Tables 5/6, Appendix L). Pine Siskin, Black-capped Chickadee (*Poecile atricapilla*), Purple Finch, and White-winged Crossbill were the most abundant and commonly observed species. Resident passerines accounted for 96.9% of the individual birds, and 84% of species observed.

Table 7.58: Total Observations by Bird Group – 2021-2022 Winter Bird Surveys

Bird Group	Group #	# Individuals	# Species
Waterfowl	1	0	0
Shorebirds	2	0	0
Other Waterbirds	3	0	0
Diurnal Raptors	4	3	1
Nocturnal Raptors	5	0	0
Passerines	6	1451	21
Other Landbirds	7	44*	3
Total		1498	25

*Fourteen unidentified woodpeckers were observed (Other Landbirds)

Nine SOCI were observed during the 2020/2021 winter surveys: American Robin, American Tree Sparrow (*Spizella arborea*), Boreal Chickadee, Canada Jay (*Perisoreus canadensis*), Evening Grosbeak, Hairy Woodpecker, Pine Siskin, Red Crossbill, and Pine Grosbeak.

Species diversity was observed to be low during the winter surveys compared to other seasons. SOCI observed are generally consistent with those observed during migration and breeding bird surveys and are not expected to be breeding during the winter months. It is suspected that the abundance of finch species observations was due in part to available habitats and foraging throughout the Study Area during the 2021-2022 winter season.

2022 Spring Migration Surveys

Spring surveys were completed within the Study Area on April 14, 16, 19, 27; and May 14, 18, 24, 30, 2022. The surveys included 102 10-minute point counts, and 12 60-minute diurnal watches.

A total of 76 species, comprising 1677 individual birds were observed in the Study Area during spring migration point count surveys (Table 7.59; Tables 7/8, Appendix L) completed on April 14, 16, 19, 27; and May 14, 18, 24, 30, 2022. (Drawing 7.23). American Robin and White-winged Crossbill were the most frequently and abundantly observed species. Migrant and resident passerines accounted for 88.1% of the individual birds and 72.4% of the species observed.

Table 7.59: Total Observations by Bird Group – 2022 Spring Migration Point Count Surveys

Bird Group	Group #	# Individuals	# Species
Waterfowl	1	27*	5
Shorebirds	2	11	3
Other Waterbirds	3	8	2
Diurnal Raptors	4	4	2
Nocturnal Raptors	5	1	1
Passerines	6	1477**	55
Other Landbirds	7	149***	8
Total		**1677**	**76**

*One unidentified duck was observed (Waterfowl)
**Three unidentified passerines were observed (Passerines)
***Six unidentified woodpeckers were observed (Other Landbirds)

SOCI encountered throughout the 2022 spring migration point counts included American Robin, Boreal Chickadee, Canada Goose, Canada Warbler, Chimney Swift, Downy Woodpecker (*Picoides pubescens*), Evening Grosbeak, Gray Jay, Hairy Woodpecker, Mourning Warbler, Nashville Warbler, Northern Harrier (*Circus cyaneus*), Northern Parula, Northern Waterthrush, Pine Grosbeak, Pine Siskin, Rose-breasted Grosbeak, Red Crossbill, Rusty Blackbird, Spruce Grouse, Wilson's Snipe (*Gallinago delicata*), and Winter Wren (*Troglodytes troglodytes*).
A total of 20 species comprising 117 individual birds were observed in the Study Area during spring migration diurnal watch surveys (Table 7.60; Tables 9/10, Appendix L) completed on April 14, 16, and 19; and May 18, 24, and 30, 2022 (Drawing 7.25). Chimney Swift was the most

frequently and abundantly observed species. Several soaring species were observed, including eight diurnal raptor species, though no large flocks of migrating waterfowl were observed. Migrant passerines accounted for 64.1% of individual birds, and 50% of species observed.

Table 7.60: Total Observations by Bird Group – 2022 Spring Migration Diurnal Watch Surveys

Bird Group	Group #	# Individuals	# Species
Waterfowl	1	2	1
Shorebirds	2	0	0
Other Waterbirds	3	0	0
Diurnal Raptors	4	36*	8
Nocturnal Raptors	5	0*	0
Passerines	6	75**	10
Other Landbirds	7	4	1
Total		**117**	**20**

*One unidentified raptor species was observed (included with Diurnal Raptors total)
**Sixteen unidentified passerine specimens were observed (Passerines)

SOCI observed during the 2021 spring migration watch surveys included American Kestrel, American Robin, Chimney Swift, Evening Grosbeak, Northern Goshawk (*Accipiter gentilis*), Northern Harrier, Pine Siskin, and Turkey Vulture.

Throughout 2022 spring migration surveys, no large flocks of migratory waterfowl or shorebirds were observed, though one smaller flock of eight finches was observed flying low in a southwesterly direction.

2022 Breeding Bird Surveys

Two breeding bird surveys were conducted within the Study Area in 2022 (June 16 and 21; July 11 and 12). In total, 54 10-minute point counts were completed across the Study Area covering a wide range of habitat types and spatial distribution (Drawing 7.23). A total of 920 individual birds, representing 66 species, were observed (Table 7.61; Tables 11/12, Appendix L). The most abundant and frequently observed species were the Black-throated Green Warbler (*Dendroica virens*), Red-eyed Vireo (*Vireo olivaceus*), and Common Yellowthroat (*Geothlypis trichas*). Migrant passerines accounted for 83.3% of the species and 94.3% of the individual birds observed.

Table 7.61: Total Observations by Bird Group – 2022 Breeding Bird Point Count Surveys

Bird Group	Group #	# Individuals	# Species
Waterfowl	1	3*	1
Shorebirds	2	3	1
Other Waterbirds	3	3	1
Diurnal Raptors	4	2	2
Nocturnal Raptors	5	0	0
Passerines	6	868	55
Other Landbirds	7	41	6
Total		**920**	**66**

*One unidentified duck was observed (Waterfowl)

SOCI observed during the 2022 breeding surveys include American Robin, Boreal Chickadee, Canada Warbler, Chimney Swift, Eastern Wood-Pewee, Evening Grosbeak, Hairy Woodpecker, Mourning Warbler, Nashville Warbler, Northern Parula, Northern Waterthrush, Olive-sided Flycatcher, Pine Siskin, Red Crossbill, Spruce Grouse, Wilson's Snipe, and Winter Wren.

2022 Nocturnal Survey

Three nocturnal surveys for nightjars and owls were completed on June 23, and July 5 and 11, 2022, during the breeding season. A total of 24 6-minute point counts were completed throughout the Study Area (Drawing 7.24), with 108 individual birds representing six species observed (Table 7.62; Tables 13/14, Appendix L). Common Nighthawk and Chimney Swift were the most frequently and commonly observed species.

Table 7.62: Total Observations by Bird Group – 2022 Nocturnal Surveys

Bird Group	Group #	# Individuals	# Species
Waterfowl	1	0	0
Shorebirds	2	3	2
Other Waterbirds	3	0	0
Diurnal Raptors	4	0	0
Nocturnal Raptors	5	0	0
Passerines	6	105	4
Other Landbirds	7	0	0
Total		**108**	**6**

Common Nighthawk and Chimney Swift were the only SOCI observed during the nocturnal surveys.

2022 Fall Migration Surveys

Fall migration surveys were completed on September 22 and 28, and October 4, 12, 18, 23, and 25, 2022, throughout the Study Area. The surveys included 80 10-minute point counts and 13 60-minute diurnal watches.

A total of 52 species, comprising 820 individual birds, were observed during the fall migration point count surveys (Table 7.63; Tables 15/16, Appendix L). Surveys were completed across a wide range of habitats, spatially distributed throughout the Study Area on September 22, and 28, and October 4, 12, 18, 23, and 25, 2022 (Drawing 7.23). Dark-eyed Junco (*Junco hyemalis*), Golden-crowned Kinglet, and Black-capped Chickadee were the most abundant and frequently observed species. Migrant and resident passerines accounted for 92.3% of the individual birds, and 71.2% of the species observed.

Table 7.63: Total Observations by Bird Group – 2022 Fall Migration Point Count Surveys

Bird Group	Group #	# Individuals	# Species
Waterfowl	1	11	1
Shorebirds	2	2	1
Other Waterbirds	3	5	1
Diurnal Raptors	4	5	4
Nocturnal Raptors	5	1	1
Passerines	6	757*	37
Other Landbirds	7	39	7
Total		**820**	**52**

*Seven unidentified passerines were observed (Passerines)

SOCI observed during the fall migratory point count surveys include American Robin, Black-backed Woodpecker, Boreal Chickadee, Cooper's Hawk (*Accipiter cooperii*), Downy Woodpecker, Evening Grosbeak, Gray Jay, Hairy Woodpecker, Nashville Warbler, Northern Goshawk, Northern Parula, Pine Grosbeak, Pine Siskin, Red Crossbill, Rusty Blackbird, and Spruce Grouse.

A total of 15 species, comprising 92 individual birds were observed during fall migration diurnal watch surveys (Table 7.64; Tables 17/18, Appendix L). The 13 60-minute diurnal watch surveys were conducted on September 28 and October 4, 12, 18 and 23, 2022, from elevated locations covering a wide range of habitats within the Study Area (Drawing 7.25). American Goldfinch (*Carduelis tristis*), Bald Eagle, Common Raven, and Red-tailed Hawk (*Buteo jamaicensis*) were the most abundantly observed species. Migrant passerines accounted for 57.6% of the individual birds, and 66.7% of the species observed.

Table 7.64: Total Observations by Bird Group – 2022 Fall Migration Diurnal Watch Surveys

Bird Group	Group #	# Individuals	# Species
Waterfowl	1	0	0
Shorebirds	2	0	0
Other Waterbirds	3	0	0
Diurnal Raptors	4	38*	5
Nocturnal Raptors	5	0	0
Passerines	6	53**	10
Other Landbirds	7	0	0
Total		**92*** **	**15**

*Three raptor observations could not be identified to the species level (included with Diurnal Raptors total)
**Eleven passerine observations could not be identified to the species level (Passerines)
***One large bird observed could not be identified

SOCI observed during the fall migratory diurnal watch surveys include American Kestrel, Evening Grosbeak, and Gray Jay.

No high-flying, large migratory flocks were observed during diurnal watch surveys. Most observations consisted of passerine species flying in small groups just above the tree line. Observations of raptors mostly consisted of individual birds.

Table 19, Appendix L, includes all SAR observed throughout field surveys. SAR abundance was observed to be low, with the exception of nocturnal survey results, while distribution was observed to be stochastic (Drawing 7.26).

7.4.5.8 Habitat Modelling Results

Following a review of desktop resources and the completion of field assessments, a habitat model for SAR encountered during breeding season field surveys was constructed based on their respective breeding habitat requirements, as described above.

- Canada Warbler
- Chimney Swift
- Common Nighthawk
- Eastern Wood-Pewee
- Evening Grosbeak
- Olive-sided Flycatcher

The results of the modelling are shown in Drawings 7.27A-7.27F.

7.4.5.9 Remote Sensing Results

Avian Radar Assessment

Data collected by the ARS for spring and fall 2022 radar monitoring campaigns were analyzed to provide the number of BTs by date, and by height bin (Tables 20/21, Appendix L).

The radar was located in an open area to the north of Indian Lake (Drawing 7.28).

The ARS identified 23,189 BTs during the spring 2022 monitoring campaign. Most of these BTs were detected on May 5 (number of biological targets [nBTs] = 6,767) and May 17 (nBTs = 9,026). No BTs were detected prior to May 5, and smaller numbers of BTs were detected until the end of the spring 2022 monitoring program on May 31, 2022 (Table 20, Appendix L).

The data indicates that avian migration activity was highest in early and mid-May 2022, and dropped later in the season, though persists into at least late-May.

During the spring 2022 monitoring campaign, most BTs were detected at heights between 250 m and 3000 m. The largest number of BTs were detected between 500 m and 1000 m (nBTs = 6,103) and 1000 m and 1500 m (nBTs = 7,792) (Table 20, Appendix L).

The ARS identified 104,075 BTs in the fall 2022 monitoring campaign. The highest number of BTs were detected on August 9 (nBTs = 97,647). Low and moderate numbers of BTs were detected between July 30 and August 8, 2022. No BTs were detected after August 9 (Table 21, Appendix L).

Similar to the 2022 spring monitoring campaign, most targets detected during the 2022 fall monitoring campaign were between the heights of 500 m and 3000 m. The largest number of BTs were detected between 500 m and 1000 m (nBTs = 37,945) and 1000 m and 1500 m (nBTs = 37,261) (Table 21, Appendix L).

Both spring and fall 2022 results suggest that avian migration activity occurred stochastically throughout (and possibly before/after) the monitoring periods. During both monitoring periods, large migration events occur where a significant number of BTs are detected in comparison to other days.

The ARS detected significantly more BTs in fall 2022 than spring 2022. While most BTs were observed during a few specific migration events, it is expected that the number of days where monitoring took place also contributes to the variance in total BTs detected. Only 37 days were monitored during the spring 2022 monitoring campaign, while 129 days were monitored during the fall 2022 campaign.

Overall, the daily total of BTs detected were highly variable during both monitoring campaigns, indicating that migratory bird activity is somewhat stochastic during both the spring and fall migration seasons. This is consistent with the findings of a large-scale avian radar study conducted in the continental United States, which determined that most migratory bird movements occur on just 10% of a migration season's nights (Horton et al., 2021).

Effect of Weather on Bird Migration

The stochastic nature of migratory bird activity is likely attributable in large part, to weather, as it is well understood that weather and atmospheric conditions influence bird migration activity

(Richardson, 1990), especially wind speed and direction (Liechti & Bruderer, 1998). Conditions when tailwinds assist the migration objective are often exploited by migrating birds to travel farther with less energy (Liechti, and Bruderer 1998).

Most birds in the region migrate south in the fall from breeding grounds in northern North America, to wintering grounds in Central and South America. Likewise, in spring, most species make the reverse journey, moving northward. The Nova Scotia peninsula extends along a southwest to northeast axis, and birds in the province often migrate along this axis, following the Atlantic coast. As such, birds migrating in Nova Scotia during the spring likely also proceed in an easterly direction in addition to north. Likewise in the fall, migrating birds may move to the west and south as they head to southerly wintering grounds.

Figure 7.5 shows that all BTs in spring 2022 were detected when the winds were from the north. This result is unexpected, given the expected movement of birds in a northerly direction during the spring migration period.

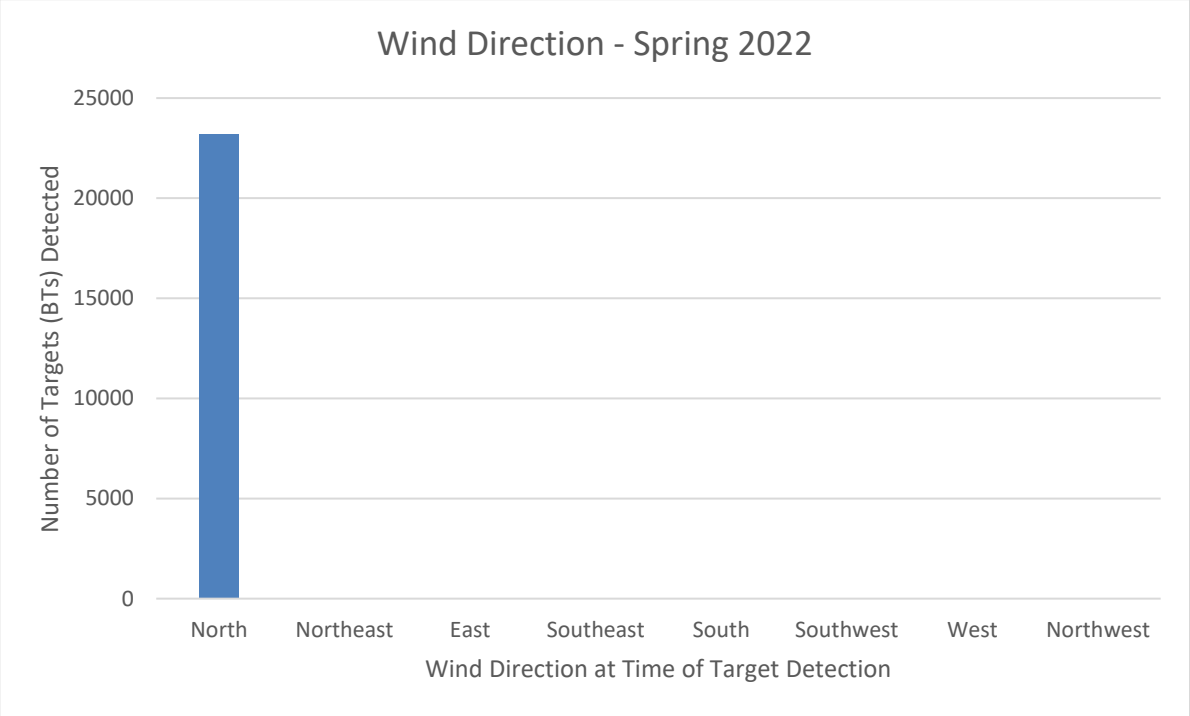

Figure 7.5: Wind Direction by number of BTs Detected, Spring 2022

Similarly, the largest proportion of BT detections in fall 2022 were associated with winds from the north (37.6%) and northwest (7.0%). However, southerly (22.0%) and westerly (28.2%) were also present for a significant number of BT detections (Figure 7.6). Those northerly winds align with the expectation that winds from a northerly direction would support birds migrating to the south to breeding grounds, while the southerly and westerly winds are unexpected.

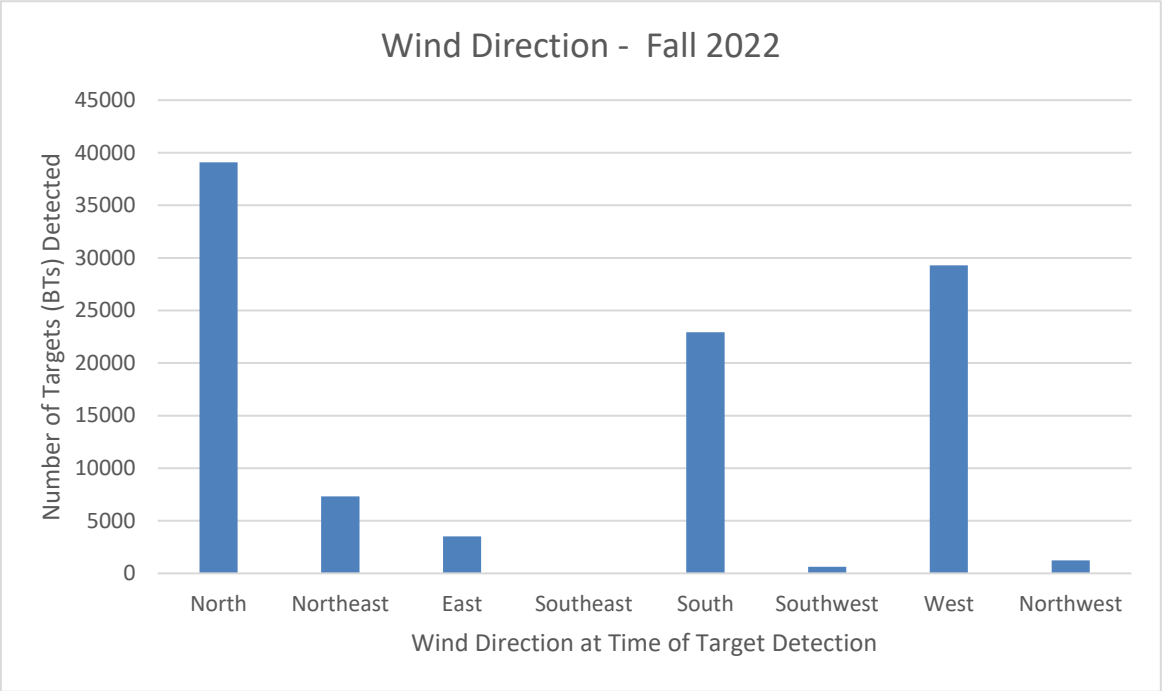

Figure 7.6: Wind Direction by number of BTs Detected, Fall 2022

These findings are partially consistent with the findings of other studies that examined the effects of weather and atmospheric conditions on bird, but it would appear that other factors are associated with the timing of migratory movements over the Study area.

The weather and tide records for the area during the monitoring campaigns are provided as Tables 30/31 in Appendix L.

Determining Migratory Bird Density

The Halo 20+ radar emits a beam that is angled 12.5° upward and downward from the radar's antenna. As the radar beam extends outwards, the volume of airspace that the radar scans increases with range. Therefore, the number of BTs detected by the ARS generally increases with range, until such a point that the radar becomes limited by range and the number of BTs detected drops.

