MERSEY RIVER WIND FARM

Environmental Assessment Registration Document

MERSEY RIVER WIND FARM

Environmental Assessment Registration Document

Prepared By:
Strum Consulting
Railside, 1355 Bedford Hwy.
Bedford, NS B4A 1C5

Prepared For:
Mersey River Wind Inc.
Suite 1500, 1625 Grafton Street
Halifax, NS B3J 0E8

MERSEY RIVER WIND

January 27, 2023

Ms. Helen MacPhail
Nova Scotia Department of Environment & Climate Change
Environmental Assessment Branch
1903 Barrington Street, Suite 2085
PO Box 442
Halifax, NS B3J 2P8

Re: Environmental Assessment Registration Document
Mersey River Wind Farm Project

Ms. MacPhail,

Please find enclosed the Environmental Assessment Registration Document for the Mersey River Wind Farm Project.

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

Sincerely,

Daniel Roscoe, P. Eng.
President
Mersey River Wind Inc.

Cc Melanie Smith

EXECUTIVE SUMMARY

Mersey Wind River Inc. acknowledges that the Mersey River Wind Farm Project is in Mi'kma'ki, the traditional and unceded territory of the Mi'kmaq people.

Mersey River Wind Inc. proposes to construct and operate the Mersey River Wind Farm Project, a 148.5 megawatt (MW) wind development located near the community of Milton in Queens County, Nova Scotia. The Project will consist of 33 (4.5 MW) wind turbines along with associated infrastructure, including access roads and interconnection lines. The development of this Project will support Nova Scotia in their target of producing 80% renewable energy by 2030, reducing the provinces 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. This 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, and will not act cumulatively with nearby developments. 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.

Mersey River Wind Inc. 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.

TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

ACCDC	Atlantic Canada Conservation Data Centre
AM	Amplitude modulation
AQHI	Air Quality Health Index
ARIA	Archaeological Resource Impact Assessment
ATSC	Advanced Television Systems Committee
ATV	All-terrain Vehicle
ARD	Acid Rock Drainage
AVDI	Average Total Diameter
BBS	Breeding Bird Surveys
BMPs	Best Management Practices
CAAQS	Canadian Ambient Air Quality Standards
CanWEA	Canadian Renewable Energy Association
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
CLC	Community Liaison Committee
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CWS	Canadian Wildlife Service
dBA	Decibels (A-weighted)
DEM	Digital Elevation Model
DFO	Fisheries and Oceans Canada
DND	Department of National Defence
DTV	Digital Television Station
EA	Environmental Assessment
ECCC	Environment and Climate Change Canada
EMF	Electromagnetic Fields
EMI	Electromagnetic Interference
EPP	Environmental Protection Plan
ESA	Endangered Species Act
FAC	Facultative
FACU	Facultative Upland
FACW	Facultative Wetland
FM	Frequency modulation
FWI	Fire Weather Index
GHGs	Greenhouse Gases
GIS	Geographic Information System
GPS	Global Positioning System
HPAs	High Potential Areas

KMKNO	Kwilmu'kw Maw-klusuaqn
IBA	Important Bird Areas
IBoF	Inner Bay of Fundy (Atlantic salmon population)
IPCC	United Nations Intergovernmental Panel on Climate Change
IRM	Integrated Resource Management
kWh/year	Kilowatts per hour per year
LAA	Local Assessment Area
LABO	Eastern red bat
LACI	Hoary bat
LANO	Silver-haired bat
LOA	Letter of Authorization
Lpm	Litres per minute
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
MEKS	Mi'kmaq Ecological Knowledge Studies
Met Tower	Meteorological Tower
mg/L	Milligrams per litre
mS/cm	MilliSiemens per centimetre
MW	Megawatt
MYOT	Myotis Species
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
NREL	National Renewable Energy Laboratory
NS	Nova Scotia
NS AAQS	Nova Scotia Ambient Air Quality Standards
NSAQR	Nova Scotia Air Quality Regulations
NSCCTH	Nova Scotia Communities, Culture, Tourism and Heritage
NSECC	Nova Scotia Environment and Climate Change
NSNRR	Nova Scotia Natural Resources and Renewables
NS Power	Nova Scotia Power Inc.
NSPW	Nova Scotia Public Works
NSSU	Nova Scotia Southern Upland (Atlantic salmon population)
NTSC	National Television Standards Committee
NSTDB	Nova Scotia Topographic Data Base
O_3	Ozone
OBL	Obligate

PESU	Tri-colored Bat
PID	Property Identification
PM	Particulate Matter
PPE	Personal Protective Equipment
Q_{20}	Long term safe yield
RAA	Regional Assessment Area
RABC	Radio Advisory Board of Canada
ROW	Right of way
RoQM	Region of Queens Municipality
RTR	Renewable to Retail
SAR	Species at Risk
SARA	Species at Risk Act
SCADA	Supervisory Control and Data Acquisition
SFA	Salmon Fishing Area
SGEM	Silvicultural Guide for the Ecological Matrix
SO_2	Sulfur Dioxide
SO_x	Sulfur Oxides
SOCI	Species of Conservation Interest
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	Microns or micrometres
µg/m3	micrograms per cubic metre
UNKW	Unknown
UPL	Upland
UTM	Universal Transverse Mercator
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
WHMIS	Workplace Hazardous Material Information System
WSS	Wetlands of Special Significance

LIST OF DRAWINGS

LIST OF APPENDICES

1.0 PROPONENT DESCRIPTION

The Mersey River Wind Farm (the Project) is a 148.5 megawatt (MW) wind power project proposed by Mersey River Wind Inc. (the Proponent) and executed by Roswall Development Inc., a team experienced with the development of renewable energy and energy retrofit projects. The company is focused on enabling regions, industries, and public institutions to become energy self-sufficient through the development of renewable resources and energy efficiency retrofits. The Roswall team has over 12 years of experience and has successfully developed, built, and operated $150 million of wind and solar projects, along with an extensive portfolio of renovated public infrastructure.

The Proponent retained Strum Consulting to support the development and submission of the Environmental Assessment (EA). Strum 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	Mersey River Wind Farm
Proponent Name	Mersey River Wind Inc.
Chief Executive Officer(s) / Principal(s)	Daniel Roscoe P.Eng., CEO Roswall Development Inc. and Mersey River Wind Inc.
Mailing and Street Address	Mersey River Wind Inc. Suite 1500, 1625 Grafton Street, Halifax, NS B3J 0E8
Proponent Contact Information for the EA Registration	Mitch Underhay Email: mitch@roswall.ca
Consultant Information	
Name of Consultant	Strum Consulting
Mailing and Street Address	Strum Consulting Railside, 1355 Bedford Highway Bedford, NS B4A 1C5
EA Contact	Melanie Smith, VP Environmental Assessment and Approvals Phone: 902-835-5560 Email: msmith@strum.com

2.0 PROJECT INFORMATION

2.1 Project Introduction

The Project is located near the community of Milton, within the Mersey River watershed in Queens County, Nova Scotia (Drawing 2.1). The Universal Transverse Mercator (UTM) coordinates for the approximate center of the Project are 44.0741° N, 64.8651° W. The Project proposes the construction of 33 Vestas V150 wind turbines (4.5 MW each) which have a hub height of 105 m and a rotor diameter of 150 m, for a total height of 180 m. The proposed turbine locations are shown on Drawing 2.2.

The Study Area consists primarily of Crown lands, with the use of some private lands necessary for the interconnection route. The Crown lands are currently utilized for forestry, hunting, fishing, and recreational use. The Project is currently in the process of applying for a Crown lease and easements, which are under review with Nova Scotia Natural Resources and Renewables (NSNRR). This EA is a prerequisite to the final Crown lease and easements, which will require Ministerial approval. Private land agreements are currently being finalized. No work will be completed on these lands until agreements are registered.

Upon approval of the EA, construction activities are proposed to begin in the Winter of 2023 and once constructed, the Project is expected to be operational for a minimum of 20 years.

2.2 Purpose and Need for the Undertaking

With this Project, for the first time ever, Nova Scotians will have choice in the electricity market and the ability to purchase clean renewable electricity directly. This Project will be the first to use the Renewable to Retail (RTR) Program. Enabled by changes to the *Electricity Act* in 2015, RTR allows private entities to register as Licensed Retail Suppliers and sell electricity directly to consumers using Nova Scotia Power Inc.'s (NS Power) infrastructure with predetermined tariffs. A company associated with the Proponent was approved by the Nova Scotia Utility and Review Board as a Licensed Retail Supplier via the RTR Program on October 27, 2021.

Nova Scotia has set a new target of producing 80% renewable energy by 2030 and the development of wind energy is expected to be a significant part of achieving that goal. As such, the Project has been proposed in support of this renewable energy target. A dependence on fossil fuels increases the vulnerability of Nova Scotians to rising international energy prices, weakens energy security, and takes valuable revenue out of the province, further leading Nova Scotia towards a preference for renewable energy (Province of NS, 2015). Negative impacts to human health, particularly in developing countries, and the environment, mainly in the form of climate change, are among the widely cited global challenges associated with fossil fuel consumption.

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 changes to the thermal dynamics and quality of aquatic habitats, shifts in migratory timing and ranges of fauna and flora, changes in fish abundance, and increased risk of extinction and 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). 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 megawatt of wind energy generated, greenhouse gas emissions are reduced in comparison to previous levels associated with coal-related production (NSNRR, u.d). 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.
- Educational opportunities for youth and the broader community about 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 contribute to meeting Nova Scotia's renewable energy goals by producing enough green energy to provide approximately 5% of Nova Scotia's electricity demand with stable, locally-produced, renewable energy.

The Project is committed to sharing economic opportunities with the local community throughout the development and life-span of the Project via the use of local skills and labour where possible, municipal tax revenue, and ongoing energy literacy/education. The Project Team will create a Community Liaison Committee (CLC), which will help to identify Project-related opportunities and benefits for the local community.

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, SOR/2019-285 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	Approved
Aeronautical obstruction clearance	Transport Canada	Approved
Lighting design for navigational purposes	Transport Canada	Approved
Final design, location and height of turbines	Natural Resources Canada (NRCan)	Notification sent
Electromagnetic Interference (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 Birds 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. 221/2018 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).

This Project is located on Crown land and will ultimately be enabled by a Crown lease and easements, presently under review with NSNRR and will require Ministerial approval. The initial application was submitted on May 15, 2020, followed by an application for Letters of Authority for meteorological testing towers in June 2020, which was granted in January of 2021. An initial development plan was submitted in November 2020, followed by another in May of 2022.

The Province of Nova Scotia has identified new areas to become wilderness areas, protected areas, or nature reserves. Much of the land next to the Mersey River has been identified as future parkland. Adjacent to those parcels is a future Nature Reserve area, bisected by a 50 m swath along an existing forestry road that will be used as a part of the Project. Next to the river, the site access and power lines will use the same approach and limit all impacts to a 50 m swath along the active forestry road, allowing the rest to be designated parkland. The configuration of the proposed protected areas, registered and potential archaeological sites, and stands of old growth forest precludes alternative site access.

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)	Alternation applications will be submitted to NSECC in accordance with the Activities Designation Regulations, NS Reg 47/95 following EA approval. Locations requiring alteration are described in Sections 7.3.
Endangered Species Act (ESA)	NSNRR	Compliance legislation – there is no expectation that an ESA permit will be required.
Use of Crown lands	NSNRR	Application has been submitted.
Notification of blasting (if required)	NSECC, NS Health and Safety	As Required.
Overweight/Special move permit	NS Public Works (NSPW)	To be obtained prior to construction phase.
Access permit Work within highway right-of-way Use of right-of-way for pole lines	NSPW	To be obtained prior to construction phase.
Elevator lift license	NS Labour Skills and Immigration	To be obtained prior to construction phase.
Archaeology Field Research Permit	NS Communities, Culture, Tourism and Heritage (NSCCTH)	Permit obtained to complete the archeology assessment.