To correct the distortions in BT detection counts at different ranges, it is necessary to correct the airspace volume scanned by the radar at each height bin. Based on the geometry of the radar's beam angle, the volume of airspace scanned in each of the height bins was determined using CAD software. These volumes are shown for each height bin in Table 7.65 and 7.66 along with the number of BTs detected in each height bin, and the target density (i.e., the number of targets detected per cubic kilometre of airspace) for both monitoring periods. Birds per km^3 has been used as a metric of bird migration in avifauna for other studies (Farnsworth 2013). Target density is representative of, and likely proportional to, the migratory bird activity in the airspace above the Study Area for the cumulative monitoring period (in this case, for the spring and fall 2022 avian radar monitoring campaigns).

Table 7.65: Target Density– Spring 2022

Height Bin (m)	Airspace Scanned (km^3)	Number of Targets (BTs) Detected	Target Density (BT/km^3)
0-25	0.1015	0	0.0
25-50	0.1016	33	324.8
50-100	0.2036	59	289.8
100-150	0.2043	56	274.1
150-200	0.2052	83	404.5
200-250	0.2063	135	654.4
250-500	1.052	1285	1221.5
500-1000	2.226	6103	2741.7
1000-1500	2.337	7792	3334.2
1500-2000	2.426	4852	2000.0
2000-3000	3.774	2791	739.5
Total	**12.8375**	**23189**	**1806.3**

Table 7.66: Target Density – Fall 2022

Height Bin (m)	Airspace Scanned (km^3)	Number of Targets (BTs) Detected	Target Density (BT/km^3)
0-25	0.1015	0	0
25-50	0.1016	0	0
50-100	0.2036	0	0
100-150	0.2043	0	0
150-200	0.2052	0	0
200-250	0.2063	3446	16703.8
250-500	1.052	10286	9777.6
500-1000	2.226	37945	17046.3
1000-1500	2.337	37261	15943.9
1500-2000	2.426	15137	6239.5
2000-3000	3.774	0	0
Total	**12.8375**	**104075**	**8107.1**

The number of BTs detected by the ARS was generally higher at higher ranges, where the radar scans a greater volume of airspace, before dropping to ranges where radar signal decay becomes limiting.

The ARS detected the most targets in the 1000 m to 1500 m height bin during the 2022 spring monitoring campaign. This peak is associated with the large migration events on May 5 and 17. Approximately 33.6% of BTs (nBTs = 7792, Table 22, Appendix L) were in this height bin. The target density for this range bin shows slightly less variation than target counts (Figure 7.7).

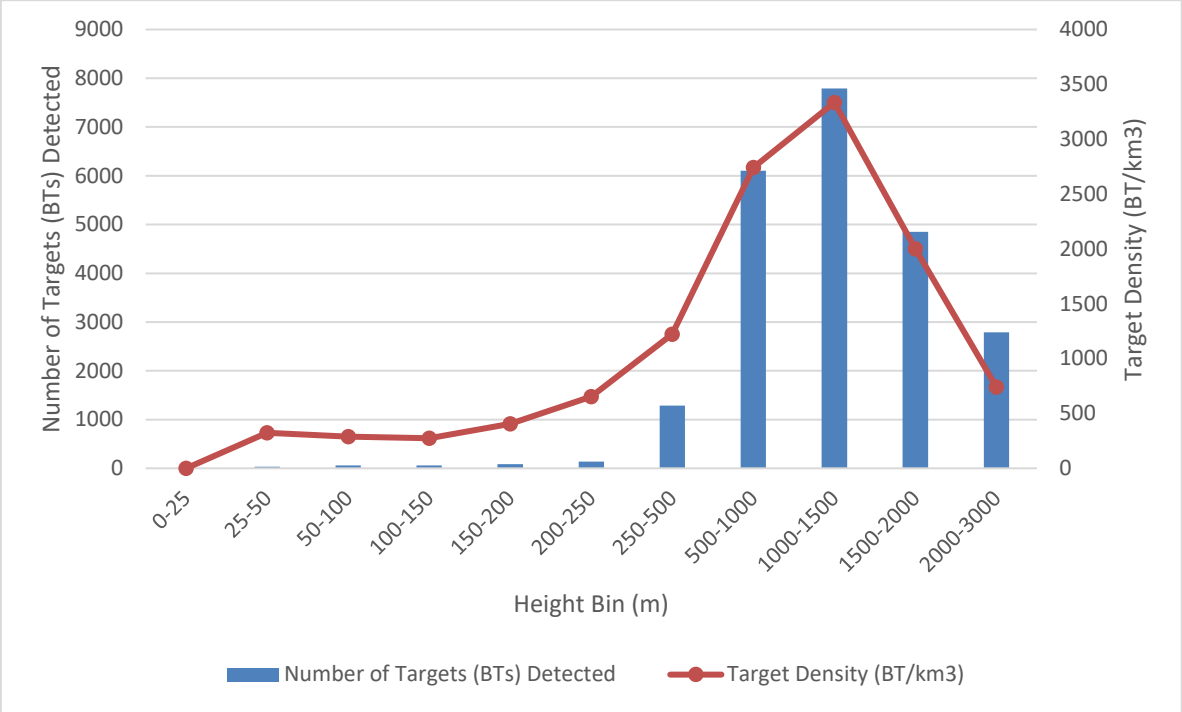

Figure 7.7: Targets Detected and Target Density – Spring 2022

The diagonal radar orientation provided reliable resolution on the height at which BTs were detected during the monitoring campaigns. The number of targets as well as the target density detected by the ARS increases with height, until the radar signal decay becomes a limiting factor in detecting targets at range (Figures 7.7 and 7.8).

The ARS detected the most targets in the 500 m to 1000 m height bin during the 2022 fall monitoring campaign. This peak is associated with the large migration event on August 9, 2022 (nBTs = 35,482). Approximately 36.5% of BTs (nBTs = 37,945) (Table 22, Appendix L) were in this height bin. The target density for this range bin shows less variation than target counts, with density plateauing between the 200 m to 1500 m height bins (Figure 7.9).

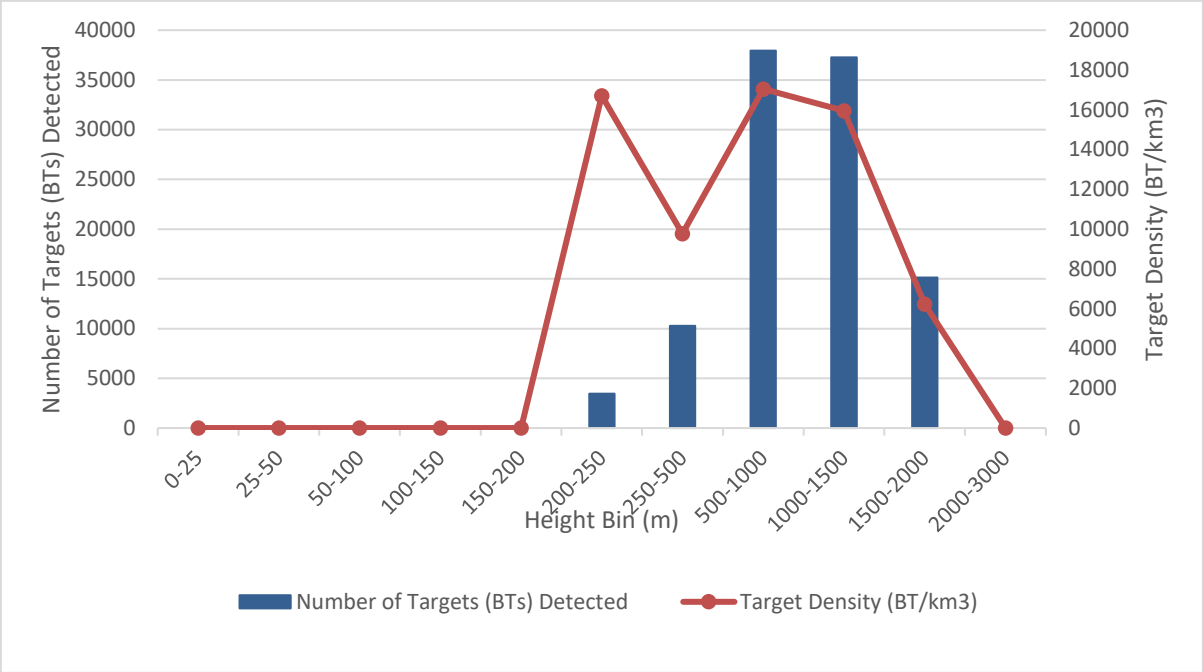

Figure 7.8: Targets Detected and Target Density- Fall 2022

Across both monitoring seasons, target density was observed to be highest above 200 m, with substantially lower density below the 200 m height bins. This indicates that migratory bird activity is somewhat even in the height bins above the airspace that the proposed turbines would occupy.

Avian interaction model

The level of interaction between migratory birds and the Project turbines can be estimated using data collected from the radar monitoring in spring and fall 2022. Interactions may include sensory disturbance to birds passing near the turbines, a requirement for birds to maneuver around the turbines (thus forcing migratory birds to expend energy), bird collisions with the turbine components, or blade strikes (for operating turbines).

The Migratory Bird Interaction Index (MBII [$\boldsymbol{M}$]) is an estimate of the level of risk that aerial infrastructure for a Project pose to migratory birds. This index is calculated using the following expression.

Equation 1:

$$\boldsymbol{M = D \div I}$$

Where $\boldsymbol{D}$ is the migratory bird density, and $\boldsymbol{I}$ is the volume of airspace that the infrastructure being assessed would occupy.

To represent the volume of airspace occupied by the infrastructure (I), the volume of airspace where avifauna would interact with the turbines was estimated using CAD software that is based

on morphology of the proposed turbines. An over-estimate of the volume of the turbine's physical components was used to represent the larger volume of airspace where the turbines would influence avifauna. Table 7.67 shows the turbine dimensions for this Project and the parameters used to calculate the interaction airspace volume for the turbine model.

Table 7.67: Turbine – Avifauna Interaction Volume Calculation Information

Turbine Model Information		
Component	**Description**	
Turbine Model	Unspecified Turbine – Up to 6.2 MW	
Number of Turbines	16	
Maximum Hub Height	125 m	
Total Maximum Height	206.5 m	
Maximum Rotor Diameter	163 m	
Blade Length	81.5 m	
Rotor Sweep Area	20,867 m^2	
Turbine – Avifauna Interaction Volume Calculations		
Interaction Airspace Model Component	**Dimensions**	**Airspace Interaction Volume**
Tower	15m diameter cylinder, 125m tall	22,089 m^3
Nacelle	7.5*7.5*24M cuboid	1,350 m^3
Rotor (Operational)	163m diameter cylinder, 7.5m thick	156,504 m^3
Rotor (Curtailed)	Three 7.5*7.5*81.5m cuboids (triangular)	13,753 m^3
Total airspace volume (Operational Turbine)		179,943 m^3

The ARS data was used to determine target density for each day of the monitoring program (calculated from values in Tables 26 to 29, Appendix L) and the interaction airspace volume (determined in Table 7.67) was used to calculate and project the MBII (Figures 7.9 and 7.10) over the spring and fall 2022 monitoring periods.

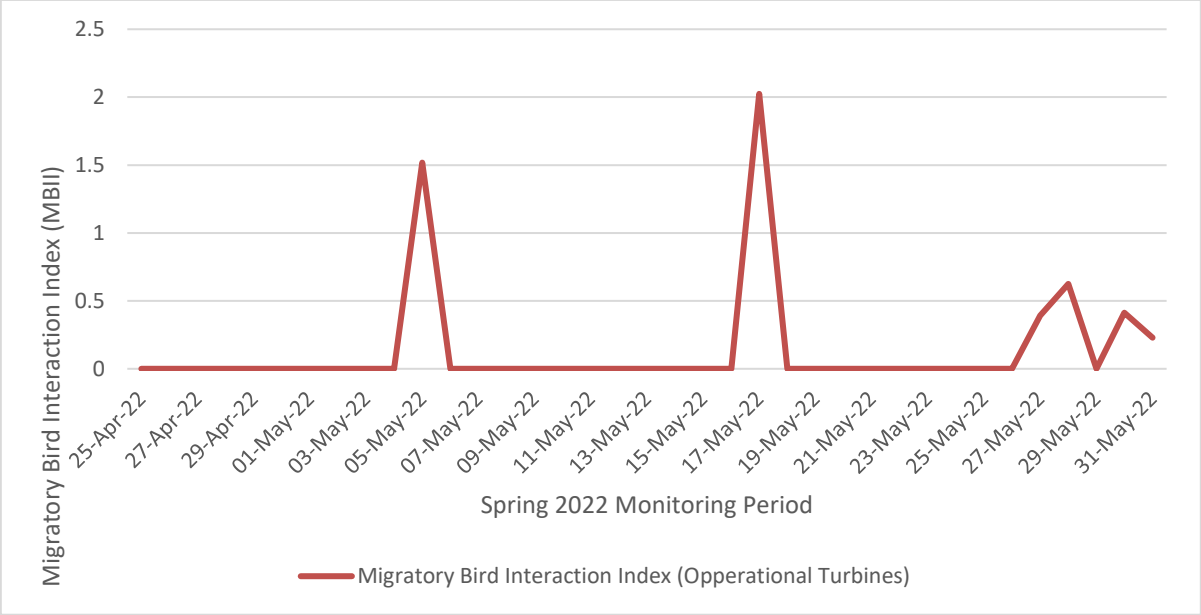

Figure 7.9: Migratory Bird Interaction Index – Projected Daily for the Spring 2022 Monitoring Period

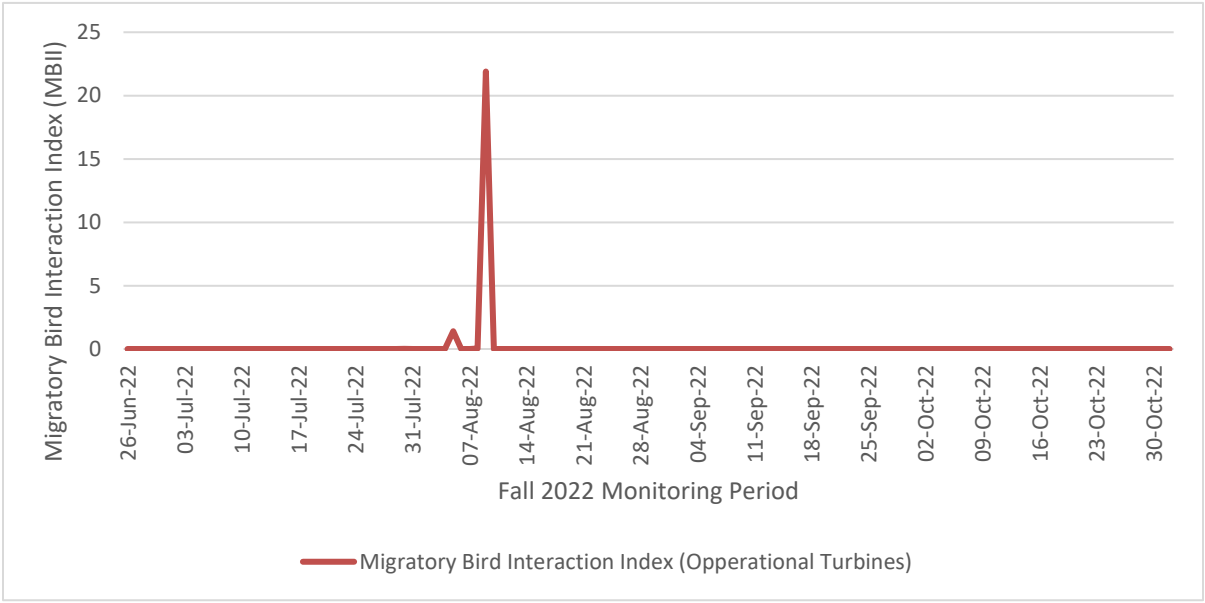

Figure 7.10: Migratory Bird Interaction Index – Projected Daily for the Fall 2022 Monitoring Period

Figure 7.9 shows the MBII value spiked for May 5 and 17, 2022, corresponding to the large migratory movement on those dates. The same kind of spike is seen for August 8 during the fall 2022 monitoring program, albeit at a much higher level that the events detected in the spring. The MBII model represents a basic estimate of the level of interaction between migratory birds and the wind turbines infrastructure. The MBII value calculated for any given day is not representative of the number of interactions that would have occurred had the proposed Project been built and operating on that date. Rather, this MBII value is useful in comparing anticipated

interaction levels between dates, to expose the frequency and intensity of migratory bird interaction events.

Acoustic Monitoring Results

The results of the spring analysis demonstrate the abundance of bird activity within the Study Area. Data clarity in the early spring is poor, and this is likely a result of several factors, including noise from Spring peepers (*Pseudacris crucifer*), a species of frog that creates a loud noise that interferes with avian acoustic monitoring from late Match until mid-June when their breeding period is over.

The bulk of the acoustic detections occurred in mid-May, with the greatest number of NFCs observed on May 14. The radar data observed its largest migration event on May 17 (Figure 7.11). NFCs were observed on May 17, identified as likely Sparrows (exact speciation is difficult due to data quality and similarities to other NFCs) indicating that migration did occur on this date. However, there were no NFCs found during the time of the migration to confirm the avian species captured through the radar analysis.

Possible reasons for an inexact temporal alignment between radar and acoustic observations are likely due to several factors, including detection range and weather conditions. A radar system has a much greater detection range than an acoustic monitor, which can allow it to observe more migrants as they fly over the study area. Additionally, certain weather conditions are more favorable for acoustic sampling than radar. For example, low level clouds, or light rain conditions can force migratory birds closer to the ground. Migrants closer to the ground are more readily heard in acoustic sampling. Furthermore, migrants navigating through conditions of reduced visibility may create more calls to aid in their migration. These same weather conditions can prove difficult for a radar which is unreliable in detecting birds against significant cloud cover.

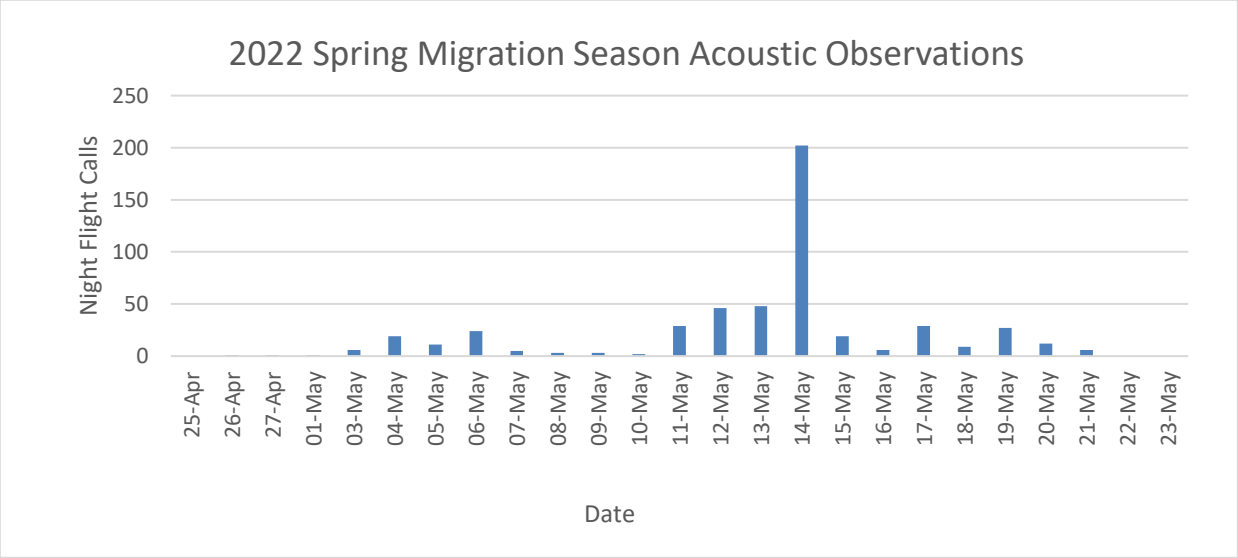

Figure 7.11: Avian Activity by Date During the 2022 Spring Migration Season, Compiling NFCs only.

The acoustic monitoring identified many NFCs throughout the fall with a peak in early October, Figure 7.12. Data clarity at the beginning of the fall migration period is poor and is likely due to several factors including the presence of crickets and katydids including *Gryllus pennsylvanicus* and *Scudderia pistillata* which create loud noises that interfere with acoustic monitoring. There was no overlap between radar detections and acoustic observations in the fall migratory season.