Requirement	Regulatory Body	Status/Comments
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

While the Project is located within the Municipality of the Region of Queens, municipal permits do not apply on Crown lands. However, the Proponent will continue to provide the Municipality with detailed Project information.

2.4 Funding

No government funding has been secured for the Project.

2.5 Structure of the Registration Document

An outline of the content of each section of the EA Registration Document is provided in Table 2.3.

Table 2.3: 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	Government and Public 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
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 within Queens County, west of the community of Milton, NS (Drawing 2.1). The Project is situated on lands adjacent to the Mersey River Hydro System, with the total laydown area encompassing provincial Crown lands, private land parcels, and full lease lands. The Project is centered at approximately 44.0741° N, 64.8651° W.

A Study Area was established as a large assessment area based on land parcels (i.e., PIDs) 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 - e.g., turbine pads, road network, transmission line right of way (ROW) and collector lines, Project substation, the existing NS Power substation, and other laydown areas], 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 proposed transmission lines.

Table 3.1: Land Parcels within the Study Area

PID	Landowner
70032982	Crown Land
70074679	Private
70079330	Private
70080569	NS Power
70080684	Private
70166988	Crown Land
70225404	Crown Land
70225420	Crown Land
70247168	Crown Land
70247176	Crown Land
70247184	Crown Land
70247192	Crown Land
70247200	Crown Land
70247481	NS Power
70247499	NS Power
70247507	NS Power
70247523	NS Power
70247531	NS Power
70248687	Crown Land
70248695	Crown Land
70259551	Crown Land
70260575	Crown Land

PID	Landowner
70264213	Crown Land
70264445	Crown Land
70264452	Crown Land
70264403	Crown Land

3.1.1 Siting Considerations

The Mersey River area is an ideal location for a wind farm due to its strong wind resource, proximity to transmission lines, distance from residences, and the pre-existing road network. The Mersey River area was originally recognized for renewable energy potential with the installation of the Mersey Hydro System, which is the second largest hydroelectric system in Nova Scotia. The Milton Substation, which was designed for the dams and the former lumber mill, acts as a regional hub, connecting seven transmission lines. It is an ideal interconnection point for a new generator. 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 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 Project-specific desktop studies, modeling, and field assessments. As a result, several layout iterations were reviewed to reflect a growing knowledge of the Study Area and surrounding community and environmental considerations before finalizing the layout.

Specifically, layout modifications considered the following:

- Siting within an optimal wind regime.
- Avoidance of Mi'kmaq resources, including registered archeological sites and areas of high archeological potential.
- Avoidance of interference with telecommunication and radar systems.
- Maintenance of a vegetated buffer between turbine locations and field identified watercourses.
- Avoidance of lakes, or other visible open water bodies as identified in 1:50,000 provincial mapping.
- Maintenance of a minimum 30 m buffer between turbine locations and field identified wetlands.
- Minimizing the Project footprint to avoid legally protected areas, field identified significant habitats, wildlife sites, provincial parks, or reserves.
- Predictive sound modeling results to meet NSECC standards (*i.e.,* 40 dBA for dwellings, daycares, hospitals, and schools).
- Predictive shadow flicker modeling results to meet NSECC standards (*i.e.,* no more than 30 hours of flicker over a year or 30 minutes of flicker per day).

In addition to the general planning "constraints" and minimum setbacks mentioned above, the Project site 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.

- Accommodation of permanent residence setback of over 1,000 m.
- 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 Project site).
- Redeveloping and expanding upon an existing site, which incorporates existing roads into the Project design, minimizing overall new road disturbance impacts and clearing requirements.
- Locating turbines closer together, minimizing the geographic extent of disturbance.

The minimum setbacks and separation distances applied during the development, design, and siting of the Project are summarized in Table 3.2.

Table 3.2 Summary of Minimum Setbacks and Separation Distances

Setback Category	Distance	Relevant Regulators / Stakeholders
Watercourses	30 m (from turbines)	NSECC
Wetlands	30 m (from turbines)	NSECC / NSNRR
Wetlands of Special Significance	At least 30 m from turbines, to be determined in consultation with NSECC	NSECC / NSNRR
Important Habitat Features - Old Growth Forests + Talus Slopes	100 m	NSNRR
Protected Areas and Public Resources	300 m (from turbines)	NSECC, NSNRR
Rare Plants and Lichens	Species specific (Sections 7.4.1 and 7.4.2)	NSNRR
Adjacent Land Use	270 m *(1.5 x Turbine Height)*	Queens
Public Roads	270 m *(1.5 x Turbine Height)*	Health Canada
Powerlines	270 m from non-project-related powerlines, except designated crossing locations *(1.5 x Turbine Height)*	NS Power
Shadow Flicker	As necessary to meet shadow flicker constraints based off shadow flicker modelling	NSECC

Setback Category	Distance	Relevant Regulators / Stakeholders
Sound / Noise	As necessary to meet sound / noise constraints based off sound modelling	NSECC

3.2 Physical Components

3.2.1 Turbine Specifications

The Project will use the Vestas V150 turbine model, which has a 105 m hub height, and a 4.5 MW energy-generating capacity (Table 3.3).