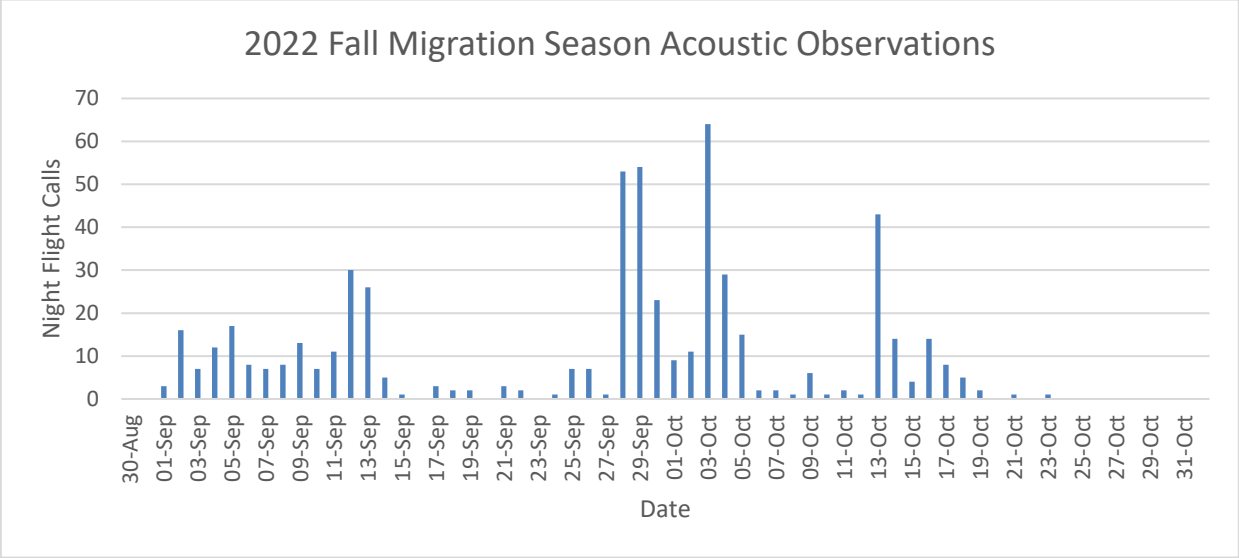

Figure 7.12: Avian Activity by Date During the 2022 Fall Migration Season, Compiling NFCs only.

This analysis gives limited aid to the radar assessment in quantifying the movement and composition of migratory avian species throughout the Study Area. Several factors which make the pairing of radar and acoustic monitoring difficult include the detection range of the acoustic monitor compared to that of the radar system, and their performances in different weather conditions. In addition, the presence of Spring peepers during the spring migration season and crickets and katydids during the fall migration season made the results difficult to parse given that these species are loud and occupy a similar frequency to many avian NFCs.

7.4.5.10 Effects Assessment

Project-Avifauna Interactions

Project activities, primarily those that involve earth moving or vegetation removal, or interactions with avifauna in the airspace have the potential to impact avifauna (Table 7.68). These activities could result in habitat removal, reductions in food availability, and direct bird-turbine interactions. Other Project related activities, including during construction and operation, may impact avifauna behaviors, such as increased traffic and noise.

Table 7.68: Potential Project-Avifauna Interactions

Valued Component	Site Preparation and Construction										Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Avifauna		X		X	X	X			X	X		X	X		X

Assessment Boundaries

For the purposes of this assessment, the LAA for avifauna includes the Assessment Area as well as the airspace that is directly surrounding the turbines, as described above in the MBII. The RAA for avifauna includes the surrounding landscape, and the airspace above these areas, up to approximately 3,000 m (Drawing 7.29).

Assessment Criteria

Assessment criteria provided in Section 4.6 also apply for avifauna. The VC-specific definition for magnitude is as follows:

- Negligible – no loss of important avifauna habitat (e.g., breeding bird habitat) and no impacts to migratory avifauna are expected.
- Low – small loss of important habitat supporting avifauna and/or impacts to migratory avifauna are expected to be low.
- Moderate – moderate loss of important avifauna habitat and/or moderate impacts to migratory avifauna.
- High – high loss of important avifauna habitat and/or high impact to migratory that would be sufficient to impact species on a population scale.

Effects

Habitat Loss and Fragmentation

Across Canada, forest harvesting, and silviculture are leading causes of habitat loss for forest-dependent avian species, with mining and energy exploration also contributing to habitat loss, as well as to the disruption of individuals and their migratory and breeding behaviors (ECCC, 2016b).

The footprint of the Project, particularly the area that will impact intact habitat, is relatively small compared to other developments in the natural resource sector. Only 11.3 km of new road will be

constructed within the Study Area, and upgrades to pre-existing roads will be removing small areas of habitat in an area that has already been disturbed. In addition, 8 of the 16 turbines are sited in areas that have been previously disturbed through forestry activities or otherwise, minimizing impacts to breeding habitats for birds. The Project design also prioritized the avoidance of old-growth forests and has minimized loss of wetland habitat. Habitat loss and fragmentation effects on avifauna are therefore expected to be low.

Additional evaluation of habitat loss and availability was completed for SAR observed within the Study Area during field surveys.

Canada Warblers were observed at a pair of locations throughout the Legacy Study Area, with both individuals observed outside the Assessment Area. Canada Warbler breeding requirements include wetland types where a closed canopy and complex shrub layer are present (ECCC, 2016a). The Project design has prioritized the use of existing roads and minimized alterations to wetlands, with no wetland alterations being anticipated for the construction of turbine pads. Furthermore, Canada Warbler habitat modelling results indicates that the Study Area contains ample suitable breeding habitat for this species (Drawing 7.27A) and impacts to breeding habitat are expected to be low.

Chimney Swifts were observed during both nocturnal and breeding point count surveys, though no confirmed breeding behavior was observed during those surveys. The preferred breeding habitat for this species includes large/mature tree cavities and more urban areas where chimneys and other tall infrastructure are present (ECCC, 2022d). Habitat modelling results indicate limited availability of suitable breeding habitat within the Study Area, likely due to the removal of most mature hardwood trees by past forestry activities. Therefore, the Project's impact on breeding habitat availability for this species (Drawing 7.27B) is expected to be low.

Common Nighthawks were observed in abundance during nocturnal field surveys, primarily foraging and passing overhead. While these observations are consistent with potential breeding behaviours, no confirmed breeding evidence was observed. Modelled habitat suggests there is ample breeding habitat available for these birds, including along roads (both active and unused) throughout the Study Area (Drawing 7.27C). In addition, the construction of turbine pads and new spur road may create additional suitable breeding habitat for Common Nighthawks.

Eastern-wood-Pewees prefer intermediate to mature deciduous or mixed wood forests, of which there are few within the Study Area (Section 7.4.1) (NSNRR, 2022b). Given the apparent limitations of breeding habitat availability as shown in Drawing 7.27D, the lone Eastern Wood-Pewee observed during breeding season field surveys is expected to have been passing through the site in search of adequate breeding partners. No confirmation of breeding evidence was observed and impacts to breeding habitats are expected to be low.

Evening Grosbeaks were observed twice within the Assessment Area during breeding bird surverys, with both instances (3 total individuals) involving the birds passing overhead. No breeding evidence was observed in either instance. Habitat modelling suggests there is limited

suitable breeding habitat within the Study Area, given the lack of appropriate mature and old-growth softwood forest (ECCC, 2022b), suggesting that impacts due to Project activities are expected to be low.

Olive-sided Flycatchers prefer breeding habitats in open coniferous and mixed wood forests, while feeding on insects in open areas, often near swamps (ECCC, 2016b). Breeding habitats appear to be somewhat limited within the Study Area (Drawing 7.27F), though this species is known to inhabit a variety of habitats where preferred habitat is less available. None of the Olive-sided Flycatchers observed during breeding season field surveys were within the Assessment Area, nor did any of them display any confirmed signs of breeding behaviour. The Project has prioritized the use of existing roads and previously disturbed areas in developing the Project Area, which minimizes impacts to preferred habitats for both breeding and foraging, including wetlands.

Road Traffic

Many species of avifauna are known to use the roadways within the Study Area, as evidenced by field survey results (Tables 1 to 24, Appendix L). An increase in road traffic will increase chances of mortality to those avifauna using the roadways, especially Ruffed Grouse and similar species, as they are known to use roadways for travel and nesting. Most roads within the Study Area are currently used for recreation by off-highway vehicle users and forestry activities. Outside of the construction phase, the Project will only require technicians to access the site to perform regular maintenance/equipment checks. Considering the pre-existing traffic load and the minimal traffic to be associated with the Project, road traffic is expected to have a negligible to low effect on avifauna in the LAA.

Bird Strikes

Bird strikes are a primary concern when considering the interactions of avifauna with the Project, as turbine blades spin at high speeds through the airspace frequented by a variety of species at all different altitudes within the rotor swept area. Bird strikes include instances when birds are struck by the rotating turbine blades, or birds collide with the turbine tower or nacelle structures, which can cause injury or mortality to birds.

The ARS data from the spring and fall 2022 monitoring campaign indicates that the density of migratory avifauna was largely even above the lower height bins that the proposed turbines would occupy, and dropped with height below 200 m. This indicates that there would likely be some level of interaction between migratory avifauna and the Project during operation; however most of the migratory movement occurs above the heights expected to be most impacted.

Observed migration events were stochastic throughout the migration seasons, and are likely influenced by weather, particularly wind direction. This is consistent with the findings of a large-scale avian radar study conducted in the continental United States, which determined that most migratory bird movements occur on just 10% of a migration season’s nights (Horton et al., 2021). Interactions with the turbine infrastructure would vary over time, with variations in migratory bird density. Bird strikes and avian mortalities are likely to be proportional to migratory bird activity.

MBII values (Figures 7.10 and 7.11) are not intended for use as a predictor of avian mortality, as the relationship between it and avian mortality is not yet known.

Other studies that examined interactions between wind turbines and avifauna have determined the level of avian mortality caused by wind turbines to be low (Zimmerling et al., 2013), including several post-construction avian mortality monitoring programs conducted by Strum at operating wind power projects in Nova Scotia within the past decade (i.e., approximately 1 detectable bird mortality[4] per wind turbine per year on average). The MBII model projection indicates that interactions would have occurred on just a few nights in each of spring and fall 2022 indicating that the level of avian mortality caused by the Project would be low for most the Project's operation, and mortality events would be limited to a few events during the migration periods.

Migration Disruption

The Project could impact bird migration directly (e.g., turbine strike), or indirectly (e.g., sensory disturbance or requiring excess calorie expenditure that would compromise a bird's ability to migrate).

The MBII model shows that interactions between birds and the turbines would be low, with infrequent spikes during migration events. Turbine lighting could cause sensory disturbances that disrupt migration activity, as migratory birds are attracted to sources of light at night, especially in low visibility conditions. Operating turbines can also cause sensory disturbances, causing birds to divert course, and possibly spend excess caloric energy, thus compromising migration success.

Lighting associated with the Project will be minimal, and the turbines will be un-lit at night (apart from a red navigation hazard light mounted on the turbine's nacelle). As such, lighting is not expected to impact bird migration. Other research that addresses the impacts of operating wind turbines on migratory bird movements has determined that the machines do not significantly alter migratory bird movements (d'Entremont et al., 2017) suggesting that impacts to migration would be minimal.

Mitigation Measures

Adaptive management of potential effects will be addressed through the development and implementation of an EPP which will include mitigation and monitoring for avian species. The primary mitigation for avifauna is avoidance in the siting of infrastructure, including:

- Avoidance of topographic funnels, such as within lake or river valleys, for turbine placement to reduce the likelihood of interactions with concentrated bird movements.
- Avoidance, to the extent possible, of important bird habitats, such as wetlands, waterbodies, old-growth forest, etc. to reduce the impact of habitat changes. This includes siting Project infrastructure within areas with existing disturbances, such as existing roads and cutover areas of forest.

[4] Detectable bird mortalities are determined during post-construction avian mortality monitoring programs by searching for bird carcasses under operating wind turbines using human searchers. This technique is subject to error from scavenger removal and searcher efficiency, so the actual bird mortality levels are likely higher than the detectable levels.

Mitigations to reduce effects on avifauna include:

- Adhere to ECCC guidelines on clearing windows for nesting migratory birds. Vegetation clearing activities will be conducted outside of the nesting period that is generally from April 1 to September 30 each year. Timing of clearing activities are generally dependent on seasonal conditions.
- Establish speed limits within the Project Area for construction vehicles to mitigate the effect of vehicle-avifauna collisions.
- Incorporate a lighting plan for construction-related activities into the EPP.
- Maintain good housekeeping practices during construction to avoid indirectly feeding birds, and potentially attracting nuisance wildlife.
- Develop a spill response plan, and an emergency response plan within the EPP to mitigate the impacts of spills, hazardous substances, and other emergencies.
- Develop a fire response plan in accordance with provincial standards.
- Revegetate disturbed areas, as appropriate.
- Install avian deflectors on powerlines, including any powerline spans, or areas of line that will be identified in the EPP as requiring mitigation based on monitoring results.
- Minimize lighting, to the extent possible.
- Develop a site reclamation plan in accordance with engineering standards and in consultation with NSECC and NSNRR.

Monitoring

A site-specific post-construction Wildlife Management Plan will be developed in consultation with NSECC, NSNRR, and all other relevant parties. The management plan will inform monitoring activities that will take place to ensure continued protection of known SOCI in the LAA and RAA. Some preliminary monitoring activities related to avifauna may include:

- Conduct post-construction avian mortality monitoring to assess mortality levels caused by turbine operations.
- Conduct the second year of avian radar monitoring (in progress, will be completed in October 2023) and provide results to CWS.
- Monitor changes to habitat within the Study Area and greater RAA that may occur as an indirect result of the Project.
- Conduct breeding bird surveys post-construction to establish potential impacts to the breeding bird community, while also addressing changes in population dynamics, with special attention to SAR.

Conclusion

While effects to avifauna species differ, the effects considered to be of greatest concern include habitat loss, migratory disruption, and bird strikes. Based on this assessment and through the implementation of proposed mitigation and monitoring activities, effects to avifauna are expected to be of low magnitude, within the LAA, of medium duration, intermittent, reversible, and not significant.

8.0 SOCIO-ECONOMIC ENVIRONMENT

8.1 Economy

8.1.1 Existing Environment

The Project is located in Pictou and Antigonish counties, near the communities of James River (7.3 km), Beaver Meadow (8.2 km), Marshy Hope (6.4 km), Kenzieville (9.1 km), and Barney's River Station (9.2 km). The counties are divided into census subdivisions, including the towns of Antigonish and New Glasgow. The Project is situated entirely within the Pictou Subdivision C and Antigonish Subdivision A.

Population statistics for the 2016 and 2021 census subdivisions for the Province of Nova Scotia as well as the census subdivisions are summarized in Table 8.1.

Table 8.1: Population Characteristics

Population Statistics	Nova Scotia	Antigonish, Subd. A	Pictou, Subd. C
Population in 2021	969,383	8,963	8,385
Population in 2016	923,598	8,278	8,443
Population change from 2016-2021 (%)	5.0	8.3	-0.7
Total private dwellings in 2021	476,007	4,478	4,470
Land area (km^2)	52,824.71	926.43	1,254.87
Population density (per km^2)	18.4	9.7	6.7

Source: Statistics Canada, 2023

The age distribution in Pictou Subdivision C reveals a median age of 52.0 years, which is significantly higher than the provincial median age (45.6) and Antigonish Subdivision A (47.2) (Statistics Canada, 2023). An overview of age distribution for 2021 is outlined in Table 8.2.

Table 8.2: Age Distribution in the Guysborough Municipal District and Nova Scotia

Age Statistics	Nova Scotia	Antigonish, Subd. A	Pictou, Subd. C
0 - 14 years	136,710 (14.1%)	1,430 (16.0%)	1,140 (13.6%)
15 - 64 years	617,345 (63.7%)	5,260 (58.7%)	5,035 (60.0%)
65+ years	215,325 (22.2%)	2,270 (25.3%)	2,205 (26.3%)
Total Population	**969380 (100%)**	**8,965 (100%)**	**8,385 (100%)**

Source: Statistics Canada, 2023

*Note that due to rounding, total percentage may be ± 100%.

Average housing costs and average individual incomes for the census subdivisions compared to the provincial and federal averages are shown in Table 8.3.

Table 8.3: Housing Costs and Average Individual Income

Jurisdictions	Average Dwelling Value in 2020	Average Total Income in 2020
Antigonish, Subd. A	$290,400	$51,450
Pictou, Subd. C	$219,200	$46,520
Province of Nova Scotia	$295,600	$47,480
Canada	$618,500	$54,450

Source: Statistics Canada, 2023

The Barney's River Fire Hall is located approximately 8.5 km northwest of the Study Area on Highway 104. The Antigonish Fire Department is approximately 19 km northeast of the Study Area, on Main Street in Antigonish.

Health and emergency services exist in the area and are accessible to Project workers if the need should arise at the St. Martha's Regional Hospital on Bay Street in Antigonish, approximately 20 km northeast of the Study Area. In the opposite direction, Health and Emergency services are also available in New Glasgow at the Aberdeen Hospital on East River Road, approximately 34 km west of the Study Area.
Statistics for Antigonish Subdivision A indicate that the unemployment rate in 2021 was 9.1% and 13.9% for Pictou Subdivision C, both being near the provincial rate of 12.7% (Statistics Canada, 2023). The Antigonish Subdivision A employment rate was 54.4% and 46.7% for Pictou Subdivision C, which are both near the provincial rate of 51.9% (Statistics Canada, 2023).

A breakdown of the labour force within both Municipal Districts is provided in Table 8.4. The highest proportion of workers fall into the "Healthcare and Social Assistance" category (19.0 and 15.6%, respectively). Other significant industries include educational services, construction, and retail trade (Statistics Canada 2023).

Table 8.4: Top Industries for the Employed Labour Force, Antigonish Subdivision A and Pictou Subdivision C

Industry	Nova Scotia	Antigonish, Subd. A	Pictou, Subd. C
Total employed labour force 15 years +	487,260	4,505	3,890
Construction	35,720 (7.3%)	410 (9.1%)	500 (12.9%)
Retail trade	58,985 (12.1%)	565 (12.5%)	565 (14.5%)
Health Care and Social Assistance	70,595 (14.5%)	855 (19.0%)	605 (15.6%)
Manufacturing	31,210 (7.3%)	170 (3.8%)	385 (9.9%)
Educational Services	38,425 (7.9%)	675 (15.0%)	270 (6.9%)

Source: Statistics Canada, 2023

There are several communities within a 10 km radius of the Project that offer a range of business services. A review of some of the businesses located near the Project is provided in Table 8.5.

Table 8.5: Local Businesses and Proximity to Study Area

Business	Distance and Direction to the Project*
Robertson's Garage	8.6 km northwest, on Robertson Road, Barney's River
Nickerson Auto Salvage	7.8 km northeast, on John Munroe Road, Marshy Hope
James River Quarry	8.3 km northeast, on Tower Road, James River
DeWolfe Autobody	9.5 km northeast, on Highway 4, James River
Precious Pet Cemetery	5.2 km northeast, on Bouchard Road, Beaver Mountain
Riverside International Speedway	6.8 km northeast, on Beaver Meadow Road, Addington Forks
Addington Forks Honey Farm	10 km northeast, on Addington Forks Road, Addington Forks
Keppoch Mountain	7.2 km northeast, on Keppoch Road, Beaver Meadow
MacLean Brothers Woodworking	6.2 km northeast, on Old Beaver Road, Camerons Brook

*All distances measured from centre of the Study Area, using the most direct route.

Aside from the immediate area and associated businesses, the nearby communities are highly dependant on the greater municipal centres of Antigonish and New Glasgow for many of their regular shops and services, including indoor recreation, big-box stores, and significant health care facilities including emergency services and inpatient care. Many residents of the communities surrounding the Project commute daily to either Antigonish or New Glasgow. The vast majority (98%+) of residents in Antigonish Subdivision A and Pictou Subdivision C speak English (Statistics Canada, 2023). All communications throughout the Project, as well as public engagement have been undertaken in English.

8.1.2 Effects Assessment

Project-Economy Interactions

Project activities have the potential to interact with the economy during all phases of the Project (Table 8.6).

Table 8.6: Potential Project-Economy Interactions

Valued Component	Site Preparation and Construction											Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Economy	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Assessment Boundaries

The LAA for economy is both Pictou and Antigonish counties. The RAA for economy includes the entire province.

Assessment Criteria

Assessment criteria provided in Section 4.6 apply to the economy as well. The VC-specific definition for magnitude is as follows:

- Positive – Project is expected to have a positive effect on the economy.
- Negative – Project is expected to have a negative effect on the economy.

Effects

It is estimated that the Project will result in approximately $110 million in investments into the province of Nova Scotia. The Proponent is committed to sharing economic opportunities with the local community throughout the development and lifespan of the Project via the use of local skills and labour where possible, municipal tax revenue, and on-going energy literacy/education. The Project Team has and will continue to engage the community, local business enterprises, municipal staff and leaders, and local businesses to help to identify Project-related opportunities and benefits for the local community.

The Proponent understands the importance of supporting local rural communities. The Project Team is committed to using as many local skills as possible. Potential work includes environmental studies, geotechnical investigation, engineering, land, and snow clearing, surveying, worksite security, road construction and on-going maintenance through construction and post construction, turbine component transportation, turbine foundation construction, turbine installation, collector system construction, and substation construction. Specifically, elements of job creation throughout the lifespan of the Project may include:

- Project Development - During the development phase of the Project, Nova Scotian professionals have and will continue to deliver services in a variety of areas, including civil and electrical engineering, legal, land, environmental, and biological surveys, archaeological, land and community relations, and many others. Dozens of professionals within Nova Scotia will render their services as part of the development of the Project.

- Construction - Though the construction phase of the Project is relatively short (i.e., 18-24 months), it will require significant manpower for realization. Much of the construction employment will come through contracting and subcontracting of Nova Scotia construction firms. This will likely include significant elements of civil and electrical construction. It is estimated that the Project will require up to 150 full-time equivalent positions for Nova Scotians over the development and construction periods.

- Operations and Maintenance - Operational wind projects require long-term operations and maintenance technicians to be located either on-site or within short driving distance of the Project. It is generally anticipated that a team of 3-5 operations and maintenance

technicians can maintain regular operations and maintenance service on approximately 16 turbines. The jobs associated with operations and maintenance are long-term, steady, stable, and well-paying jobs.

- In addition to operations and maintenance of the wind turbines, there will be a variety of wind farm activities that will require on-going resources such as snow removal and road surface maintenance, administrative support, inventory/materials management, scheduling, and coordination of maintenance inspections to accommodate the facility's operation (i.e., power collection system, electrical substation inspections, etc.). To this end, the Proponent has engaged local community members and service providers to identify suitable candidates and/or businesses to support these roles.

In addition to the direct investments that the Project would bring to Nova Scotia's economy, a suite of auxiliary economic benefits can also be expected. Workers that are directly involved with the development would contribute to local economies by redistributing wealth to a variety of goods and services such as hotels, gasoline/service stations, restaurants, and grocery stores (USDE 2008).

As outlined in the *Wind Turbine Facilities Municipal Taxation Act*, SNS 2006, c 22, the Municipality of Pictou County will receive tax revenues per MW on an annual basis and as such, the royalty will annually increase as the Consumer Price Index rises. The Project is expected to enhance the community's economic development by providing tax revenues of approximately $750,000 annually to the Municipality.

A renewable energy project in a community allows residents to gain a better understanding of wind technology and how wind power can help reduce reliance on fossil fuels. Energy literacy is an increasingly important skill in today's economy, and the Project Team is committed to providing energy literacy to the surrounding communities and is available to answer questions and provide a better understanding of local and provincial energy issues.

Mitigation Measures

The economic impact to the LAA and RAA is positive; therefore, no mitigation is proposed.

Monitoring

A specific monitoring program for the economy is not recommended.

Conclusion

The impact on the economy is expected to be positive, extend to the RAA for a medium duration, be continuous and irreversible.

8.2 Land Use and Value

8.2.1 Existing Environment

The Study Area is primarily “Commercial Forest”, privately held by several different landowners. Land use around the Study Area is primarily forested and includes a few blueberry fields to the northeast and a mix of residential and farmlands to the east, south, and northeast along the surrounding roads. As Highway 104 to the north is the primary point of access for people travelling from mainland Nova Scotia to Cape Breton and Newfoundland, there is significant traffic volume that fluctuates with tourism in the summer.

There are several public protected lands and parks in the area (Drawing 7.6), including the Beaver Mountain Provincial Park and Eigg Mountain – James River Wilderness Area to the northeast of the Project. Keppoch Mountain and its associated trails are one of the main points of interest in the area, along with fishing in the Beaver River and the associated lakes within the watershed.

8.2.2 Effects Assessment

Project-Land Use and Value Interactions

Project activities have the potential to interact with land use and value during all phases of the Project (Table 8.7).

Table 8.7: Potential Project-Land Use and Value Interactions

Valued Component	Site Preparation and Construction											Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Land Use and Value	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Assessment Boundaries

The LAA for land use and value includes both Antigonish and Pictou counties. The RAA is not applicable.

Assessment Criteria

The assessment criteria provided in Section 4.6 apply for land use and value as well. The VC-specific definition for magnitude is as follows:

- Negligible – no change in land value expected and surrounding land use can largely continue as is.
- Low – small change in land value expected and/or minor limitations to surrounding land use.
- Moderate – moderate change in land value and/or moderate limitations to surrounding land use.
- High – high change in land value and/or widespread limitation to surrounding land use.

Effects

Due to the nature of wind turbines being tall structures with small footprints, they are highly compatible with other land uses like agriculture, forestry, and ground-based recreation. The forestry activities in the area will not be materially disrupted by the Project, aside from short term traffic disruptions for Project-related infrastructure. As existing land users are primarily industrial in nature, upgraded roads and infrastructure stand to improve access, limit weather disruptions, and lessen impacts of poor roads on their equipment. None of the points of interest noted above are expected to be impacted by the Project.

A recent study mentions that given the traditional energy industry's impacts on conservation in both direct and indirect ways, wind energy can be seen as a complementary land use to conservation and protected areas in a broad way, as wind energy is not a carbon emitter (Wind Europe, 2017). Given the context of Nova Scotia where the traditional energy source has primarily been coal, land use for wind energy can be seen as a positive step.

Potential effects on property value are often a concern of neighbouring residents due largely to anecdotal reports from appraisers of drastic declines in property values following the nearby installation of a wind energy facility (as reviewed in Gulden 2011). Despite these concerns, many rigorous and statistically defensible studies have concluded that wind energy developments have had no significant effect on surrounding property values.

Prior to 2013, the most comprehensive study on the impact of wind farms on property values had been completed by Hoen et al. (2009). This research analyzed data on nearly 7,500 sales of single-family homes situated within 10 miles (16 km) of 24 existing wind farms in the United States. Eight different hedonic pricing models failed to generate statistically significant evidence that property values for houses located within 10 miles (16 km) of wind farms are influenced by the developments. Subsequent research by the same laboratory, but employing further analyses, confirmed these results (Hoen et al., 2011).

Carter (2011) analyzed home transactions in a rural landscape surrounding small (1-4 turbines) wind energy developments, while employing a hedonic model to statistically control for variables affecting all real estate transactions such as square footage, age of home, and school zone. This study concluded that proximity to the wind farms did not impact average selling price of homes; in fact, in one case, homes closer to a wind farm sold for significantly higher than those elsewhere (Carter, 2011).

A study by Hinman (2010) tracked property transactions in communities located close to a 240-turbine wind farm for an eight-year period that spanned pre-development and operation stages. Hinman (2010) found that before project approval, property values in the area decreased. This was attributed to a fear of the unknown effects that the development would have; an effect known as anticipation stigma. However, once the development became operational, property values recovered. This recovery was attributed to a greater understanding of the operational effects of the development. Anticipation stigma, however, was not detected in a similar study in Colorado (Laposa and Mueller 2010), in which it was concluded that the announcement of a large wind energy development did not significantly reduce the selling prices of homes surrounding the proposed development.

Until recently, the primary limitation of previous research on the effects of wind energy facilities on surrounding home values has been that research has been based on relatively small sample sizes (data sets) of relevant home-sale data. The inability to account for the complexity of the various factors which affect property values has also been cited as a limitation to previous studies. In particular, data had been limited for homes located within about a half mile (800 m) of turbines, where impacts would be expected to be the largest: Hinman (2010) (sample size of 11); Carter (2011) (sample size of 41). This is in part because setback requirements generally result in wind facilities being sited in areas with relatively few dwellings, limiting the number of sales transactions available to be analyzed (Hoen et al., 2013). Although these smaller data sets are adequate to examine large impacts (e.g., over 10%), they are less likely to reveal small effects with any reasonable degree of statistical significance.

A study published in August 2013 by Berkeley National Laboratory (principal authors) was conducted to address these gaps in data and included the largest home-sale data set to date. Researchers collected data from 51,276 home sales spanning 27 counties in nine states, related to 67 different wind facilities (Hoen et al., 2013). These homes were within 10 miles (16 km) of 67 different wind facilities, and 1,198 of the sales analyzed were within 1 mile (1.6 km) of a turbine, giving a much larger data set than previous studies have collected. The data span the periods well before announcement of the wind facilities to well after their construction (Hoen et al., 2013).

Two types of models were employed during the study to estimate property-value impacts: (1) an ordinary least squares model, which is standard for this type of study, and (2) a spatial-process model, which accounts for spatial variability. These models allow the researchers to control for home values before the announcement of a wind facility (as well as the post-announcement, pre-construction period), the spatial dependence of unobserved factors effecting home values, and value changes over time. A series of robust models was also employed to add an additional level of confidence to the study results (Hoen et al., 2013).

Regardless of model specification, the results of the study revealed no statistical evidence that home 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 average impacts are relatively small (within the margin of error in the models) and/or sporadic (impacting

only a small subset of homes) (Hoen et al., 2013).
A recent review based on housing and property values within specific radii of wind farms and other energy infrastructure by Brinkley and Leach (2019) finds that while most energy infrastructure has an impact on nearby land values, renewable energy projects (including wind farms) do not have statistically significant impacts. These findings are based on seven individual studies of varying scales that all consider the value of property relative to the proximity to wind power, whether a single turbine or more (Brinkley & Leach, 2019).

Research has consistently demonstrated that, in a variety of spatial settings and across a wide temporal scale, sale prices for homes surrounding wind energy facilities are not significantly different from those attained for homes sited away from wind energy facilities.

Mitigation Measures
The Project has been designed to minimize potential effects to land use and value through siting considerations and engagement with neighbouring landowners. This has included the movement of specific turbines based upon stakeholder engagement and the results of desktop, field, and modelling studies. No specific mitigation related to land use and value is recommended.

Monitoring
A specific land use and value monitoring program is not recommended.

Conclusion
The impact on land use and value is expected to be negligible and is therefore considered not significant.

8.3 Traffic and Transportation

8.3.1 Existing Environment
The centre of the Project is located approximately 6 km south of Highway 4 at Marshy Hope and 4 km south of the under-developed section of Highway 104. The primary road running through the centre of the Study Area is Weaver's Mountain Road, which begins at Highway 4, approximately 8 km northwest of the centre of the Study Area and ends at Black Brook Road, 7.5 km to the southeast of the centre of the Study Area. Keppoch Road, Morvan Road, and Black Brook Road run as a continuous thoroughfare near the eastern/southeastern boundary of the Study Area from Beaver Meadow before reaching east river Saint Mary's to the south. Barney's River east side road runs near the west side of the Study Area from Highway 4, approximately 8 km to the northwest, and provides access that is connected by trails and forestry tracks to Weavers Mountain Road.

Throughout the Study Area, the roads are accessible by truck/SUV as well as other vehicles designed for rough dirt roads and tracks. During the summer months, there are few vehicles visiting the area aside from the rare drive-through or ATV user. Due to the relatively remote location and lack of year-round inhabitants, as well as the relatively poor quality of the roads, there is very little public through traffic in the summer. Roads are also utilized for commercial

forestry operations.
During the fall and winter months, the Study Area is more frequently visited, both for hunting and other recreation activities, including snowmobiling and ATV use. Smaller roads that cover the Study Area, many of which are dead ends, are primarily used for ATVs year-round, though most see very little traffic. Access is limited in the winter to users with specific equipment depending on the depth of snow, or who are travelling on foot. The Antigonish Sno-Dogs snowmobile club maintain the trails in the area and charge membership fees that are related to the Snowmobile Association of Nova Scotia. The Proponent has engaged with the snowmobile club directly (Section 6).

The transportation route to deliver turbine components to the Project is subject to the final turbine technology provider, who will undertake a comprehensive logistics study to determine the transportation route from the receiving and unloading port. Primary access routes during the operational lifespan of the Project are expected to be Weavers Mountain Road and the associated roads between it and Highway 104, and/or Beaver Mountain Road, Bouchard Road, and the associated roads between it and Highway 104. Appropriate permits and engagement with NSPW will occur prior to transportation.

Air Navigation, communications, and navigation aids are addressed in Section 10.2.

8.3.2 Regulatory Context

The following permits and considerations are anticipated to be required for the transportation of turbine components:

- Work Within Highway Right of Way Permit (NSPW)
    - Required if removing access signs and guard rails.
- Overweight Special Moves Permit (Service NS and Internal Services)
    - Required to transport oversized and overweight components.
- Provincial road weight restrictions will also need to be considered, especially Spring Weight Restrictions, for heavier equipment and materials that will be transported to the Project Area.
- Access points will be designed with proper height and width to accommodate large trucks and will adhere to commercial stopping sight distances.

8.3.3 Effects Assessment

Project-Transportation Interactions

As on-site traffic is minimal, Project activities primarily have the potential to interact with transportation during the delivery and removal of turbine components (Table 8.8).

Table 8.8: Potential Project-Transportation Interactions

Valued Component	Site Preparation and Construction											Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Transportation							X							X	

Assessment Boundaries

The LAA for transportation is Antigonish and Pictou Counties. The RAA is not applicable.

Assessment Criteria

The assessment criteria provided in Section 4.6 apply for transportation as well. The VC-specific definition for magnitude is as follows:

- Low – small change in traffic levels and/or minimal disruptions to traffic flow and routing.
- Moderate – moderate change in traffic levels and/or moderate disruptions to traffic flow and routing.
- High – high change in traffic levels and/or high disruptions to traffic flow and routing.

Effects

The transportation route may require road modifications, including the removal of signage and guardrails. During the Project's construction phase, trucks and other vehicles will be frequently visiting the area resulting in increased vehicular sound and air emissions. Outside of the construction phase, the Project will only require a small number of technicians to access the site to perform regular maintenance/equipment checks.

Mitigation Measures

- Install notices in public areas to inform residents of signage removal or road infrastructure alterations, as well as notify relevant municipal government staff of construction scheduling and safety measures.
- Replace removed signage and guardrails immediately with appropriate temporary signage to ensure travelling public safety.
- Complete upgrades to roads and overhead wires, branches, and signs if conflicts arise.
- Complete modifications and associated reinstatement to relevant specifications.
- Avoid, to the extent possible, transportation through urban areas during high traffic times (e.g., 7-9 am and 3-6 pm; Monday to Friday).
- Conduct all travel using safe work practices for transporting oversized loads.

- Utilize the minimum number of vehicles possible to minimize impacts to road-way flow and impacts on air quality due to exhaust.
- Ensure vehicles only visit and work on-site during normal daytime hours of operation, where possible, and avoid high-traffic times of day to reduce local traffic congestion.

Monitoring

A specific traffic monitoring program is not recommended.

Conclusion

The impact to traffic and transportation is expected to be moderate, extend to the RAA for a short duration, be intermittent and reversible. Impacts related to transportation are considered not significant.

8.4 Recreation and Tourism

8.4.1 Existing Environment

The Project is located near the border of Antigonish and Pictou Counties, and has no major tourism centre nearby, being situated between Antigonish and New Glasgow in the Northumberland Shore region.

The communities of James River, Beaver Meadow, Marshy Hope, Kenzieville, and Barney's River Station are all home to a variety of primarily outdoor recreational activities. In the summer, ATV use on the various trails that are used for snowmobiling in the winter, and the use of other outdoor facilities, are the primary recreational draws. Beaver Mountain Provincial Park is located approximately 5.5 km northeast of the Project and is often frequented by hikers and picnickers in the summer. Keppoch Mountain, a four-season outdoor recreation hub for northeastern Nova Scotia, is approximately 7.2 km northeast of the Study Area. The mountain hosts downhill and cross-country skiing, mountain biking, snowshoeing, disc golf, and all forms of outdoor recreation compatible with their facilities. The facility stretches east to interconnect with the White Rock trail system.

Despite the lack of direct tourism destinations within the Study Area, there are many tourists who pass near the area on Highway 104 to the north. It is the primary access route to Cape Breton Island and Newfoundland, as well as part of the Trans-Canada Highway. There are several restaurants and accommodations, as well as other tourist attractions in Antigonish, approximately 20 km northeast of the Study Area. St. Francis Xavier University is also in Antigonish and often hosts regional, national, and international events. The Riverside International Speedway is a self-contained facility hosting a camping area and racetrack near Highway 104 in James River, where stock car racing events are hosted each year, including the IWK 250.

The standard deer hunting season in Nova Scotia stretches from the last Friday in October through the first Saturday in December. There is no hunting allowed on Sundays, except for the first two Sundays of the deer hunting season. Although no hunters were directly encountered

during field surveys, blinds and tree stands that appear to have been used for hunting were encountered, as well as shell casings. Other mammalian hunting or trapping may occur within the Study Area, though no signs were observed during field surveys.

Several fish are confirmed to be present in the Indian and MacEachern's lakes and several avian species were observed, which could be of interest to birdwatchers. There are access points to the edges of the lakes, granting reasonably unobstructed access, indicating possible fishing and/or waterfowl hunting in this area.

Most recreation within the Study Area is concentrated on the already developed roads and trails. ATV use in the warmer months and snowmobile use in the winter account for most of the recreational use; however, other uses exist.

8.4.2 Effects Assessment

Project-Recreation and Tourism Interactions

Project activities have the potential to interact with recreation and tourism during all phases if access is temporarily limited to facilitate work (Table 8.9).

Table 8.9: Potential Project-Recreation and Tourism Interactions

Valued Component	Site Preparation and Construction											Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Recreation and Tourism	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Assessment Boundaries

The LAA for recreation and tourism is Antigonish and Pictou Counties. The RAA is not applicable.

Assessment Criteria

The assessment criteria provided in Section 4.6 apply for recreation and tourism as well. The VC-specific definition for magnitude is as follows:

- Negligible – no expected changes to recreation and tourism.
- Low – small change to tourism expected and/or minor limitations to recreation use.
- Moderate – moderate change to tourism and/or moderate limitations to recreation use.
- High – high change to tourism and/or widespread limitation to recreation use.

Effects

The 2017 Nova Scotia Visitor Exit survey, administered by Tourism Nova Scotia in 2015 and 2017 combined with results published in 2019, shows little information about attractions that could be related to the region surrounding the Project. No spatial data is available regarding the places visited within the province, limiting the understanding of the impact that tourism has on the communities that surround the Project. Given that the main attractions discussed in the exit survey report are coastal scenery, the world's highest tides, lobster consumption, and the attractions in the Halifax Regional Municipality, the communities surrounding the Project do not appear to be significant tourist destinations. Understanding that recreational opportunities exist in the surrounding areas, the Proponent has engaged with the Keppoch Mountain community to understand how the Project can create a positive relationship with those users of the area (Section 6).

It is difficult to determine with certainty how tourists will react to a wind power development. Wind farms are visually interesting landscape features, and could generate tourism for the local community, although the aesthetics of wind farms are subjective. Some wind farms attract thousands of visitors per year and the benefits of even drawing a fraction of that number of visitors to a community can be felt by many businesses including shops, restaurants, and hotels (CanWEA 2006a). Pincher Creek, Alberta developed a 19 MW wind farm in 1993. Since that time, tourism revenue from visitors from as far away as Russia has generated $5,000 in annual sales of clothing and souvenirs branded with the "Naturally Powerful Pincher Creek" logo (CanWEA 2006a). The North Cape Wind Farm, a 10.56 MW wind facility located near Tignish, Prince Edward Island, has become a regional attraction, bringing in over 60,000 visitors per year. PEI's provincial government constructed a restaurant and gift shop at the site, resulting in a capital expenditure of $1.4 million. At the time of publication, the restaurant and gift shop were generating approximately $260,000 in annual revenue and employing 20 seasonal workers from mid-May to the end of October (CanWEA 2006b).

A 2002 study by Market and Opinion Research International interviewed tourists visiting Argyll and Bute, Scotland and asked them about their attitudes towards the presence of wind farms in the area. Of those who knew about the surrounding wind farms (40% of those interviewed), 43% felt that wind farms had a positive effect on the area, 43% felt it made no difference, and 8% felt it had a negative effect (Market and Opinion Research International 2002).

Pictou and Antigonish Counties, including the region that surrounds the Study Area, is a relatively rural landscape with little commercial or residential development outside of the major population centres and concentrated communities. There are several forested areas that have been managed for timber harvest and subsequent silviculture. Significant quarrying activities and industrial construction have been undertaken as part of the Highway 104 expansion project to bypass Marshy Hope. Further industrial impacts to the landscape are seen in the immediate vicinity of the Study Area with the Riverside International Speedway near the Beaver Mountain Provincial Park. For further information on the view planes and landscape impacts, see Section 10.3.

The turbines will consist of a small footprint on private land. The Project Team is committed to working with local recreational groups to ensure continued access to the area and associated trails, within the bounds of all safety considerations. As discussed above, the presence of turbines is highly compatible with most land-based recreation activities and is not expected to limit the usability of the area.

Mitigation Measures

- Continue to work with local recreation groups to ensure continued access within the Project Area.

Monitoring

A specific tourism and recreation monitoring program is not recommended.

Conclusion

The impact on recreation and tourism is expected to be negligible and is therefore considered not significant.

8.5 Other Undertakings in the Area

The nearest wind development to the Study Area is the Avondale Community Wind Park, located approximately 13 km north, consisting of one Enercon E92 wind turbine. The Glen Dhu Wind Farm is situated 15 km north of the Study Area and has an installed capacity of 60 MW, with 27 turbines in both Antigonish and Pictou counties. The Auld's Mountain Wind Farm and Pictou Landing Wind Farm are both located in Pictou County, 15 km northwest of the Study Area, with a combined generation capacity of approximately 7 MW, consisting of three turbines. The Maryvale Wind Farm is 25 km northeast, with four turbines producing 6 MW (NRCan, 2021).