Table 3.3: Turbine Technical Specifications Vestas V150

Turbine Component	Vestas V150 Specifications
Rated Capacity	4.5 MW
Rotor Diameter	150 m
Hub Height	105 m
Cut-out Wind Speed	22.5 metres per second (m/s)
Swept Area	17,671 square metres (m^2)
Rotor Speed	Variable
Power Regulation	Pitch regulated with variable speed
Generator	50/60 hertz (Hz)
Brake System	Blade Pitch Control and Hydraulic Disk Brake
Remote Monitoring	Vestas Supervisory Control and Data Acquisition (SCADA)

3.2.2 Road Layout

A comprehensive road network exists in the Study Area already and is associated with forestry activity and the NS Power Mersey Hydro System. 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

Collector lines within the Project Area will connect the wind turbines to an on-site substation, stepping up the voltage from 34.5 kV to 138 kV. The higher voltage transmission line will then connect the Project to the existing NS Power Milton Substation.

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

During the construction phase, Project roads will be maintained with additional gravel or periodic grading. 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 re-used.

The following equipment is typically used during road upgrading and construction:

- Excavators
- Dump trucks
- Bull dozers
- Rollers
- Graders
- Crusher
- Light 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 20 m diameter (typical for a 4.5 MW wind turbine) and extend to a depth of 3m to 5 m below grade. Foundations will be backfilled (underground) with the exception of the concrete pedestal which will be up to 4 m diameter and extend up to 0.5 m above ground to support the wind turbine tower structure.

Each wind turbine temporary laydown area may be up to 120 m x 120 m in area, which includes clearing limits and any overburden. 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
- Bull dozers
- Rollers
- Graders
- Crusher
- 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 foundation, 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 2 to 5 days. The following equipment is expected to be used for turbine assembly:

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

Grid Connection
Electricity produced from each turbine will be fed into an on-site electrical collector network that will be routed to a new on-site Project substation, where the voltage will be stepped up from 34.5 kV to a single 138 kV transmission line that will connect to the existing NS Power substation at the same voltage.

The following equipment is expected to be used during the grid connection process:

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

Removal of Temporary Works and Site Restoration
Upon construction completion at each turbine location, all temporary works will be removed and the roads, turbine laydown areas, and other areas within the Project's footprint will be appropriately graded.

The following equipment is expected to be used this process:

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

Commissioning
The turbines will undergo a series of tests for mechanical, electrical, and control functions prior to initializing the unit start-up sequence. Once the start-up sequence has been initiated, another series of performance checks for safety 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 and electrical utility (i.e., NS Power) employees. Additional testing may also be required for transformers, power 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 standard operating procedures.

The life span of the Project is estimated to be a minimum of 20 years. During this time, roads will be used to access the turbines by operations and maintenance personnel. The roads will be maintained as required. During the winter months, all roads will be plowed, sanded, and/or salted, as needed, to ensure safe driving conditions and access in the event of an emergency.

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. Timing of vegetation management will depend on site-specific conditions.

Due to the potential for public access to the Project, 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 (i.e., ice throw). These signs will be maintained throughout the life of the Project.

Maintenance work will be carried out on a proactive, periodic, and as needed basis. Maintenance activities may require the use of a variety of cranes for brief periods of time for the 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 decommissioning phase will follow the same steps as the construction phase:

- Dismantling and removal of the turbines.
- 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 3.4 presents the Project schedule from EA registration to Project decommissioning.

Table 3.4: Project Schedule

Project Activity	Timeline
EA Registration	Winter 2023
Post-EA Environmental Monitoring Programs	2023 onward
Geotechnical Assessment	Winter/Spring 2023
Engineering Design	Winter/Spring 2023

Project Activity	Timeline
Clearing	Spring 2023
Construction	Summer 2023 – Spring 2024
Commissioning	Summer 2024
Operation	Fall 2024 onward
Decommissioning	2045 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 Nova Scotia *Environment Act*. 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)
- 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 site. 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 effects after the application of mitigation measures.

The EA 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 the Mi'kmaq of Nova Scotia, regulators, 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 environmental effects after the implementation of mitigation measures using VC-specific criteria.
- Identify monitoring or 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 the Mi'kmaq of Nova Scotia, regulators, and the public:

- Biophysical environment
  - weather, climate, air quality
  - geology, hydrogeology/groundwater
  - watercourses, fish and fish habitat
  - wetlands
  - flora, fauna (including Mainland moose), habitat
  - bats
  - avifauna
  - species at risk (considered in the appropriate VC chapter, as necessary)
- Socioeconomic environment
  - economy, land use, transportation, recreation and tourism, human health
  - archaeological and cultural resources
  - electromagnetic interference
  - 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 the 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 land parcels (i.e., PIDs) that are included in the development area (Table 3.1, Drawing 2.2). An Assessment Area was established for more detailed field investigations. The Assessment Area represents 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 proposed transmission lines. Where appropriate, the Study Area and Assessment Area may be identified as either the LAA or 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	Temporal Boundary
Site Preparation and Construction	18-24 months
Operation and Maintenance	20 years
Decommissioning	Approximately 20 years post-commissioning

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 effects after mitigation is determined using defined criteria. Most criteria will be the same for all VCs (Table 4.2); however, the magnitude criteria are VC-specific and are 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 an effect occurs	**Project Area –** residual effects are restricted to the Project Area **LAA –** residual effects extend into the local assessment area **RAA –** 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
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 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 regulators, 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 THE MI'KMAQ OF NOVA SCOTIA

The Proponent acknowledges that the Project is in Mi'kma'ki, the traditional and unceded territory of the Mi'kmaq people.

5.1 Overview

The Study Area and Project Area, located along the Mersey River, are both entirely within Kespukwik District (Territory). The Kespukwik (Last Flow, Land Ends) District includes all the lands and waters draining into the Bay of Fundy from approximately Margaretsville, the Gulf of Maine coast and the Atlantic coast to the western shore of the LaHave River. The section of the Mersey River within the Study Area is just a portion of travel route that provided travel connections to other river systems and other coasts through a network of interior lakes and the upper Mersey River. The most notable of the ancient connections was the overland route between the Atlantic Coast and the Bay of Fundy through the Mersey River, interior lakes, and the Allains River emptying into the Annapolis River. Some of the original interior lakes have since been absorbed by the dammed waters of Lake Rossignol today. Evidence of early peoples on the Mersey River is overwhelming and the general area has undergone a substantial amount of archaeological work.