9.0 ARCHAEOLOGICAL RESOURCES

9.1.1 Overview

The purpose of the Archaeological Resource Impact Assessment (ARIA) is to identify areas of high archaeological potential within the Assessment Area. Boreas Heritage Consulting Inc. (Boreas Heritage) was contracted to conduct the ARIA, which was directed by Stephen Garcin.

9.1.2 Regulatory Context

The *Special Places Protection Act,* RSNS 1989, c 438 provides the province of Nova Scotia with a mandate to protect important archaeological, historical, and paleontological sites and remains, including those underwater. A permit is required for any archaeological or paleontological exploration or excavation in Nova Scotia. The permit system ensures that work is completed based on established standards by qualified applicants.

This ARIA was conducted in accordance with the terms of Heritage Research Permit A2023NS002, issued by the NSCCTH – Special Places Program.

As archaeological work can often result in findings or information that is confidential or sensitive, a summary of the results of the ARIA are provided in the EA, with the ARIA report itself provided directly to NSCCTH for review. It is understood that the findings and recommendations of the ARIA are considered “draft” until the report is accepted by NSCCTH.

9.1.3 Assessment Methodology

The objectives of the ARIA were to:

- Evaluate archaeological potential within the Assessment Area.
- Identify, delineate, and investigate (where recommended) areas considered to exhibit high potential for encountering archaeological resources.
- Provide detailed and accurate information on the results of the survey.
- Provide comprehensive recommendations so that appropriate archaeological resource management strategies can be devised.

To achieve these objectives, Boreas Heritage designed an assessment strategy consisting of a desktop component (background screening) and a field component (archaeological reconnaissance).

The desktop component examined three elements: the environmental context, the archaeological context, and the historical context of the Assessment Area. The environmental context is examined to identify past and current environmental influences or conditions that may elevate archaeological potential (e.g., topography, local resources, and potential for agriculture). The archaeological context is examined to identify how people used and occupied the surrounding landscape based on evidence from previously registered archaeological sites and past archaeological work conducted near the Project. The historical context is examined to identify how people used and occupied the local area based on evidence from published archival documents, ethno-historic records, local oral traditions, historic maps, local and/or regional histories, scholarly texts, and available property records.

In Nova Scotia, the Maritime Archaeological Resource Inventory (MARI) is maintained by the Nova Scotia Museum, on behalf of NSCCTH. Reports from past archaeological assessments and academic research conducted near the Project provide archaeological context, which informs the interpretation and evaluation of any potential archaeological resources identified during the field component of the ARIA.

Additionally, the desktop component involved a general review of topographic maps, coastal charts and aerial photographs to identify topographical and hydrological attributes that correlate with high archaeological potential (e.g., waterfalls/rapids as focal points for fishing or requiring portage, submerged marine terraces representing former coastline). These attributes were also incorporated into the archaeological potential model, developed by Boreas Heritage.

The field component involved an on-site visual examination of the Assessment Area. Parallel pedestrian transects were completed, at intervals of 20 m to 30 m (maximum of 50 m), across

the Assessment Area to visually assess archaeological potential. These transects assist in maintaining effective coverage. Structured pedestrian transects assist in the recognition of topographic and/or vegetative anomalies that may inform the extent and nature of previous disturbance factors in the Assessment Area (e.g., clear-cutting, ploughing, construction earthworks), or suggest an elevation in archaeological potential, including evidence of buried archaeological resources (e.g., small knolls, apple trees in the forest, overgrown depressions, or abandoned roads).

The process and results of the field component were documented in field notes and with digital photographs. Upon identification of areas of high archaeological potential, or confirmed archaeological resources, these locations and features are sufficiently documented to make informed archaeological resource management recommendations. Confirmed archaeological resources, as determined by NSCCTH, will result in the registration of the site(s) in the MARI database.

9.1.4 Assessment Results

The field component of the ARIA was carried out between January and May 2023 and resulted in the identification of 16 areas considered to exhibit high potential for encountering archaeological resources (i.e., HPAs).

- Three are located along proposed roads (HPAs 01-03).
- One is located at a former turbine location and will be avoided (HPA 04).
- Six are associated with former infrastructure locations and will be avoided (HPAs 05, 06, 10 and 14-16).
- Six are located along proposed new access roads (HPAs 07-09 and 11-13).

All remaining portions of the Assessment Area are considered to exhibit low archaeological potential for encountering archaeological resources. As a result, Boreas Heritage recommends these areas be cleared by NSCCTH of any further requirement for future archaeological assessment.

9.1.5 Effects Assessment

Project-Archaeological Resources Interactions

Project activities could interact with archaeological resources during earth moving activities in the construction phase (Table 9.1).

Table 9.1: Potential Project-Archaeological Resources Interactions

Valued Component	Site Preparation and Construction										Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Archaeological Resources		X		X	X	X									

Assessment Boundaries

The LAA for archaeological resources is the Assessment Area. The RAA is not applicable.

Assessment Criteria

Assessment criteria provided in Section 4.6 apply for archaeological resources. The VC-specific definition for magnitude is as follows:

- Negligible – activities have no potential for encountering archaeological resources during ground disturbance.
- Low – activities have a low potential for encountering archaeological resources during ground disturbance.
- Moderate – activities have a moderate potential for encountering archaeological resources during ground disturbance.
- High – activities have a high potential for encountering archaeological resources during ground disturbance.

Effects

There is low potential for effects to archaeology resources across most of the Assessment Area. Any HPAs that cannot be avoided during the design phase will be subject to shovel testing. The Proponent is committed to following any forthcoming recommendations from NSCCTH related to this work.

Mitigation

The following mitigation measures are recommended:

- Complete shovel testing in areas of high potential prior to ground disturbance if they cannot be avoided during the detail design phase.
- Provide the EA Branch with the acceptance letter from NSCCTH prior to any disturbance in those areas.
- Develop a chance find procedure in the EPP related to the potential unexpected discovery of archaeological items or sites, or human remains, during construction. This

would include halting any work immediately upon discovery of suspected resources and contacting NSCCTH. If the resources are suspected to be of Mi'kmaq origin, the Executive Director of KMKNO would also be contacted.
- Conduct additional archaeological assessment if, during the detail design phase, it is determined that ground disturbance is required in areas not previously assessed. The EA Branch will be provided with the acceptance letter from NSCCTH prior to completion of any disturbance in newly proposed areas.

Monitoring
No monitoring programs are recommended.

Conclusion
With the implementation of the above mitigation measures, the potential for encountering archaeological resources is low to moderate. Effects would occur once, be short-term, restricted to the LAA, and be irreversible (to be confirmed based on any identified resources, as applicable). Effects are considered not significant.

10.0 OTHER CONSIDERATION

10.1 Human Health

The Project will be completed in the safest manner possible according to applicable health and safety related standards and requirements. Wind turbine models chosen for this Project were selected to ensure compliance with international wind class standards and incorporation of safety features to reduce the risk of lightning strikes, ice build-up, and general malfunctions. In addition, wind turbine siting considerations were incorporated into the Project's design to reduce potential impacts on nearby receptors.

Potential human health impacts associated with air quality, shadow flicker, sound, effects from climate change, and other natural environmental hazards on the Project, and accidents and malfunctions are addressed in the following sections:

- Section 7.1.1 – Atmosphere and Air Quality
- Section 10.3 – Shadow Flicker
- Section 10.5 – Sound
- Section 12.0 – Effect of the Environment on the Undertaking
- Section 13.0 – Accidents and Malfunctions

Other potential effects to human health include electromagnetic fields (EMFs), ice throw, and electrical fires, which are discussed in the sections that follow.

10.1.1 Electromagnetic Fields

EMFs are a form of naturally occurring energy that is produced using equipment or electrical appliances, not unique to wind turbines or farms. EMF fields are concentrated near the source, quickly dissipating with distance (Health Canada, 2020). Sources of low frequency EMFs may be

associated with the following Project components:

- Wind turbines
- Transmission lines
- Underground cables
- Generator transformers

Several studies and reports have demonstrated that EMFs generated by wind turbines and associated infrastructure are not considered to be a concern to human health (CMOH, 2010; Knopper et al., 2014; & McCallum et al., 2014). Therefore, impacts to human health from Project emitted EMFs are negligible.

10.1.2 Ice Throw

Ice throw and ice fall (or shedding) occurs when ice builds up and releases from the turbine's rotor blades, tower, or nacelle under specific temperature and humidity conditions. Ice fragments can either be thrown from the rotor due to centrifugal and aerodynamic forces or fall to the ground during idling or shutdown periods (CREA, 2020).

Typically, ice buildup is associated with high winds or extreme weather events when the turbines are already shutdown. In addition, wind turbines have built-in ice or vibrational sensors that will shut down the turbine in the event of an ice buildup. Ice throw typically only occurs due to a malfunction of the control system or during start-up when speeds are low. The risk of injury or damage as a result of ice throw is only present within close proximity to the turbine during conditions of ice buildup. The maximum throwing distance of accumulated ice from a turbine is determined using the following equation (CREA, 2020):

$$d_t = 1.5 * (D + H)$$

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

Based on the above equation and turbine model specifications (163 m rotor diameter and 125 m hub height), the maximum throwing distance associated with the Project's turbines is 432 m. Turbines for the proposed Project have been located at least 1 km from the nearest non-participating potential receptor. The public road within closest proximity to a turbine will be the newly constructed Highway 104, which will be approximately 2.71 km north of the nearest turbine, when complete. Therefore, there is little to no risk associated with ice throw to the public using these roads. Anti-icing technology is also being considered for the Project. However, there is a collection of logging roads and trails that exists throughout the Study Area, which are frequented by recreationalists for snowmobiling, hunting, and ATV use.

Mitigation measures to protect recreation users and site workers will include:

- Continue engagement and education with local recreational users (Section 6.0) regarding the safe continued use of lands within the Study Area.
- Install signage illustrating and warning of potential hazards associated with ice throw and fall around wind turbines.
- Equip staff and workers accessing the Project Area for maintenance or other purposes with necessary PPE and associated safety protocols and procedures to mitigate risk of injury and/or fatality, especially during potential icing conditions.

With the implementation of these mitigation measures, the impacts to human health from ice throw are negligible.

10.1.3 Electrical Fires

Wind turbines contain the key elements required for fire: fuel, oxygen, and a source of ignition. These elements are housed in the turbine nacelle, which is a compact and enclosed space at a height of 125 m. Fires may be ignited by lightning, an electrical malfunction, mechanical malfunction, or during maintenance. The height and remote nature of the turbines may make the early detection and effective control of fires difficult. However, these factors also reduce the direct impacts of electrical fires to human health. Evidence indicates that the occurrence of fires in wind turbines is rare. Between the years of 1995 and 2012, an average 11.7 fires were reported globally on an annual basis, resulting in four injuries and no fatalities over this time (Uadiale et al., 2014). With ~200,000 operational turbines worldwide in 2011, fires were reported in 0.006% of turbines (Uadiale et al., 2014). It is believed, however, that turbine fires are under-reported, and the proportion of fires occurring in turbines is closer to 0.05% (Uadiale et al., 2014). This percentage is still small, and wind turbine fires remain rare in comparison to fires occurring in other energy industries (Whitlock, 2015).

The wind energy industry has implemented various standards and guidelines to minimize the chances of fires occurring in turbines. This Project specifically has located turbines at least 1 km from the nearest non-participating potential receptor, and at least 2.71 km from the nearest public road. In addition to 24/7 Project monitoring, a fire prevention and evacuation plan will be implemented for Project personnel as part of the EPP, in addition to general safety protocol and training. Impacts to human health from electrical fires are negligible.

10.1.4 Conclusion

The impact on human health is expected to be negligible and is therefore considered not significant.

10.2 Electromagnetic Interference

10.2.1 Overview

The rotating blades and support structures of wind turbines can interfere with various types of electromagnetic signals emitted from telecommunication and radar systems (RABC & CanWEA, 2020).

EMI created by a wind turbine can be classified into two categories: obstruction and reflection. Obstruction occurs when a wind turbine is placed between a receiver and a transmitter, creating an area where the signal is weakened and/or blocked. Reflection is caused by the distortion between a raw signal and a reflection of the signal from an object. Scatter is a sub-category of reflection caused by the rotor blade movement.

The EMI assessment identified point-to-point, broadcast systems, radar, navigation, and communications systems susceptible to the effects of windfarm interference. The specific characteristics of a wind turbine will influence the type and magnitude of the interference. Other factors that influence interference include blade dimension and design, tower height, diameter of the supporting tower, as well as the material used for blade and tower construction.

10.2.2 Assessment Guidelines

The Radio Advisory Board of Canada (RABC) and CanWEA developed guidelines for assessing the EMI potential from a wind turbine development: Technical Information and Coordination between Wind Turbines and Radiocommunication and Radar Systems; hereafter referred to as the RABC Guidelines (RABC & CanWEA, 2020).

These guidelines outline a consultation-based assessment protocol that establishes areas, called “consultation zones”, around transmission systems, based on the type and function of the system.

10.2.3 Assessment Methods

Consultation is generally the best method of notification, and this process typically begins with a letter distribution to those parties affected by the development. A summary of the RABC Guidelines for determining consultation zones can be found in Table 10.1.

Table 10.1: RABC Guidelines – Recommended Consultation Zones

Systems	Consultation Zone
Point-to-Point Systems above 890 MHz	**1 km**
Broadcast Transmitters (AM, FM, and TV stations)	AM station: **5 km** for omnidirectional (single tower) antenna system **15 km** for directional (multiple towers) antenna system FM station: **2 km** TV station: **2 km**
Over-the-Air Reception (TV off-air pickup, consumer TV receivers)	Analog TV Station (NTSC): **15 km** Digital TV (DTV) station (ATSC): **10 km**
Cellular Type Networks, Land Mobile Radio Networks, and Point-to-Point Systems below 890 MHz	**1 km**

Systems	Consultation Zone
Satellite Systems (Direct to Home, Satellite Ground Stations)	**500 m**
Air Defence Radars, Vessel Traffic Radars, Air Traffic Control Radars, and Weather Radars	DND Air Defence Radar: **100 km** DND or Nav Canada Air Traffic Control Primary Surveillance Radar: **80 km** DND or Nav Can Air Traffic Control Secondary Surveillance Radar: **10 km** DND Precision Approach Radar: **40 km** Canadian Coast Guard Vessel Traffic Radar System: **60 km** Military or Civilian airfield: **10 km** Environment Canada Weather Radar: **50 km**
VHF OmniRange (VOR)	**15 km**

To conduct an EMI assessment, the following information regarding turbine design and placement is generally required to complete notifications:

- Turbine UTM coordinates
- Number of turbines
- Ground elevation
- Tower/hub height of each turbine
- Nacelle height
- Rotor diameter
- Turbine blade sweep diameter (or length of blades)
- Turbine base diameter
- Substation/converter location coordinates and height(s) along with new transmission line(s) to connect to a grid

Response time and feedback from the various organizations vary and can take up to 12 weeks. If turbine type, layout or design changes, many organizations will need to be re-consulted prior to proceeding.

10.2.4 Assessment Results

Consultation with relevant agencies was completed and results are provided in Table 10.2. Reponses are provided in Appendix M.

Table 10.2: EMI Consultation Results

Signal Source	Operator	Consultation Results
Air defense and air control radar systems DND Radio Communications	DND	April 2023 EMI notification letter sent. Still awaiting response.
Maritime vessel traffic system radars	Canadian Coast Guard (CCG)	April 2023 EMI notification letter sent. May 2023 Letter of non-objection received.
VHF omnidirectional range Primary air traffic control surveillance radar	NAV CANADA	April 2023 EMI notification letter sent. Still awaiting response.
Weather radar	ECCC	April 2023 EMI notification letter sent. May 2023 Letter of non-objection received.
Radiocommunication Systems	RCMP	April 2023 EMI notification letter sent. May 2023 Response received requesting coordination with Bell, who are acting on behalf of the RCMP in the province with leased towers.
Regulator	ISED, formerly Industry Canada	April 2023 EMI notification letter sent. April 2023 Acknowledgement e-mail received.
Telecom	Bell Aliant Eastlink NCS Managed Services Inc. Rogers Communications Seaside Communications	April 2023 EMI notification letter sent. April 2023 Acknowledgement e-mail received from Eastlink. May 2023 E-mail from Bell Aliant received indicating their wireless team had reviewed information and did not expected impact to existing Bell wireless infrastructure. However, an additional study was requested to prove no interference. Still awaiting response from NCS Managed Services Inc., Rogers Communications, and Seaside Communications.

Signal Source	Operator	Consultation Results
Emergency Services	Antigonish County Volunteer Fire Department Barney's River Volunteer Fire Department	April 2023 EMI notification letter sent. April 2023 Acknowledgement e-mail received from Barney's River Volunteer Fire Department. No response yet received from Antigonish County Volunteer Fire Department.

10.2.5 Effects Assessment

Project-EMI Interactions

Project activities only interact with electromagnetic signals during operations (Table 10.3).

Table 10.3: Potential Project-EMI Interactions

Valued Component	Site Preparation and Construction											Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
EMI												X			

Assessment Boundaries

Assessment boundaries align with the consultation boundaries established by the RABC Guidelines.

Assessment Criteria

Assessment criteria provided in Section 4.6 apply for EMI. The VC-specific definition for magnitude is applied to each operator individually as follows:

- Low – letter of no objection received.
- Moderate – organization requests additional consultation.
- High – letter of objection received.

Effects

As shown in Table 10.2, 13 notifications were submitted.

Correspondence received from CCG, ISED, ECCC, RCMP, Eastlink, and Barney's River Volunteer Fire Department confirmed receipt. CCG and ECCC have indicated no objections.

Bell Aliant indicated they did not expect impact to existing Bell wireless infrastructure. However, an additional study was requested to prove no interference.

No response has yet been received from DND, NAV CANADA, NCS Managed Services Inc.

Mitigation
The following general mitigation measures regarding EMI will be implemented:

- Ensure operators are consulted on any future layout updates.
- Continue consultation with operators who have not yet responded to the notification letters and/or who express concerns about the layout presented.
- Follow up with Bell Aliant once additional study has been completed.

Should additional layout modifications be required, the above agencies will be provided with updated information, as appropriate.

Monitoring
No monitoring programs are recommended.

Conclusion
Results are characterized as low magnitude, within the consultation zones defined by RABC Guidelines, medium duration, continuous, reversible, and not significant.

10.3 Shadow Flicker

10.3.1 Overview

Shadow flicker can occur when rotating blades cast flickering shadows during times of direct sunlight. The magnitude of shadow flicker is determined by the position and height of the sun, wind speed and direction, geographical location, time of year, cloud cover, turbine hub height and rotor diameter, and proximity to the turbine.

For shadow flicker to occur, the following criteria must be met:

- The sun must be shining and not be obscured by clouds/fog.
- The source turbine must be operating.
- The wind turbine must be situated between the sun and the shadow receptor.
- The wind turbine must be facing directly towards, or away from, the sun such that the rotational plane of the blades (i.e., rotor plane) is perpendicular to the azimuth of incident sun rays. For this to occur, the wind direction would have to be parallel to the azimuth of the incident sun rays throughout the day.
- The line of sight between the turbine and the shadow receptor must be clear. Light-

impermeable obstacles, such as vegetation, tall structures, etc., will prevent shadow flicker from occurring at the receptor.
- The shadow receptor must be close enough to the turbine to be in the shadow.

10.3.2 Regulatory Context

There are no municipal, provincial, or federal guidelines related to shadow flicker, but many jurisdictions (including NSECC) have adopted the industry standard of no more than 30 hours of shadow flicker per year, or no more than 30 mins of shadow flicker in a day at residential receptors.

10.3.3 Assessment Methodology

The shadow flicker assessment was completed through modelling to achieve the following objectives:

- To identify nearby receptors that may potentially experience shadow flicker from the Project's operation.
- To quantify and assess the duration and frequency of shadow flicker for nearby residents under a worst-case scenario.
- To determine if applicable guidelines are met.
- To mitigate and minimize shadow flicker experienced by nearby residents, if necessary.
- To consult with potentially affected residents, if necessary.

Potential receptors located within 2 km of the Study Area were identified using GIS data from the Nova Scotia Geomatics Centre and aerial imagery. For the purposes of this model, potential receptors included all structures identified in GIS data from the Nova Scotia Geomatics Centre, as well as any additional identifiable structures based on aerial imagery. A field investigation was completed to confirm the receptors within proximity to turbine locations and to identify any additional receptors that were not included in the desktop GIS data. Any structures located on "Project lands" were not included in the assessment.

An analysis was conducted using the windPRO version 3.5.552 under a worst-case scenario, which assumes that all the criteria listed in Section 10.3.1 are always met. The worst-case modelling also assumes receptor structures are a 'greenhouse', having windows on all surfaces.

10.3.4 Assessment Results

A total of 113 potential receptors were identified within 2 km of the Assessment Area (Drawings 10.1A and B). Under the worst-case scenario conditions (meeting criteria described in Section 10.3.1 above), no potential receptors exceed 30 hours of shadow flicker per year and/or 30 mins of shadow flicker per day. Detailed results for all potential receptors within 2 km of the Assessment Area are provided in Appendix N.

10.3.5 Effects Assessment

Project-Shadow Flicker Interactions

Project activities only interact with shadow flicker during operations (Table 10.4).

Table 10.4: Potential Project-Shadow Flicker Interactions

Valued Component	Site Preparation and Construction											Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Shadow Flicker												X			

Assessment Boundaries

The LAA for shadow flicker includes a 2 km area around the Study Area (Drawings 10.1A and B). The RAA is not applicable for shadow flicker.

Assessment Criteria

Assessment criteria provided in Section 4.6 apply for shadow flicker. The VC-specific definition for magnitude is as follows:

- Negligible – no measurable shadow flicker predicted at receptor locations.
- Low – measurable shadow flicker predicted at receptor locations, but results are below guidance.
- High – shadow flicker predicted to exceed guidance at receptor locations.

Effects

Modelling for the theoretical-case scenario predicts that all receptors will experience less than 30 hours of shadow flicker per year and 30 mins of shadow flicker per day.

Mitigation

No mitigation is recommended.

The Project will develop a complaint response protocol, which will consider complaints related to shadow flicker and outline a process to investigate these complaints. Mitigation to resolve complaints, if determined to be necessary, will be completed on a case-by-case basis in consultation with the affected landowner and may include the provision of screening or the development of a turbine-specific curtailment plan.

Monitoring
No monitoring programs are recommended.

Conclusion
Results are characterized as low magnitude, within the LAA, medium duration, intermittent, reversible, and not significant.

10.4 Visual Impacts

10.4.1 Overview
The development of wind turbines has the potential to change the visual landscape and/or aesthetics of a local area. The level of change varies depending on the significance of the landscape, local topography, and the degree to which the wind turbines alter or modify the landscape. Locations of concern may include:

- Public viewpoints
- Protected areas
- Areas of local significance
- Recreational areas (hiking trails, biking routes, etc.)

Aeronautical safety lighting associated with wind turbines may also result in visual impacts, especially during the nighttime.

10.4.2 Regulatory Context
There are no provincial or federal guidelines related to viewscape.

Operational turbine lighting is regulated by NAV CANADA and Transport Canada.

10.4.3 Assessment Methodology
Visual simulations were undertaken to assess the wind turbines' impact on the visual landscape and local aesthetics. Locations for the visual assessment were selected based on accessible locations of concern that meet the criteria listed in Section 10.4.1, where wind turbines were expected to be visible within the area surrounding the Project. The following locations were selected (Drawing 10.2A to 10.2F):

- Keppoch Road (one photo taken at bearings 255^{o}; coordinates provided in Drawing 10.2B).
- Highway 2 (one photo taken at bearing 216^{o}; coordinates provided in Drawing 10.2C).
- Weavers Mountain Road (one photo taken at bearing 193^{o}; coordinates provided in Drawing 10.2D).
- Keppoch Mountain (one photo taken at bearing 261^{o}; coordinates provided in Drawing 10.2E).
- Near Highway 104 (one photo taken at bearing 232^{o}; coordinates provided in Drawing 10.2F).

Photos were taken using a Canon EOS REBEL T7 camera with a 50 mm lens. Precise location, time, direction of view, and weather conditions at the time of the photo were also recorded. The visual simulations were completed using windPRO software version 3.5.552 that incorporates elevation (DEM), turbine location, and camera/photo location information to simulate what the landscape will look like after the wind turbines have been constructed. Weather conditions (clear sky, overcast, etc.) and visibility (clear, fog, etc.) can be selected during the process to demonstrate the visual aesthetics of the Project over various environmental conditions.

The result is a series of photos showing the landscape from selected locations with the wind turbines in place.

10.4.4 Assessment Results

Visual simulations are provided in Drawings 10.2A to 10.2F.

If required by Transport Canada and NAV CANADA as part of their assessment of the Project, wind turbines will be equipped with pilot warning and obstruction avoidance lighting to ensure compliance.

10.4.5 Effects Assessment

Project-Visual Aesthetics Interactions

Project activities only interact with visual aesthetics during operations (Table 10.5).

Table 10.5: Potential Project-Visual Aesthetics Interactions

Valued Component	Site Preparation and Construction											Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Visual Aesthetics												X			

Assessment Boundaries

The LAA for visual effects includes the observer locations (Drawings 10.2A to 10.2F). The RAA is not applicable for visual effects.

Assessment Criteria

Assessment criteria provided in Section 4.6 apply for visual effects. The VC-specific definition for

magnitude is applied to each observer location individually as follows:

- Negligible – Project components cannot be seen from the observer location.
- Low – Project components may be seen from the observer location, but do not stand out or are not discernible in the view (i.e., low exposure on the horizon).
- Moderate – Project components can be seen from the observer location but are not a prominent feature in the view.
- High – Project components are the prominent feature in the view from the observer location.

It is noted that the magnitude criteria for visual effects is considered a neutral criterion as the perception of a change to the visual landscape can be adverse or positive depending on the individual observer.

Effects

Based on the simulations, the wind turbines are visible from all observer locations.

Operational lighting could be visible from the wind turbines during the night. However, potential impacts to residents are expected to be limited due to the distance between the Project and nearest non-participating potential receptor, which is over 1 km. Lighting intensity and flashes will be minimized, as allowable by Transport Canada; and the exterior turbine maintenance lights will be turned off prior to maintenance staff leaving the site where health and safety requirements allow.

Mitigation

No mitigation is recommended related to viewscapes.

The following mitigation is recommended regarding turbine lighting:

- Limit lighting on wind turbine nacelles and towers to minimum levels while still meeting requirements of NAV CANADA and Transport Canada.
- Prohibit general lighting within the Project Area where allowed by health and safety requirements. Lighting for operations activities will only be used when technicians are working on-site.

Construction activities will be limited to daytime hours when possible. It is noted that wind turbines may be erected during the evening as the activity must be completed when the wind is less than 8 m/s as a safety measure. Additionally, where concrete pours are in progress, night work may be required to maintain the integrity of the pour. On-site lighting will be pointed downward to minimize light throw.

Monitoring

No monitoring programs are recommended.

Conclusion

Results are characterized as moderate magnitude, within the LAA, medium duration, continuous, reversible, and not significant.

10.5 Sound

10.5.1 Overview

The assessment of sound considered both construction and operational generated noise from the Project.

During construction, heavy equipment, machinery, and light vehicles will emit sound to the surrounding environment from activities associated with the development of wind turbine pads, roads, the transmission interconnection and grid connection, along with the subsequent assembly of wind turbines. To quantify potential impacts, noise levels of equipment anticipated to be used for the Project's construction were used to calculate noise levels at set distances from the Assessment Area in consideration of nearby receptors.

During the operational phase of the Project, wind turbines will emit sound to the surrounding environment from mechanical equipment operation and the turbines interaction with the surrounding air (aerodynamic sound). Design and engineering of wind turbine components (e.g., anti-vibration products) have reduced, but not eliminated, mechanical and aerodynamic sound and its associated impacts. To quantify potential impacts of turbine generated noise on nearby receptors, detailed sound modelling was completed.

10.5.2 Regulatory Context

Changes to the acoustic environment during construction and operational activities could result in displacement, annoyance, and interference of communication, sleep, and/or working efficiency. As such, sound levels are regulated at the various government levels (Table 10.6).

Table 10.6: Summary of Sound Level Regulations and Guidelines

Regulated By	Regulation/Guidance	Sound Level (dBA)	Hours / Duration
For Residential Receptors			
Nova Scotia Department of Environment and Labour (now NSECC)	Guidelines for Environmental Noise Measurement and Assessment (NSECC, 1990)*	≤65	0700 to 1900
		≤60	1900 to 2300
		≤55	2300 to 0700
NSECC	Guide to Preparing an EA Registration Document for Wind Power Projects in Nova Scotia (NSECC, 2021)	≤40	During the operation of wind turbines
Municipality of the County of Antigonish	By-Law Respecting the Control of Noise (Municipality of the County of Antigonish, 2008)**	≤70	2200 to 0700
		≤90	0700 to 2200
For Occupational Safety			
Workplace Health and Safety Regulations & Canadian Centre for Occupational Health and Safety (CCOHS)	Noise – Occupational Exposure Limits in Canada (Workplace Health and Safety Regulations & CCOHS, 2022)	85	8-hour maximum

*Note: NSECC is in the process of updating these guidelines (NSECC, 2022c) which are currently in consultation phase. Any changes to the guidelines as a result of this update will be referenced/incorporated as part of the Project's EPP.
**These regulations only apply within the Antigonish County Planning Area which does not overlap with the Project Area or Study Area.

10.5.3 Assessment Methodology

Ambient Sound

Desktop resources and field observations were used to identify nearby sources of sound and characterize the ambient sound within the Study Area.

Construction Sound

The assessment of construction sound is based on desktop studies and addresses Project-related effects on human receptors. The objectives aim to achieve the following:

- Establish the potential construction sound levels produced by the Project.
- Identify nearby receptors that may be exposed to construction sound produced by the Project.
- Determine if the applicable guidelines are met/exceeded.
- Mitigate and minimize any impacts experienced by nearby receptors.

Potential receptors (including sensitive receptors such as schools, daycares, and senior residences) located within 2 km of the Assessment Area were identified using GIS data from the Nova Scotia Geomatics Centre and aerial imagery.

Sound levels and impacts from blasting activities have not been included in this assessment as these activities are not anticipated at this time. If blasting is determined to be required during construction, noise impacts will be temporary as they will only pertain to a period during

construction. If blasting is required, the Proponent will notify NSECC and apply for any required permits and approvals. Any potential impacts, mitigation, and subsequent required monitoring will be described in the Project's EPP.

Operational Sound

The operational sound assessment was completed through a combination of desktop studies and modelling with the following objectives in mind:

- Identify receptors/dwellings within 2 km of the Study Area.
- Identify existing operational turbines within 3 km of the Project (none identified).
- Identify and assess any potential impacts on these receptors, including cumulative effects from neighbouring turbines, if present (none identified).
- Avoid and/or mitigate impacts of Project generated sound on nearby receptors.
- Confirm the modelled Project sound levels at nearby receptors will be below guidelines.

The sound assessment identified potential receptors within a 2 km radius of the Study Area. The assessment was completed using the WindPRO version 3.5.552 software package. For the purposes of this model, potential receptors included all structures identified in GIS data from the Nova Scotia Geomatics Centre, as well as any additional identifiable structures based on aerial imagery. A field investigation was completed to confirm the receptors within proximity to turbine locations and to identify any additional receptors that were not included in the desktop GIS data. Any structures located on "Project lands" were not included in the assessment.

The model followed ISO 9613-2 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method and calculations, and was based on the following input information:

- UTM coordinates for the wind turbines.
- 1/1 Octave band sound power level data, either provided by the manufacturer or calculated by WindPro, for the wind turbines. For the purposes of modelling, the Nordex N163 was used in the WindPro model, as it generates the highest sound-power levels of the three wind turbine models being considered.
- UTM coordinates for potential receptors (all non-Project participant structures within a 2 km radius of the Study Area were evaluated).
- A wind speed of 8.8 m/s, the speed at which the highest sound power level output is achieved (based on test data from the manufacturer).
- Topographic data for the surrounding area.

The ISO 9613-2 calculation method assumes meteorological conditions that are ideal for noise propagation, including a ground temperature of 10°C and 70% relative atmospheric humidity. A ground factor of 0.7 was applied to the model, representing predominantly porous ground (i.e., capable of vegetative growth) interspersed with hard surfaces (e.g., rock).

An ambient sound level of 35 dBA was also applied to each potential receptor as part of the modelling.

Modelling results were mapped and presented as an isopleth, demonstrating the sound levels each potential receptor will experience.

10.5.4 Sound Assessment Results

Ambient Sound

When evaluating sound levels produced by the Project, it is important to understand ambient sound existing in and around the Study Area pre-development. Several existing developments that contribute to ambient sound levels within/near the Study Area include:

- Active forestry (throughout and surrounding the Study Area)
- Highway 104 (<1 km north)
- Highway 104 Rerouting – currently under construction (<1 km north)
- Riverside International Speedway (1 km east)
- Keppoch Mountain Recreational Area (2 km east)
- Pictou County ATV Club Trails (4 km northeast)

Sounds associated with these activities include operation of heavy machinery, blasting, tree felling, logging trucks, etc. Recreational and local traffic also exists within the Study Area, increasing ambient sound levels from cars, ATV, dirt bikes, snowmobiles, etc. Lastly, in addition to anthropogenic sources, there are also natural sources of sounds originating from wildlife, wind, water, and vegetation.

Construction Sound

During construction activities, sound will predominantly be generated through the operation of construction equipment and heavy machinery such as cranes, backhoes, excavators, dump trucks, graders, and transportation vehicles. A summary of sources and anticipated volumes of sound produced during the Project's construction is provided in Table 10.7.

Table 10.7: Decibel Limits of Construction Equipment Required for the Project

Equipment	Average Noise Level Ranges (in dBA)
Road, Transmission Line, Grid Connection, and Turbine Pad Development	
Backhoe	85-104[1]
Concrete Truck/Pump	103-108[2]
Dozer	89-103[1]
Dump Truck	84-88[1]
Excavator	97-106[2]
Harvesting Equipment (log truck, manual faller, etc.)	85-103[3]
Roller	95-108[2]
ATV	97[4]
Loaders	88[3]
Pickup Trucks	95[4]
Tracked Drilling Units	91-107[5]
Tracked Dump Truck/Decks	91[6]

Equipment	Average Noise Level Ranges (in dBA)
Tracked Man Lift/Bucket Machines	85[6]
Tracked Radial Boom Derricks/Cranes	93-98[2/6]
Turbine Assembly	
Crane	78-103[1]
Handheld Air Tools	115[2]
Compressor (drilling, pneumatic tools, etc.)	85-104[7]

Note that measurements shown are relevant to the decibel level ranges within close proximity (i.e., less than 15 m of distance) between a receptor and the relevant piece of equipment.

Sources: [1]WorkSafe BC (n.d.)
[2]Transport Scotland (n.d.)
[3]WorkSafe BC (2016)
[4]Government of Oregon (n.d.)
[5]The Driller (2005)
[6]SCE (2016)
[7]Government of Ontario (2021)

The range of decibels anticipated for the Project's construction activities will be between 78 to 115 dBA (from a single piece of equipment within 15 m from the source).

Assuming that sound attenuates at the standard rate of 6 dBA per doubling in distance from a given point source, approximate sound levels experienced at incremental distances during construction activities for the Project are provided in Table 10.8. The attenuation rate of sound presented below does not consider local landscape/topography or buildings, and therefore, is considered a "worst-case" scenario for sound levels produced by a single piece of equipment.

Table 10.8: Attenuation of Construction Related Sounds

Case	Example Equipment Type	Sound Level @ 15 m (dBA)*	Point Source Sound Levels (dBA) at Incremental Distances					
			50 m	100 m	200 m	500 m	1,000 m	2,000 m
Minimum	Crane	78	67.5	61.5	55.5	47.5	41.5	35.5
Median	Pickup/ATV	96	85.5	79.5	73.5	65.5	59.5	53.5
Maximum	Handheld Air Tools	115	104.5	98.5	92.5	84.5	78.5	72.5

*Approximate point source sound levels, based on data collected in Table 10.8 above. Combined sound levels produced by multiple pieces of equipment operating simultaneously have not been included in the assessment.

For the median case, sound levels are anticipated to meet the ≤65 dBA guideline for daytime noise levels at approximately 500 m from a given point source of noise/the Assessment Area.

Operational Sound

A total of 113 potential receptors were identified within 2 km of the Study Area; the nearest non-participating potential receptor to a turbine is approximately 1 km. Results of the sound modelling (presented as an isopleth) are shown on Drawing 10.3 and detailed results are provided in Appendix O. No wind turbines exist within 3 km of the Project; therefore, only the Project turbines were modelled. No receptors exceed the recommended guideline of 40 dBA.

Information from the wind turbine manufacturer supplied the 1/3 octave low frequency power levels at 125 m hub height. The power levels were entered into a Finland low frequency model in WindPRO software to produce the maximum dBA at each receptor. The highest predicted sound level at a receptor is 30.4 dBA. The most critical noise demand from WindPRO's Finland low frequency model is 59.1 dBA (Appendix O). A literature review related to infrasound/low frequency sound is also provided in Appendix O.

10.5.5 Effects Assessment

Project-Sound Interactions

Project activities will interact with the acoustic environment during all phases of the Project. Sound related to the decommissioning phase is not specifically addressed because sound levels are expected to be comparable to construction levels (Table 10.9).

Table 10.9: Potential Project-Sound Interactions

Valued Component	Site Preparation and Construction											Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Sound		X		X	X	X	X	X	X			X	X	X	X

Assessment Boundaries

The LAA for sound includes a 2 km buffer around the Study Area (Drawing 10.3). The RAA is not applicable for sound.

Assessment Criteria

Assessment criteria provided in Section 4.6 apply to sound. The VC-specific definition for magnitude is provided for construction and operational sound as follows:

Construction Sound

- Negligible – sound levels from Project activities are expected to be ≤55 dBA at residential and sensitive receptor locations.
- Low – sound levels from Project activities may measure between 55-65 dBA at residential and sensitive receptor locations.
- Moderate – sound levels from Project activities may exceed 65 dBA at residential and sensitive receptor locations, but only during high-impact activities (intermittently).

- High – sound levels from Project activities are expected to exceed 65 dBA at residential and sensitive receptor locations during multiple activities.

Operational Sound

- Low – measurable sound levels predicted at receptor location(s), but results are below NSECC guidance.
- High – sound levels predicted to exceed NSECC guidance at receptor location(s).

Effects

During construction of the Project, decibel limits above 55 dBA at residential receptors can result in disruptions of sleep during nighttime hours while sounds above 65 dBA may cause annoyance and disturbance during daytime hours. Sound produced during construction has the potential to exceed these thresholds at some residential receptors located within close proximity to activities at some locations within the Project Area. For the median case, sound levels will meet the 65 dBA guideline for daytime noise levels at approximately 500 m from a given point source of noise. Within 500 m of the Assessment Area, nine non-participating potential receptors were identified which may experience sound levels exceeding daytime thresholds depending on the type and location of the activity required. Eight of the potential receptors are located along Bouchard Road and Beaver Mountain Road (near the proposed substation and collection system) with one potential receptor located on Weavers Mountain Road next to Indian Lake (near a proposed road). No sensitive receptors were identified within proximity to the Assessment Area.

Given that the construction footprint is widespread, Project-related construction noise potentially exceeding NSECC guidance at individual receptors would occur intermittently and over a very short time frame. Furthermore, the median sound level from construction is similar to sound produced from an ATV or pick-up truck, which is already a common source of sound within the Study Area, as are logging trucks and harvesting equipment. There is also ongoing highway construction adjacent to the Assessment Area associated with the re-routing of Highway 104. As a result, most Project-related construction sound will be consistent with existing sound levels in the area. Activities producing higher levels of sound such as blasting (if required), or handheld air tools will be less frequent and last for a very short duration.

Operational sound at non-participating potential receptor locations is predicted to comply with the guidelines adopted in Nova Scotia (i.e., 40 dBA).

Mitigation

To minimize construction sound and the potential to disturb receptors during construction, the following general mitigation/protective measures will be implemented:

- Use noise suppressants (e.g., mufflers) on vehicles/equipment, where possible.
- Limit vehicle idling.
- Conduct construction activities within the recommended daytime hours of 7:00 am to 10:00 pm to the extent possible.

- Include mitigation and monitoring for blasting in the Project's EPP, if geotechnical investigations determine this activity is required during construction.

No mitigation is recommended for operational sound.

The Project will develop a complaint response protocol, which will consider complaints related to sound and outline a process to investigate complaints. Mitigation to resolve complaints, if determined to be necessary, will be completed on a case-by-case basis in consultation with the affected landowner. Pre-construction sound levels at key receptor locations will be measured as part of this process to establish baseline conditions for future reference (if needed).

Monitoring
No monitoring programs are recommended.

Conclusion
Construction phase results are characterized as moderate magnitude, within the LAA, short duration, continuous, reversible, and not significant.

Operational phase results are characterized as low magnitude, within the LAA, medium duration, continuous, reversible, and not significant.

11.0 EFFECTS OF THE UNDERTAKING ON THE ENVIRONMENT

11.1 Summary of Effects of the Undertaking on the Environment

Table 11.1 summarizes the results of the effects assessment for each VC.