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

5.2 Mi'kmaq Ecological Knowledge Study

A MEKS presents a thorough and accurate understanding of 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 report 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 (referred to as the "Study Area" in the MEKS report). A copy of the MEKS is provided in Appendix B.

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 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 20 interviews were undertaken by the MEKS Team with Mi'kmaq knowledge holders from the Acadia First Nation communities of Ponhook, Medway, Wildcat, and Gold River between October 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 as well as 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 in regard to its significance to the Mi'kmaq people.

A summary of the MEKS findings is provided below. Detailed results and mapping are in Appendix B.

Traditional Use in the Project Area

- There is reported Mi'kmaq use reported in the Project Area. Activities include trout, salmon, and eel fishing as well as deer, partridge, and rabbit hunting. The majority of activities took place as historical past (39%, +25 years ago) with remaining activities occurring in recent past (34%, 11-25 years ago) and current use (25%, within the last 10 years) categories.
- There was other fishing, hunting, and gathering activities reported, and an area was identified to have Mi'kmaq artifacts.

Traditional Use in the Study Area

- Trout, salmon, and eel fishing, along with deer, partridge and rabbit hunting were also the activities reported by interviewees in the highest frequency. Overall, the activities took place primarily in the recent past (41%) and historical past (37%)

categories. Current use activities accounted for 20% of the data.
- There was other fishing, hunting, and gathering activities reported, as well as an area identified to have Mi'kmaq artifacts.

Historic Review
- There are no known archaeological sites or finds within the Project Area.
- The Mersey River within the Study Area has some 70 known archaeological sites/finds demonstrating the rich archaeological resources within the ancient travel route between the Atlantic coast to the Fundy coast.
- The Study Area is close to the traditional Hunting Territories 9 and 10 using the source's map and numbered reference system.
- A review of Specific Claims shows one current and active First Nation Claims within the vicinity of the Study Area.

No recommendations were provided in the MEKS completed for the Project; however, the following concerns were expressed during the MEKS interviews:

- Noise from the turbines and effect this may have on local wildlife, specifically birds and Mainland moose that have been travelling through the area for years.
- Increased foot traffic near personal cabins.
- Possible impacts on the surrounding ecology.

Potential impacts related to noise, traffic, and ecology as a result of Project activities have been addressed as part of this EA and can be found in Sections 7.0, 8.0, and 10. The Proponent is committed to engaging and working with the Mi'kmaq of Nova Scotia throughout the duration of the Project.

5.3 Mi'kmaq Engagement

Outreach and engagement with Mi'kmaq communities specific to the Project has been active since 2021. The Proponent focused early engagement efforts with Acadia First Nation due to proximity to the Project. Engagement with the Mi'kmaq of Nova Scotia is summarized in Table 5.1.

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

First Nation / Organization	Role(s)/Representatives	Contact Details
Acadia First Nation	Chief Deborah Robinson Economic Development Officer Legal Council Three Councillors Community Members	October 4, 2021 Email with introductory power point slides explaining the Project and the Project Team. Invitation to meet and discuss Acadia's participation in Project. November 1, 2021 Letter to Acadia introduces the Project Team

First Nation / Organization	Role(s)/Representatives	Contact Details
		and our new award as a licensed retail supplier through the renewable to retail program. January 25, 2022 Call to Acadia, voicemail February 1, 2022 Virtual meeting including legal counsel to go through Project status and details. Acadia was potentially interested in the Project for the Rate Based Procurement, which was not our focus. April 14, 2022 Call to Acadia, voicemail. April 28, 2022 Letter to Acadia requesting formal participation as equity partners in the Project, RDI itself, or to help with the Mersey River EA. August 23, 2022 Project update email, invitation to participate in the RTR program after the Rate Based Procurement had completed. To enable this, we offer to fund a full-time position. October 13, 2022 A Council member, attended presentation to Kwilmu'kw Maw-Klusuaqn (KMKNO). December 8, 2022 Three council members attended site visit with KMKNO. January 10, 2023 Chief and Council received copy of introductory letter sent to all Mi'kmaq First Nations of Nova Scotia. January 12, 2023 Discussions with community group focusing on the potential archaeological and environmental impacts of the Project. The Project Team offered to conduct a site tour

First Nation / Organization	Role(s)/Representatives	Contact Details
		and will continue to provide updates throughout the Project.
KMKNO	Patrick Butler, Senior Mi'kmaq Energy & Mines Advisor	October 13, 2022 Introductory presentation to KMKNO. A Council member from Acadia First Nation also attended. December 8, 2022 The Project Team conducted a site visit with members of Acadia First Nation, two KMKNO representatives, and the Project archaeologists. Following a land acknowledgement, two crews visited some of the areas of high potential for archaeological resources, some turbine locations, and met tower 2. There was high interest in archaeology and continued land access during the site visit, with the archaeologists and Project Team members sharing information and responding to questions. The Project Team explained how the Project will minimize impacts by using existing roads and cutblocks. Participants were also interested in opportunities to participate in the RTR program. There was discussion about burial grounds and they were confirmed to be outside of the Study Area. January 25, 2023 The Project Team met with Councilors from Acadia First Nation and representatives from the KMKNO as a follow-up to the site visit in early December. Discussions focused on archeology and ensuring the Project maintains a small footprint and avoids high potential areas where possible. Next steps were discussed to continue and expand engagement with the Mi'kmaq through presentations and a community meeting.
Annapolis Valley First Nation	Chief Gerald Toney Council	January 10, 2023 Introductory letter
Bear River First Nation	Chief Carol Dee Potter Council	January 10, 2023 Introductory letter