Table 11.1: Effects of the Undertaking on the Environment - Summary

VC	Magnitude of Effects	Geographic Extent of Effects	Timing and Duration of Effects	Frequency of Effects	Reversibility of Effects	Significance Level	Mitigation and/or Monitoring Required?
Atmosphere and Air Quality	Low to negligible – Minimal to no changes are expected to ambient air quality	Within the LAA	Seasonal aspects not applicable; short-term duration	Intermittent	Reversible	Not significant	Mitigation required; no monitoring required
Climate Change	Positive – The project is expected to have a positive effect on GHG emissions	Within the LAA	Seasonal aspects not applicable; medium-term duration	Continuous	Irreversible	Significant (positive)	Mitigation required; no monitoring required
Geophysical Environment	Moderate – Changes to local topography/geology are possible as geologic hazards exist within proximity to the Assessment Area; impacts to the quality/quantity of groundwater wells are possible (wells exist within 800 m of the Assessment Area)	Within the LAA	Seasonal aspects not applicable; medium-term duration	Continuous	Reversible	Not significant	Mitigation and monitoring may be required
Waterbodies and Watercourses	Moderate – small loss of aquatic habitat and altered hydrology expected but can be managed with routine measures	Within the LAA	Seasonal aspects applicable; short-term duration	Single event	Reversible	Not significant	Mitigation and monitoring required
Fish and Fish Habitat	Low – Small loss of fish habitat or impact to fish behaviour	Within the LAA	Seasonal aspects applicable; short-term duration	Single event	Reversible	Not significant	Mitigation and monitoring required
Wetlands	Low – Direct loss of wetland habitat, but overall wetland functions remain intact	Within the LAA	Seasonal aspects applicable; short-term duration	Single event	Reversible	Not significant	Mitigation and monitoring required
Terrestrial Habitat	Low – Loss of terrestrial habitat, but overall habitat functions remain intact	Within the LAA	Seasonal aspects not applicable; long-term duration	Single event	Reversible	Not significant	Mitigation required; no monitoring required

VC	Magnitude of Effects	Geographic Extent of Effects	Timing and Duration of Effects	Frequency of Effects	Reversibility of Effects	Significance Level	Mitigation and/or Monitoring Required?
Terrestrial Flora	Low – Small loss of habitat supporting terrestrial flora SOCI, but no terrestrial flora SOCI individuals lost	Within the LAA	Seasonal aspects not applicable; long-term duration	Single event (for habitat, N/A for SOCI)	Reversible	Not significant	Mitigation required; no monitoring required
Terrestrial Fauna	Low – Small loss of habitat supporting fauna, but no impacts to fauna behaviour expected	Within the RAA	Seasonal aspects applicable; long-term duration (for habitat, N/A for SOCI)	Continuous	Reversible	Not significant	Mitigation required; monitoring may be required
Bats	Moderate – Minimal loss of individuals or impacts to bat behaviours, but these impacts will only be experienced by individuals rather than entire populations	Within the LAA	Seasonal aspects not applicable; medium-term duration	Intermittent	Reversible	Not significant	Mitigation and monitoring required
Avifauna	Low – Small loss of important habitat supporting avifauna and/or impacts to migratory avifauna are expected to be low	Within the LAA	Seasonal aspects not applicable; medium-term duration	Intermittent	Reversible	Not significant	Mitigation and monitoring required
Economy	Positive – Project is expected to have a positive effect on the economy	Within the RAA	Seasonal aspects not applicable; medium-term duration	Continuous	Irreversible	Significant (positive)	No mitigation or monitoring required
Land Use and Value	Negligible – No change in land value expected and surrounding land use can largely continue					Not significant	No mitigation or monitoring required
Traffic and Transportation	Moderate – Moderate change in traffic levels and/or moderate disruptions to traffic flow and routing	Within the RAA	Seasonal aspects not applicable; short-term duration	Intermittent	Reversible	Not significant	Mitigation required; no monitoring required

VC	Magnitude of Effects	Geographic Extent of Effects	Timing and Duration of Effects	Frequency of Effects	Reversibility of Effects	Significance Level	Mitigation and/or Monitoring Required?
Recreation and Tourism	Negligible – No expected changes to recreation and tourism						Mitigation required; no monitoring required
Archaeological Resources	Moderate to low – Activities have a moderate to low potential for encountering archaeological resources during ground disturbance	Within the LAA	Seasonal aspects not applicable; short-term duration	Single event	Irreversible (to be confirmed based on any identified resources, as applicable)	Not significant	Mitigation required; no monitoring required
Human Health	Negligible – No expected impacts to human health					Not significant	Mitigation required; no monitoring required
Electromagnetic Interference	Moderate to low – Letters of no objection received, and organizations have requested additional consultation	Within consultation boundaries established by the RABC Guidelines	Seasonal aspects not applicable; medium-term duration	Continuous	Reversible	Not significant	Mitigation required; no monitoring required
Shadow Flicker	Low – Measurable shadow flicker predicted at receptor locations, but results are below guidance	Within the LAA	Seasonal aspects applicable; medium-term duration	Intermittent	Reversible	Not significant	No mitigation or monitoring required
Visual Impacts	Moderate – Project components can be seen from the observer location but are not a prominent feature in the view	Within the LAA	Seasonal aspects not applicable; medium-term duration	Continuous	Reversible	Not significant	No mitigation or monitoring required

VC	Magnitude of Effects	Geographic Extent of Effects	Timing and Duration of Effects	Frequency of Effects	Reversibility of Effects	Significance Level	Mitigation and/or Monitoring Required?
Sound: Construction Phase	Moderate – sound levels from Project activities may exceed 65 dBA at residential and sensitive receptor locations, but only during high-impact activities (intermittently)	Within the LAA	Seasonal aspects not applicable; short-term duration	Continuous	Reversible	Not significant	Mitigation required; no monitoring required
Sound: Operation Phase	Low – measurable sound levels predicted at receptor location(s), but results are below NSECC guidance	Within the LAA	Seasonal aspects not applicable; medium-term duration	Continuous	Reversible	Not significant	No mitigation or monitoring required

11.2 Summary of Mitigation Measures

A compiled list of mitigation measures identified throughout the EA is provided below.

Atmospheric Environment

General mitigation measures for fugitive emissions, exhaust emissions, and GHG emissions include:

- Conduct grading and site preparation in phases to minimize disturbed soil areas until just prior to construction activities.
- Stabilize exposed soil surfaces by sloping or using vegetation, stone, soil, or geotextiles to prevent dust and airborne particles.
- Compact and/or ridge disturbed soil to prevent dust formation.
- Cease dust-generating construction activities during periods of excessive wind.
- Enclose or cover soil storage and/or stockpile areas.
- Wet (with water) aggregate and soil stockpiles to control dust.
- Design storage areas and material stockpiles with prevailing wind directions in mind.
- Wet roadways and heavy traffic areas with water or dust suppressant technologies to minimize airborne emissions.
- Tie down, cover, and/or store loose site materials and/or products prior to inclement weather and wind events to prevent materials from becoming airborne.
- Wash down vehicles and equipment using hoses and water to remove accumulated mud/dirt on undercarriages, tracks, or wheel wells.
- Ensure Project personnel adhere to all safety protocols and wear appropriate PPE in the event of significant fugitive emissions events (i.e., windstorms, dust storms).
- Ensure equipment meets all applicable provincial and air quality regulations and emissions standards.
- Ensure equipment is fueled using low-sulfur diesel (to reduce SO_x air emissions).
- Maintain engines and exhaust systems according to the manufacturer's specifications and the recommended maintenance schedule.
- Remove from service malfunctioning equipment and/or equipment generating excess amounts of smoke, odour, or noise, until an assessment and necessary repairs can be completed.
- Remove from service construction equipment with improperly functioning emissions control systems.
- Restrict the idling of equipment where feasible.
- Use locally sourced materials, where possible, to reduce CO2, CH4, and NOx emissions associated with transport.
- Incorporate the shortest construction/transport routes where possible to minimize the use of fossil fuels during construction.
- Recover and recycle construction and demolition waste, where possible.
- Recycle and compost workforce waste (i.e., food waste). Diverting this waste will reduce methane generated in landfills as it decomposes.

- Minimize deforestation during land clearing by only clearing the area that will be needed. This will reduce CH4 and NOx emissions associated with soil disturbance and limit the use of equipment (lowering emissions produced during equipment operations).
- Plan construction activities to reduce the double handling of materials, reducing GHG emissions associated with heavy equipment operations.
- Use recycled or repurposed materials, where possible, to reduce GHG emissions associated with embodied energy (i.e., the energy associated with manufacturing a product or service).
- Ensure Project equipment meets all applicable provincial and air quality regulations and emissions standards.
- Maintain engine and exhaust systems according to the manufacturer's specifications and applicable maintenance schedule.
- Remove from service malfunctioning equipment or equipment generating excess amounts of smoke, odour, or noise until an assessment and necessary repairs can be completed.
- Ensure construction equipment with an improperly functioning emission control system is not operated.
- Ensure regular equipment maintenance is undertaken to maintain good operations and fuel efficiency.
- Ensure equipment containing coolant (i.e., air conditioning units) undergoes preventative maintenance and inspections (i.e., leak testing).
- Train Project personnel (as appropriate) in the proper disposal of halocarbon-containing substances.
- Dispose of halocarbon-containing substances at an approved hazardous waste facility per applicable regulations and in compliance with local requirements.
- Ensure trucks removing waste from or bringing materials to the Project are filled to the maximum allowable capacity where practical (dependent on the truck size and load weight) to reduce transportation requirements and limit the number of trips, where practical.
- Implement an anti-idling policy to limit GHG emissions from vehicles and equipment and limit the use of fossil fuels.
- Incorporate energy-efficient infrastructure (i.e., solar panels) where feasible to limit GHG emissions and the use of fossil fuels resulting from standard equipment (e.g., diesel-powered generators or light stands).

Geophysical Environment

General mitigation measures for avoidance of geologic hazards and groundwater resources include:

- Conduct blasting, if required, in accordance with provincial legislation and subject to terms and conditions of applicable permits.
    - Ensure all blasts are conducted and monitored by certified professionals.
    - Ensure all protective measures outlined in the EPP are implemented in advance of blasting activities.
    - Notify landowners within 800 m of any blasting activities.

    - Conduct a pre-blast survey for wells within 800 m of the point of blast in accordance with NSECC's Procedure for Conducting a Pre-Blast Survey (1993) to monitor for changes in well quality or quantity.
    - Recover and revegetate exposed soils or bedrock as required to minimize any exposure following blasting.
- Include specific mitigation for sulfide bearing materials in the EPP, if they are identified through pre-construction geotechnical surveys.
- Plan site work to minimize disturbance of slate bedrock and exposure of disturbed slate bedrock to rainfall.
- Avoid locating any disturbed or stockpiled slate within or near wetlands, watercourses, and/or waterbodies.
- Ensure rock removal in known areas of elevated sulfide potential will conform to the Sulphide Bearing Material Disposal Regulations, NS Reg 57/95 and any requirements from relevant regulatory departments.
- Store all soil removed during the excavation phase according to provincial standards and best practice guidelines.
- Store any soil needed for backfilling, after foundations have been poured, temporarily adjacent to the excavations until needed. Any remaining excavated material will be used on-site or removed and sent to an approved facility.
- Install erosion and sedimentation control measures prior to excavation activities and inspect controls on a regular basis.
- Remove temporary erosion and sedimentation controls once backfilled material has stabilized. Attention will be paid during site reinstatement to ensure areas will promote wildlife return to the area, to the extent possible.

Aquatic Environment

General mitigation measures for impacts to watercourses, waterbodies, fish and fish habitat, and wetlands include:

- Educate Project personnel on the sensitivity of aquatic habitat.
- Ensure watercourses are clearly marked and avoid impacts to the watercourse and adjacent riparian habitat to the extent possible.
- Revegetate along the watercourse edge and above the ordinary high-water mark to stabilize the area.
- Redesign existing watercourse crossings to facilitate habitat upgrades, including unblocking culverts and making waterways more conducive to fish passage.
- Locate new crossings away from potential salmonid spawning areas, such as pools with a dominant substrate of small-to-medium sized gravel (DFO, 2022a).
- Conduct work between June 1 and September 30 to avoid sensitive periods in the life cycles of fish, to better control water flow, and to allow for a faster revegetation period (NSECC, 2015a).
- Develop a site-specific erosion and sedimentation plan during the detailed design phase.
    - The plan will target the disturbance to banks (as required) and adjacent land, and

will address the type of control structures, proper installation techniques, grading, maintenance and inspection, timing of installation, and revegetation.

- Limit the area of exposed soil and the length of time soil is exposed without mitigation (e.g., mulching, seeding, rock cover).
- Limit the slope and gradient of disturbed areas to minimize the velocity of surface water runoff.
- Integrate water management systems including diversion and collection ditches, roadside drainage channels, vegetated swales, and stormwater retention ponds.
- Design any necessary alterations in a way that maintains the natural grade of the watercourse, to ensure the hydroperiod remains as it was pre-alteration.
- Fit any watercourse crossings with appropriately sized infrastructure, as prescribed by a certified Watercourse Alteration Installer/Sizer.
- Leave riparian vegetation as intact as Project developments will allow.
- Integrate outlet protection features to dissipate flow velocities and decrease erosion at the outflow.
- Ensure that if concrete is to be used, it is pre-cast and cured for at least one week prior to use at a crossing site (NSECC, 2015a).
- Utilize untreated, rot-resistant timber (e.g., hemlock, tamarack, juniper, or cedar) below the ordinary highwater mark to avoid the leaching of toxic preservatives into waterways (NSECC, 2015a).
- Utilize rock material that is clean, coarse granular, non-ore-bearing, non-watercourse-derived, and non-toxic to aquatic life (NSECC, 2015a).
- Flag wetlands to avoid interference with wetland habitat to the extent possible.
- Complete in-season wetland surveys for areas subject to minor layout modifications (refer to Section 7.3.3.5).
- Avoid impacts to wetlands to the extent possible.
    - Where unavoidable, complete wetland alterations in accordance with the NS Wetland Conservation Policy and the wetland alteration process during the permitting stage, which includes a requirement to compensate for lost wetland habitat and functions.
    - Design wetland crossings to occur at the narrow part of the wetland or the wetland's edges, to the extent possible.
- Design wetland crossings to avoid permanent diversion, restriction, or blockage of natural flow, such that hydrologic function of wetlands will be maintained.
- Limit the area of exposed soil and the length of time soil is exposed without mitigation (e.g., mulching, seeding, rock cover).
- Use the existing roads and access routes to the extent feasible.
- Avoid travel through wetlands. If travel through wetlands is required:
    - Use anti-rutting mitigation (e.g., mud mats), as appropriate.
    - Cross the wetland at the narrowest portion, where possible.
    - Time work to occur during frozen ground conditions, where possible.
- Avoid surface run-off containing suspended materials or other harmful substances.
- Direct run-off from construction activities away from wetlands.

- Maintain existing vegetation cover, where possible.
- Use water or an approved dust suppressant to control dust on roads, as required.
- Enforce site speed limits to minimize dust generation.
- Use quarried, crushed materials for road construction to reduce the introduction of invasive vascular plant species, where possible.
- Prior to arrival on site equipment will be cleaned and inspected to prevent the introduction of invasive/non-native species.
- Delineate and flag wetlands to avoid unnecessary compaction within wetlands.
- Train staff on the requirements for work in and around wetlands.
- Avoid travel through wetlands. If travel through wetlands is required:
    - Use anti-rutting mitigation (e.g., mud mats), as appropriate.
    - Cross the wetland at the narrowest portion, where possible.
    - Time work to occur during frozen ground conditions, where possible.

Terrestrial Environment

General mitigation measures for impacts to terrestrial habitat, flora, fauna, bats, and avifauna include the following:

- Minimize overall area to be cleared, fragmentation of habitats, and isolation of existing habitats by utilizing pre-existing roads and previously altered areas (i.e., clearcuts).
- Restore cleared areas where possible to reduce permanent habitat loss, primarily through revegetation of road rights-of-way.
- Revegetate disturbed areas, exposed soils, and cleared areas using native seed mixes.
- Minimize use of road salt to minimize attraction of ungulates to roadsides during the winter.
- Use seed mixes that do not contain clover to avoid attracting deer (which carry ticks) to the area when revegetating road rights-of-way and other cleared areas requiring revegetation.
- Complete in-season rare plant and lichen surveys for areas subject to minor layout modifications (further discussed in Section 7.3.3).
- Maintain avoidance of flora SOCI from areas with known occurrences during the design phase.
    - Desktop and field assessments identified important habitat features with terrestrial flora SOCI locations to be avoided during the design phase.
    - Additional surveys will be conducted to determine the presence (if any) of flora SOCI in the Assessment Area which have not yet been surveyed during the growing season.
- Educate Project personnel about the potential for plant or lichen SOCI during construction.
    - Guidance will be provided to Project personnel to raise awareness of terrestrial flora SOCI that are known to exist within the Study Area to increase the number of trained eyes looking for these species.
- Consult with NSNRR if an unexpected flora SOCI is encountered during construction

activities. Potential mitigation measures based upon recognized practices to transplant or collect seeds can be used as a contingency if flora SOCI are unexpectedly encountered during construction activities. A transplantation plan will be developed along with a monitoring protocol through consultation with NSNRR should this be required during construction.

- Minimize (through avoidance) the loss of important habitat which supports terrestrial flora SOCI during the detailed design phase.
- Restore as much habitat as possible through revegetation (with native seed mix) to promote continued growth of terrestrial flora across the Study Area.
- Ensure equipment is as clean as possible to prevent the introduction of non-native species into previously untouched areas.
    - Because non-native species are already present within the Study Area, care will be taken when travelling from developed areas to intact areas so that plant material is not transferred between locations.
- Continue to review habitat modelling results, field survey results, and guidance from NSNRR through the detail design phase.
- Revegetate roadsides and cleared areas to minimize lost habitat as much as possible.
    - Reclaim small roads leading to turbines to minimize long-lasting effects of habitat loss.
- Augment connectivity by maintaining semi-artificial pathways such as wildlife corridors, greenbelts, and vegetated buffers around wetlands and watercourses, where possible.
- Revegetate as much cleared area as possible to limit the effects of fragmentation.
- Design the Project footprint to minimize road density and utilize pre-existing roads to the greatest extent possible.
- Install traffic signs to alert road users of speed limits and the presence of wildlife in the area.
    - Inform all Project-related staff working on the site of dangers to wildlife and create awareness around wildlife hotspots on the site.
- Minimize Project-related traffic to reduce chances of wildlife collisions and traffic-related stress to wildlife.
- Impose restrictions on site access if deemed necessary due to a substantial increase in wildlife collisions and mortality.
- Avoid removal of vegetation/habitat alteration in key habitat areas during sensitive windows for priority species, where possible, including:
    - Mainland moose – late May to early June (birthing season) and September to October (breeding season)
    - Fisher – March to April
- Minimize loss of important habitat required by priority species for reproduction events, including:
    - Mainland moose – wetlands and isolated islands/peninsulas
    - Fisher – large diameter snags, large woody debris, or live standing trees in mature, intact forests

- Minimize overall area to be cleared to maintain refugia and cover for protection from predators.
- Maintain all equipment and machinery on site to reduce noise and vibration emissions associated with malfunctions. Where practical, install vehicles and machinery with noise muffling equipment to limit disturbance.
- Restrict on-site lighting, especially at night, to limit disturbance.
- Prohibit harassment and feeding of wildlife by Project personnel.
- Complete clearing during winter months when bats are overwintering in caves (end of September to late April).
- Maintain avoidance of important bat habitat (i.e., Lear Shaft, caves, and abandoned mines) to the greatest extent possible.
- Avoid/minimize the removal of large diameter (≥25 cm) snags and hollow trees (bat over-day roosting habitat) within the Project Area during the detail design phase, to the greatest extent possible.
- Minimize fragmentation and habitat isolation during the design phase.
- Continue to prioritize the use of existing roads to the extent possible to minimize increases in the road density.
- Restrict lighting to minimums required for safety considerations.
- Utilize noise controls (e.g., mufflers) on machinery, equipment, etc. during construction of the Project.
- Avoidance of topographic funnels, such as within lake or river valleys, for turbine placement to reduce the likelihood of interactions with concentrated bird movements.
- Avoidance, to the extent possible, of important bird habitats, such as wetlands, waterbodies, old-growth forest, etc. to reduce the impact of habitat changes. This includes siting Project infrastructure within areas with existing disturbances, such as existing roads and cutover areas of forest.
- Adhere to ECCC guidelines on clearing windows for nesting migratory birds. Vegetation clearing activities will be conducted outside of the nesting period that is generally from April 1 to September 30 each year. Timing of clearing activities are generally dependent on seasonal conditions.
- Establish speed limits within the Project Area for construction vehicles to mitigate the effect of vehicle-avifauna collisions.
- Incorporate a lighting plan for construction-related activities into the EPP.
- Maintain good housekeeping practices during construction to avoid indirectly feeding birds, and potentially attracting nuisance wildlife.
- Develop a spill response plan, and an emergency response plan within the EPP to mitigate the impacts of spills, hazardous substances, and other emergencies.
- Develop a fire response plan in accordance with provincial standards.
- Revegetate disturbed areas, as appropriate.
- Install avian deflectors on powerlines, including any powerline spans, or areas of line that will be identified in the EPP as requiring mitigation based on monitoring results.
- Minimize lighting, to the extent possible.
- Develop a site reclamation plan in accordance with engineering standards and in consultation with NSECC and NSNRR.

Socio-Economic Environment

General mitigation measures for traffic, transportation, recreation, and tourism include:

- Install notices in public areas to inform residents of signage removal or road infrastructure alterations, as well as notify relevant municipal government staff of construction scheduling and safety measures.
- Replace removed signage and guardrails immediately with appropriate temporary signage to ensure travelling public safety.
- Complete upgrades to roads and overhead wires, branches, and signs if conflicts arise.
- Complete modifications and associated reinstatement to relevant specifications.
- Avoid, to the extent possible, transportation through urban areas during high traffic times (e.g., 7-9 am and 3-6 pm; Monday to Friday).
- Conduct all travel using safe work practices for transporting oversized loads.
- Utilize the minimum number of vehicles possible to minimize impacts to road-way flow and impacts on air quality due to exhaust.
- Ensure vehicles only visit and work on-site during normal daytime hours of operation, where possible, and avoid high-traffic times of day to reduce local traffic congestion.
- Continue to work with local recreation groups to ensure continued access within the Project Area.

Archaeological Resources

The following mitigation measures are recommended:

- Complete shovel testing in areas of high potential prior to ground disturbance if they cannot be avoided during the detail design phase.
- Provide the EA Branch with the acceptance letter from NSCCTH prior to any disturbance in those areas.
- Develop a chance find procedure in the EPP related to the potential unexpected discovery of archaeological items or sites, or human remains, during construction. This would include halting any work immediately upon discovery of suspected resources and contacting NSCCTH. If the resources are suspected to be of Mi'kmaq origin, the Executive Director of KMKNO would also be contacted.
- Conduct additional archaeological assessment if, during the detail design phase, it is determined that ground disturbance is required in areas not previously assessed. The EA Branch will be provided with the acceptance letter from NSCCTH prior to completion of any disturbance in newly proposed areas.

Other Considerations

General mitigation measures for impacts to human health, EMI, shadow flicker, visual impacts, and sound include the following:

- Continue engagement and education with local recreational users (Section 6.0) regarding the safe continued use of lands within the Study Area.
- Install signage illustrating and warning of potential hazards associated with ice throw and fall around wind turbines.

- Equip staff and workers accessing the Project Area for maintenance or other purposes with necessary PPE and associated safety protocols and procedures to mitigate risk of injury and/or fatality, especially during potential icing conditions.
- Ensure operators are consulted on any future layout updates.
- Continue consultation with operators who have not yet responded to the notification letters and/or who express concerns about the layout presented.
- Follow up with Bell Aliant once additional study has been completed.
- Use noise suppressants (e.g., mufflers) on vehicles/equipment, where possible.
- Limit vehicle idling.
- Conduct construction activities within the recommended daytime hours of 7:00 am to 10:00 pm to the extent possible.
- Include mitigation and monitoring for blasting in the Project's EPP, if geotechnical investigations determine this activity is required during construction.

12.0 EFFECTS OF THE ENVIRONMENT ON THE UNDERTAKING

The following section discusses potential effects of the natural environment, including natural hazards and weather events, on the infrastructure and operation of the Project. Potential sources of effects from the environment are described below, including mitigation and design strategies for reducing the significance of residual effects.

The primary mitigative measure employed during the construction and operation of the Project will be to educate and train site personnel. Environmental and safety orientations will be conducted prior to the start of construction and all staff will be informed of the potential effects of the environment on the Project. Staff responsible for the operation and maintenance of the Project will be trained in the design and operation of the turbine, including applicable operating procedures, safety protocols, and evacuation plans. To further mitigate damage that cannot be controlled by education and training alone, turbines will all be equipped with safety mechanisms to limit damage resulting from extreme weather events.

12.1 Climate Change

Climate change is the persistent change in the state of the climate which lasts for decades or longer (IPCC, 2018). Climate change may impact the Project through increased occurrences of extreme weather, precipitation, and subsequent flooding. In addition, increased weather extremes due to climate change may impact turbines, powerlines, and/or roadways, causing washouts and/or damage to infrastructure.

12.1.1 Temperature

One major change associated with climate change is global warming, which is defined as an increase in global mean surface temperature averaged over a 30-year period, relative to pre-industrial temperatures (IPCC, 2018). Projected rising temperatures associated with global warming may impact many phases of the Project and on-site personnel. For example, longer and more intense heat waves may increase heat-related illnesses and increase the risk of food and

water-borne contamination. Hotter and drier conditions also increase the risk of droughts and wildfires during construction and operation activities (GOC, 2019c). Requirements for stopping work or taking regular breaks to cool down and rehydrate will be mandated throughout the Project's lifetime to protect Project personnel.

Warmer temperatures can also spread forest and agricultural pests and disease vectors (i.e., ticks) to the Project location. Invasive plant species are discussed in greater detail in Section 7.4.2.

12.1.2 Sea Level Rise

The Project Area is over 15 km south from Lower Barneys River, the closest tidal water to the Assessment Area. The proposed access road leading to the Project Area is approximately 190 to 215 masl. The majority of the Assessment Area is, however, between approximately 200 to 260 masl, and the proposed turbine locations are between 220 masl and 275 masl and should therefore experience negligible impacts from rising sea levels.

12.1.3 Flooding

Flooding in the Study Area may increase due to more frequent severe precipitation associated with climate change. Due to the effects of ocean warming, climate change is predicted to produce more intense precipitation, which may result in increased flood risk (US EPA, 2022a). Flooding may impact both terrestrial and aquatic habitat, damage project infrastructure, and limit site access. The Project will mitigate the risks of flooding by concentrating the road and turbine layout in high elevation areas, maintaining regular upkeep and grading of roads to reduce formation of ruts, designing roadside ditches and water off-take infrastructure next to all roads to encourage drainage of rainwater off the roads, and revegetating roadsides to absorb excess water.

12.2 Natural Hazards

12.2.1 Severe Weather Events

Nova Scotia is subject to severe weather events, including heavy rainfall, blizzards, and hurricanes, all of which may lead to negative outcomes including power outages, health related emergencies, infrastructure damage, and road damage, and therefore may pose direct risks to wind farm infrastructure (GOC, 2018). Heavy rainfall is a common, highly probable natural hazard in Nova Scotia. Short duration heavy rainfall is defined as 25 mm or more of rain within one hour, while long duration heavy rainfall can range from 25 mm of rain or more within 24 hours during winter, or 50 mm of rain or more within 24 hours during summer (ECCC, 2020). Heavy rain or snow melt has the potential to deposit high quantities of water within the Project Area in a short period of time. Project design features noted in Section 12.1.3 will also mitigate the effects of heavy rainfall and snow melt to maintain road access during severe precipitation events.

Wind and lightning, which may be associated with heavy rainfall or hurricane conditions, may increase the risk of mechanical issues or electrical fires. Restricted access to the site during severe weather events may limit the ability to shut down the system to prevent damage. To mitigate this risk, the turbines will be equipped with an automatic shut down when thresholds for wind are reached and will also be designed with a built-in grounding system for lightning strikes. In addition, the Proponent will ensure access is maintained, either by clearing the roads or providing vehicles that can traverse all conditions.

12.2.2 Turbine Icing

Turbine icing occurs when ice accumulates on the surface of turbine blades, a condition created by specific temperatures and levels of humidity or the presence of freezing rain. The chances of turbine icing increase when the blades reach 150 m above ground, where the lower clouds may contain supercooled rain (Seifert et al., 2003). Turbine icing may lead to ice throw or ice fall, and the distance and direction in which the ice is thrown/falls is dependent on factors such as wind speed, rotor speed, rotor azimuth, the position of the ice on the blade, and the characteristics of the ice itself. Due to the numerous factors contributing to where these ice fragments may land when thrown/fallen, the likelihood of a human being struck is insignificant and thus the risk of injury is minute (LeBlanc, 2007). The impacts from turbine icing on human health are discussed further in Section 10.1.1. To further reduce the risk of injury from ice throw or falling ice, restricted site use may be enforced when the ideal weather conditions for turbine icing are present. Education of operators, adequate signage warning of falling ice, and the requirement to wear hardhats around operational turbines will also be implemented. Additionally, the turbines will be equipped to automatically shut down when thresholds for ice formation are detected.

12.2.3 Wildfire

The Forest Fire Protection Regulations, NS Reg 135/2019 outline restrictions for burning and operating power saws during the fire season (March 15 to October 15). Burning restrictions are determined daily, depending on the Fire Weather Index (FWI). The Nova Scotia government employs an FWI during the fire season to determine fire danger across the forested areas in Nova Scotia (NSNRR, 2021b). A higher FWI score indicates that if a fire were to start it would be of high intensity and pose greater danger than a lower FWI score. Operation of power saws and/or clearing saws in forested areas within the Project Area will only occur when and as permitted under the Forest Fire Protection Regulations, NS Reg 135/2019. Any activities requiring burning during the Project lifetime will be timed according to local burning restrictions.

As a best practice, the FWI can be used to determine fire danger associated with activities that may result in burning. The FWI during the summer months across the Study Area ranges from low (0-5) to high (10-20) (NRCan, 2022b). Federal and provincial FWI data is updated daily, with the closest provincial weather stations to the Study Area being Keppoch Mountain (NSNRR, 2021b; NRCan, 2022b). Although most days (64 out of 122 days) between June to September had a low FWI score, to mitigate potential risk of wildfire, safety protocols will be put into place such as implementing a fire prevention and site evacuation plan. Furthermore, the FWI will be checked regularly at nearby weather stations during summer months to determine the potential

for highly dangerous wildfires. Precautions should be taken when undergoing construction or maintenance activities that could result in fires on days when FWI scores are >5, such as mechanical brushing/land clearing, using spark-producing tools, or piling of woody debris (Wildfire Regulation, BC Reg 38/2005). Should the risk of fires increase throughout the lifetime of the Project, mitigation strategies to protect Project infrastructure and relevant VCs will be adapted accordingly.

12.3 Potential Residual Effects

Environmental effects associated with climate change and natural hazards have the potential to result in a significant effect on the Project. Project location siting and design measures will minimize many of the risks associated with these environmental hazards, and the mitigation measures described above will allow for both proactive and adaptive management of any remaining risks, thus limiting the likelihood of impacts on all phases of the Project. Therefore, the residual effects associated with climate change are considered not significant.

13.0 ACCIDENTS AND MALFUNCTIONS

Without proper mitigation, accidents and malfunctions can interact with many VCs and potentially result in adverse effects. However, implementing preventative measures limits the probability of occurrence, and having appropriate response procedures in place reduces the magnitude of residual effects.

Accidents, malfunctions, and unplanned events considered for this Project include:

- Erosion and Sediment Control Failure
- Fire
- General Hazardous Material Spill

The safety of on-site personnel is a vital Project component; however, it is not specifically considered in the EA, as workplace occupational health and safety is regulated by the policies, procedures, plans, and codes of practice set in the *Occupational Health and Safety Act,* SNS 1996, c 7.

13.1 Erosion and Sediment Control Failures

Failure of erosion and sedimentation controls may result in potential adverse effects on VCs (primarily during construction), most notably to watercourses, wetlands, and fish and fish habitat. Erosion and sedimentation controls may fail due to extreme weather conditions (e.g., flooding), improper installation, improper maintenance, and unforeseen accidents (e.g., collisions). Failure of these control measures may release sediment into the environment, impacting water quality and aquatic and terrestrial habitats.

Mitigation measures to limit the probability of an occurrence and reduce the magnitude and extent of potential effects include:

- Implement all mitigation related to erosion and sediment control provided in Sections 7.3.1, 7.3.2, and 7.3.3.
- Develop and implement an erosion and sedimentation control plan (ESCP) for all phases of the Project.
- Ensure erosion and sediment controls are installed per the manufacturer's specifications.
- Heed ECCC's special weather warnings to ensure proper care is given to stabilize erosion and sediment controls in advance of, and following, extreme weather events.
- Conduct regular monitoring of all the erosion and sediment controls and repair or replace them as necessary.
- Ensure erosion and sediment controls are functioning effectually, and that additional supports or controls are available on hand and able to be applied to support these efforts.
- Ensure workers are trained to properly install and repair erosion and sediment controls.

13.2 Fires

An accidental fire could potentially adversely affect the atmospheric environment (emissions), the terrestrial environment (vegetation and wildlife), and the socio-economic environment (land use and value) during all Project phases.

Mitigation measures to limit the probability of an occurrence and reduce the magnitude and extent of potential effects include:

- Prohibit the use of campfires or burning within the Project Area by staff and contractors.
- Dispose of all flammable waste regularly at an approved facility.
- Implement mitigation related to chemical and fuel storage (Section 13.3).
- Smoke in designated areas only.
- Equip heavy machinery and turbines with fire suppressant equipment and ensure response materials are available during construction and turbine operation.
- Maintain vegetation clearing at turbines pads throughout the Project's operation to act as a firebreak, and remove cleared vegetation from the Project Area to reduce fuel build-up

13.3 General Hazardous Material Spills

Hazardous spills resulting from fuel (i.e., storage, refueling, operation of combustion vehicles) and other on-site chemicals may occur during the Project's construction and operations activities. Hazardous spills can adversely impact air, soil, surface water, groundwater quality, human health, and safety. In addition, hazardous spills may risk the health of aquatic, avian, and terrestrial wildlife. The severity of the impacts will depend on the nature of the hazardous material and the quantity spilled.

Mitigation measures to limit the probability of an occurrence and reduce the magnitude and extent of potential effects include the following:

- Develop spill prevention and response procedures as part of the Project's EPP, which will set out spill prevention and response procedures.
- Store all fuels, lubricants, and hazardous material in designated containers and areas.
- Provide secondary containment in storage areas (where possible).
- Inspect equipment for fluid leaks.
- Locate fuel storage areas, refueling, and/or equipment lubrication a minimum of 30 m from surface water (i.e., watercourse) and groundwater feature (i.e., well).
- Refuel machinery and equipment on an impervious surface, where possible. If this is not possible, require that the work is completed in a designated area, greater than 30 m from a watercourse/water body/wetland.
- Complete equipment service off-site, where possible. If this is not possible, require that the work is completed in a designated area, greater than 30 m from a watercourse/water body/wetland.
- Store all dangerous goods in compliance with the Workplace Hazardous Material Information System.
- Equip mobile equipment with spill kits stocked with appropriate spill containment materials for the activities taking place, such as soaker pads, oil-absorbing materials, and containment booms.
- Locate stationary spill kits or spill drums at work areas utilizing mobile equipment, hazardous fluids and/or in proximity to environmentally sensitive areas (i.e., wetlands or watercourses).
- Stock spill kits with the appropriate quantity and type of material for the anticipated product type(s) and volume(s) in use.
- Train site workers on site specific spill response requirements and equipment.

With the implementation of the above preventative measures, the likelihood of an accident or a malfunction is low. Appropriate response plans will be put in place to ensure any interactions with VCs from an accident or malfunction are limited and the effects can be quickly contained.

14.0 CUMULATIVE EFFECTS

14.1 Overview

Cumulative effects are changes to environmental, social, and economic values caused by the combined effect of past, present, and potential future human activities and natural processes (Government of British Columbia, n.d). Concerns are often raised about long-term changes that may occur not only as a result of a single action but of the combined effects of each successive action on the environment (Hegman et al., 1999). While a single undertaking might not cause significant adverse effects, multiple undertakings may result in incremental impacts, referred to as cumulative effects. These cumulative effects may potentially result in an overall impact to a VC of interest.

14.2 Other Undertakings in the Area

There are no wind farm developments located within 3 km of the Study Area, as per the recommended buffer in the Guide to Preparing an EA Registration Document for Wind Power Projects in Nova Scotia (NSECC, 2021). The nearest wind developments outside that buffer include:

- Avondale Community Wind Park located approximately 13 km north near Avondale, NS. This wind development was developed in 2016 and consists of one Enercon E92 wind turbine (NRCan, 2021).
- Glen Dhu Wind Farm located approximately 15 km north near Baileys Brook, NS. This wind development was developed in 2001 and consists of 27 Enercon E-82/2300 wind turbines (NRCan, 2021).
- Auld's Mountain Wind Farm and Pictou Landing Wind Farm located approximately 15 km northwest near Broadway, NS. These wind developments were developed between 2015 and 2017, with a combined three Enercon E92 wind turbines (NRCan, 2021).
- Maryvale Wind Farm located approximately 25 km northeast in Pictou County. This wind development was developed in 2010 and consists of four Vensys V77 wind turbines (NRCan, 2021).

The aforementioned wind developments will not be considered/assessed further for potential cumulative effects based on the distance from the Project (NSECC, 2021) and the majority of the wind developments are small scale (one to two wind turbines).

Table 14.1 summarizes other industrial activities/developments near the Assessment Area (within approximately 5 km).

Table 14.1: Nearby Industrial Activities/Developments

Development	Development Activity	Status of Activity	Activity Location	Distance from AA*
Forestry	Harvests, thinning, plantations, & other treatments	Active	Throughout Study Area	Within AA
Highway 104 Construction	Rerouting of Highway 104	Active	North of Study Area	0.1 km north
Riverside International Speedway	Asphalt speedway	Active	James River, NS	1.6 km east

*Distance to nearest point of the Assessment Area

14.3 Cumulative Effects Assessment

Cumulative effects were assessed for the Project by taking into consideration the potential residual effects of significance (as identified in VC sections) in relation to the activities that have taken place in the past, those that currently exist, and those that can be reasonably expected to be developed within the area surrounding the Project (i.e., undergoing regulatory approval/under

construction). Table 14.2 summarizes the potential for VCs to have cumulative impacts with other undertakings in the area.

Table 14.2: Potential for Cumulative Effects on Identified VCs

VC	Cumulative Effects Assessed	Reasoning
Atmosphere	No	Residual positive impacts in regard to provincial GHG emissions from the use of renewable energy resources.
Geology	No	The Project will not impact the geologic environment outside the Project Area or interact with nearby industrial activities.
Waterbodies & Watercourses	No	The Project is maximizing use of existing roadways, minimizing the disturbance of surface freshwater resources. Residual impacts will be mitigated, monitored, and be contained within the Project Area.
Fish & Fish Habitat	No	Utilization of existing roadways, minimizing the requirement for new crossings/disturbance of potential fish habitat. Watercourse crossings will have applied mitigation and monitoring.
Wetlands	No	The Project is maximizing use of existing roadways, minimizing the disturbance to wetlands. All impacted wetlands will be compensated.
Terrestrial Habitat	No	The Project Area is located within an active forest management area, such that a large portion of tree removal would have been subject to future harvesting in the absence of the Project.
Terrestrial Flora	No	Avoidance of SOCI.
Terrestrial Fauna	No	Avoidance of SOCI.
Bats	No	Nearest wind developments are located 13 km from the Study Area.
Avifauna	No	Nearest wind developments are located 13 km from the Study Area.
Economy, Land Use, Transportation, & Recreation/Tourism	No	Residual impacts considered not significant or positive.
Archeology, Culture, & Heritage	No	Avoidance of archaeological, historical, or culturally significant areas.
Human Health	No	Residual impacts to human health are not anticipated.

VC	Cumulative Effects Assessed	Reasoning
EMI	No	Residual impacts considered not significant.
Shadow Flicker	No	Shadow flicker produced by the Project is within guidelines. No other wind developments are within 3 km of the Project.
Visual Aesthetics	No	Residual impacts considered not significant.
Sound	No	Sound levels from the operation of wind turbines are below guidelines. No other wind developments are within 3 km of the Project.

None of the identified VCs have been considered or assessed at a cumulative level based on: the nearest wind development being 13 km from the Study Area and the nature of nearby industrial activities. Nearby developments identified (i.e., forestry & highway construction) are not anticipated to interact with the Project in a way that results in adverse cumulative impacts on the surrounding biophysical, archeological/ cultural, or socioeconomic environment. Active forestry activities have already resulted in wide-spread habitat removal and an existing road network throughout the Study Area, which the Project is utilizing to minimize requirements for clearing. It is also likely that a large portion of the remaining required tree removal for the Project would have been subject to future harvesting in the absence of the Project.

15.0 CONCLUSION

In accordance with A Proponent's Guide to Environmental Assessment (NSECC, 2017), the studies, regulatory assessments and VC evaluations described within this EA Report have been considered both singularly and cumulatively, for all phases of the Project.

The results of this assessment indicate that in consideration of the Project's mitigative and protection measures, adverse residual effects are not anticipated to be significant.

16.0 CLOSURE

This EA Report was completed by Strum Consulting, an independent, multi-disciplinary team of consultants with extensive experience with submission of EA Registration documents for undertakings within Atlantic Canada. Curriculum vitae for EA Report contributors and Project Team members are provided in Appendix P. A list of the Project Team and their associated roles is provided below.

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