First Nation / Organization	Role(s)/Representatives	Contact Details
Eskasoni First Nation	Chief Leroy Denny Council	January 10, 2023 Introductory letter
Glooscap First Nation	Chief Sidney Peters Council	January 10, 2023 Introductory letter
Membertou First Nation	Chief Terrance Paul Council	January 10, 2023 Introductory letter
Millbrook First Nation	Chief Robert Gloade Council	January 10, 2023 Introductory letter
Paqtnkek First Nation	Chief Tma Francis Council	January 10, 2023 Introductory letter
Pictou Landing First Nation	Chief Andrea Paul	January 10, 2023 Introductory letter
Polotek First Nation	Chief Wilbert Marshall	January 10, 2023 Introductory letter
Sipekne'katik First Nation	Chief Michelle Glasgow	January 10, 2023 Introductory letter
Wagmatcook First Nation	Chief Norman Bernard	January 10, 2023 Introductory letter
We'koqma'q First Nation	Chief Annie Bernard Daisley	January 10, 2023 Introductory letter

5.3.1 Review of Concerns

Key areas of interest identified through engagement, including archaeological resources and continued access to the land, as described in Table 5.1.

5.3.2 Ongoing Engagement

The Proponent is committed to on-going, 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 informal engagement with Acadia First Nation and community groups.

6.0 GOVERNMENT AND PUBLIC ENGAGEMENT

The Proponent is committed to meaningful engagement with the public, stakeholders, and the government of Nova Scotia. This includes the initial project design as well as on-going operations. As future stewards of a portion of these lands and neighbours to the community, the Proponent is building lasting relationships.

To date, the Project Team has participated meetings with NSNRR about the use of Crown land, delivered presentations to the Municipality of the Region of Queens Council, and hosted two open house events at the Milton Community Hall on May 25 and August 10, 2022. Associated presentations, posters, meeting agendas and minutes, advertisements, letters of support, and feedback are provided in Appendix C.

6.1 Engagement with Government Departments, Agencies, and Regulators

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

The Proponent has also met regularly with the Lands Division regarding the use of Crown lands for a wind energy project. In addition, the Project Team met with Minister Masland (who is also the local Member of the Legislative Assembly) several times to provide Project information and updates.

Table 6.1: Government Meetings and Events

Government Departments, Agencies, & Regulators	Representative	Dates, Activities, Comments
Federal Government		
Canadian Coast Guard	Wind Farm Coordinator	September 2022 EMI study notification letter sent via email. October 2022. Letter of non-objection received.
Department of National Defence (DND)	Military Air Defence and Air Traffic Control; Military Radio communication users	September 2022 EMI study notification letter sent via email. September 2022 Request for NAV Canada Land Use number received. November 2022 Letter of non-objection received.
ECCC	Weather Radars	September 2022 EMI study notification letter sent via email. September 2022 Letter of non-objection received.
Innovation, Science, and Economic Development Canada	Nova Scotia District Office	September 2022 EMI study notification letter sent via email. Acknowledgement email received September 2022.

Government Departments, Agencies, & Regulators	Representative	Dates, Activities, Comments
NAV Canada	Land Use Specialist	January 2021 Correspondence regarding installation of multiple Meteorological (Met) Towers. October 2021 Approval for Long Term (2+ years) installation of Met Towers. September 2022 EMI study notification letter sent via email. October 2022 Land Use file number provided and Met Tower location information requested. January 2022 Met Tower location information provided
RCMP	Wind Farm Coordinator	September 2022 EMI study notification letter sent via email. September 2022 Received request for coordination with Bell, who are acting on behalf of the RCMP in the province with leased towers.
CWS	EA Analyst Wildlife Biologist	June 2019 Email correspondence with Wildlife Biologist regarding the review and feedback on the proposed Avian Assessment Plan. August/September 2020 Email correspondence regarding the review and feedback on the proposed updated Avian Assessment Plan.
Provincial Government		
NSNRR, Land Administration Division	Land Administration Officer, Managers, and Director of Land Administration Species At Risk Biologist	May 15, 2020 Application for use of Crown land June 6, 2020 Application for Letter of Authority for Met Towers

Government Departments, Agencies, & Regulators	Representative	Dates, Activities, Comments
		November 9, 2020 Submit Development Plan for the use of Crown land January 19, 2021 Letter of Authority for Met Towers April 7, 2021 Met 1 installation June 14, 2021 Preliminary results, no PID conflicts with Phase 1 or 2 July 14, 2021 Application for additional Met Tower August 13, 2021 Meeting with Lands and Forestry Staff January 19, 2022 Letter from Crown regarding protected areas January 2022 Email correspondence with Land Administration Officer and Species at Risk Biologist regarding data sensitivity for Mainland moose and what data should be provided in the EA versus to NSNRR directly. February 4, 2022 Letter of Authority for additional Met Tower March 4, 2022 Geographic information system (GIS) data sent, and meeting with Crown Officer to explain the extensive GIS package.

Government Departments, Agencies, & Regulators	Representative	Dates, Activities, Comments
		March 8, 2022 Meeting with several NSNRR representatives on detailed site options on the Mersey River Wind Project, showing multiple interconnection and access options to minimize impacts. April 27, 2022 Emails from Crown with questions about the interconnection options May 31, 2022 Emails clarifying PID data sets May 2022 Meeting regarding additional Met Tower, email correspondence regarding guidance for bat, bird, and wood turtle surveys. Additional correspondence regarding criteria for determining if a site is considered “coastal” June 30, 2022 Additional met tower Letter of Authorization (LOA) revision June 2022 Email 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. September 28, 2022 Meeting with NSNRR staff on the progress of Crown land review

Government Departments, Agencies, & Regulators	Representative	Dates, Activities, Comments
NSECC	EA Officer EA Supervisor Business Relations Manager Air Quality Protection Advisor	June 2021 NSECC shared advice from ECCC/CWS on bird radar requirements. January 2022 Email correspondence regarding data sensitivity for Mainland moose and what data should be provided in the EA versus to NSNRR directly. September 2022 Meeting with EA Officer and Business Relations Manager to provide an overview of the Project and work completed to date. October 2022 Email exchanges with EA Supervisor regarding the approach for incorporating the results of the Archaeological Resource Impact Assessment (ARIA) into the EA and to discuss the timing of the CCTH review of the ARIA. November 9, 2022 Meeting with Air Quality Protection Advisor to discuss expectations for the assessment of low frequency noise.
NSCCTH	Director of Special Places Protection	October 2022 Email exchanges regarding the confidentiality of archaeological and cultural resources information and approach for incorporating results into the EA.
Municipal Government		
Municipality of the Region of Queens	Municipal Planner Development Officer	January 2021 Initial conversations with Municipal Planner and Development Officer regarding a wind project and the erection of a meteorological testing tower. No municipal permit was required. May 2021 Discussion regarding Development Agreement process on Crown land. Conflict was identified regarding the municipality's jurisdiction over Crown land and their ability to issue a permit before the final Crown lease.

Government Departments, Agencies, & Regulators	Representative	Dates, Activities, Comments
		September 2021 Further Development Agreement discussion with Municipal Planner. The outcome of which was to provide the Municipality with all of the Project information, mirroring the Development Agreement process. October 2021 Information and detailed site plan submission in lieu of Development Agreement. November 17, 2021 In-person meeting. May 24, 2022 Presentation of Project to Council, including timelines, layouts in advance of the public meeting the following evening. July 2022 Further correspondence regarding the Development Agreement Process, which resulted in a meeting between the land division of NSNRR and the Municipality where it was deemed that the no Development Agreement was needed on lands administered by a higher order of government.

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).

The Project will be on Crown lands, which will require a Crown land lease.

While the Project is exempt from the Municipal Development Agreement requirement because it is located on Provincially administered lands, the Proponent intends to continue providing information to the Municipality that mirrors the Development Agreement requirements.

The Mayor of the Region of Queens Municipality and the local Councilor have provided letters of support for the Project (Appendix C). Discussions with Municipal government staff and elected officials will continue throughout Project development and operation.

6.2 Public and Stakeholder Engagement

The Project Team has been involved in engagement activities with the public and stakeholders to ensure the community was made aware of the Project and given ample opportunity to receive information, ask questions, and share local knowledge. This included hiring a local citizen to engage and share Project information with community members and staff at Kejimkujik National Park. This engagement resulted in several community members providing letters of support for the Project (Appendix C).

A review of stakeholder engagement and meetings is included in Table 6.2.

Table 6.2: Stakeholder Engagement and Meetings

Community/Stakeholder Organization	Engagement
Western Regional Enterprise Network	November 18, 2021 Lunch with the CEO to discuss Project specifics and future business opportunities.
Various Businesses	September 15, 2022 Roswall Development Stakeholder Event
Public Open House 1	May 25, 2022
Public Open House 2	August 10, 2022

6.2.1 Digital Communications

The Project website went live in early 2022 at www.merseywind.ca. It includes information about the Project and Proponent, as well as the EA process and posters presented at the open houses. As of January 18, 2023, the website had 2,531 views from 570 unique visitors.

An email distribution list was created from participants at the open houses. A Project newsletter was subsequently distributed digitally in August 2022 following the second open house.

6.2.2 Public Open House Events

Two public open house events were held at the Milton Community Hall. Contact information was collected from participants for follow up.

Open house #1 took place on Wednesday May 25, 2022, from 6-8 pm. This event was advertised in the LighthouseNOW weekly newspaper and by direct mail to residents in the area (an approximately 10 km radius to 1,000 residences). Over 30 people attended this open house (Figure 6.1).

Open house #2 took place on Wednesday August 10, 2022, from 6-8 pm. This event was advertised in the LighthouseNOW weekly newspaper and by direct mail to residents in the area (an approximately 10 km radius to 1,000 residences). Over 20 people attended this open house (Figure 6.2). Attendees were able to provide written feedback through an exit survey (Appendix C).

Figure 6.1: Open House #1 on Wednesday, May 25, 2022

Figure 6.2: Open House #2 on Wednesday, August 10, 2022

6.2.3 Community Liaison Committee and Community Benefits

Community Liaison Committee (CLC)
As part of the Proponent's ongoing commitment to community engagement, a CLC is being established to provide an opportunity for ongoing dialogue between the Project Team and local communities. The establishment and operation of the CLC will follow the principles of Nova Scotia Environment's Guide for the Formation and Operation of a Community Liaison Committee (2010)

The CLC will provide community views, advice, and guidance on Project plans and activities.

The CLC, as an advisory body, will:

- Represent community interests by providing an opportunity for a mutual exchange of information between the Project and the community.
- Provide a forum where CLC members can bring any issues of public concern to the attention of the Project, including any impacts or perceived impacts on the environment.
- Keep constituent organizations abreast of Project plans, progress, and activities.
- Convey community perspectives and information to Project representatives.
- Offer Project representatives suggestions on how to enhance and communicate the Project's socio-economic benefits.
- Have access to technical experts involved in the Project.

Community Benefits

Direct community benefits of this Project could include:

- Creation of an annual Community Dividend, based on Project financial performance, for the creation of an endowment fund that directly supports community initiatives.
- Creation of a non-for-profit energy rate to provide additional savings to important community services.
- Employment of at least 100 people during construction. During operation, this Project will require 6-12 full time equivalent technicians.
- Approximately $1,170,000 annual tax revenue for Municipality of the Region of Queens.
- Forest stewardship programs and public trails, subject to discussion with NSNRR, Acadia First Nation, the Mi'kmaq of Nova Scotia, and the CLC.

6.2.4 Review of Concerns

Issues and concerns raised by the public can be grouped into broader categories which have been assessed throughout the EA (Table 6.3)

Table 6.3: Questions Received from the Public

Key Issues	Proponent Response	Section of EA
Human Impacts		
How loud will the turbines be?	Results of the sound modelling (presented as a heat map) are shown and described in Section 10.5. No operational turbines exist within 3 km of the Project; therefore, only the Project turbines were modelled. No receptors exceed the recommended guideline of 40 dBA. The highest predicted sound level at a receptor is 33.3 dBA.	10.5 Sound
Will roads be closed off during construction or operation?	Nova Scotia Highway 103 and Nova Scotia Trunk 8 will be the primary roads used to deliver turbine parts to the Project. There is a network of access roads present within the Study Area that will be used as the primary points of access to each turbine. During the Project's construction phase, trucks and other vehicles will be frequently visiting the area. The transportation route will require road modifications, including the removal of signage and guardrails. The Proponent commits to: • Install notices in public areas to inform residents of signage removal or road infrastructure alterations. • Replace removed signage and	8.3 Traffic and Transportation

Key Issues	Proponent Response	Section of EA
	guardrails immediately with appropriate temporary signage to ensure 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 locations 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.	
Will the area become inaccessible to hunters/fishers at any point in the Project timeline?	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. The presence of turbines is highly compatible with most land-based recreation activities and is not expected to limit the usability of the area, especially for uses related to the existing environment such as hunting and trapping.	8.4 Recreation and Tourism
Environmental Impacts		
Where can I access the environmental studies?	Once registered, this EA will be publicly available at https://novascotia.ca/nse/ea/	N/A
Community Benefits		
What will be the benefits to the local community?	The direct community benefits of this Project could include:	N/A

Key Issues	Proponent Response	Section of EA
	• Creation of an annual Community Dividend, based on Project financial performance, for the creation of an endowment fund that directly supports community initiatives. • Creation of a non-for-profit energy rate to provide additional savings to important community services. • At least 100 people will be temporarily employed during construction. During operation, this Project will require 6-12 full time Equivalent technicians. • Approximately $1,170,000 annual tax revenue for Municipality of the Region of Queens. • Forest stewardship programs and public trails, subject to discussion with NSNRR, Acadia First Nation, the Mi'kmaq of Nova Scotia, and the CLC.	
When will residential customers be able to directly purchase power?	Customers could purchase power as soon as the Project comes online. Priority access to RTR clean energy rates will be given to customers within the Region of Queens Municipality.	N/A
Once the Project is operational, can the Proponent help to make this area more accessible for recreation activities like biking/hiking/swimming?	The Proponent is committed to being a good neighbour and plans to develop a Community Dividend based on Project financial performance. This endowment fund will directly support community initiatives such as parks, trails, community centre maintenance, scholarships, etc.	N/A

6.2.5 Ongoing Engagement

The Project Team will continue to help address any concerns raised by stakeholders and members of the public over the duration of the Project's development.

7.0 BIOPHYSICAL 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)
- ECCC Weather and Climate (ECCC, 2022a; ECCC,2022b)
- 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 (centered at 44.0741° N, 64.8651° W) lies within the Rossignol (750) and Sable (760) Ecodistricts of the Nova Scotia western ecoregion (700) (Neily et al., 2017) (Drawing 7.1).

The Rossignol and Sable Ecodistricts are located in southwestern Nova Scotia. The Rossignol Ecodistrict is home to Nova Scotia's largest inland waterbody reservoir (Lake Rossignol) and the Sable Ecodistrict is the second largest in the western ecoregion. These westerly ecodistricts tend to have the earliest and warmest spring in the province. While large amounts of precipitation occur within these areas (approximately 1,470 mm per annum), the ecodistricts continue to experience summer moisture deficits. Overall, the climate is characterized as mild, compared to the rest of the province (Neily et al., 2017).

The local temperature and precipitation data (1981-2010 Climate Normals) were obtained from the Liverpool Big Falls meteorological station (Climate ID 8203100) located approximately 9 km northwest of the Project (Table 7.1).

Table 7.1: Climate Normals from the Liverpool Big Falls Meteorological Station (1981-2010)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Temperature													
Daily Avg. (°C)	-4.6	-3.6	0.2	5.6	11.0	16.1	19.4	19.2	15.2	9.4	4.7	-0.9	7.7
Daily Max. (°C)	0.2	1.2	4.9	10.5	16.8	22.0	25.0	24.8	20.7	14.4	8.6	3.2	12.7
Daily Min. (°C)	-9.3	-8.4	-4.6	0.7	5.3	10.2	13.8	13.5	9.7	4.5	0.7	-4.9	2.6
Extreme Max. (°C)	18.0	16.1	25.0	27.8	36.0	34.4	35.0	35.6	34.4	28.5	22.2	18.0	-
Extreme Min. (°C)	-31.0	-34.0	-26.1	-12.2	-6.7	-3.3	1.1	-2.2	-4.4	-9.4	-16.0	-26.0	-
Precipitation													
Rainfall (mm)	91.0	84.8	115.9	113.9	102.4	97.4	97.6	90.8	108.0	127.7	158.9	117.3	1305.6
Snowfall (cm)	56.5	38.3	36.7	9.5	0.2	0.0	0.0	0.0	0.0	0.0	7.4	32.0	180.6
Precipitation (mm)	147.5	123.1	152.6	123.5	102.6	97.4	97.6	90.8	108.0	127.7	166.3	149.3	1486.2

Source: ECCC 2022a

For the period from 1981 to 2010, the mean annual temperature was 7.7 degrees Celsius (°C), with a mean daily high of 12.7 °C and a mean daily low of 2.6 °C (ECCC, 2022a). January and February were the coldest months (-9.3 °C and -8.4 °C, respectively), while the warmest months were July and August (25.0 °C and 24.8 °C, respectively) (ECCC, 2022a).

From 1981 to 2010, mean annual snowfall was 180.6 cm and mean annual rainfall was 1,305.6 mm (ECCC, 2022a). Most snowfall is received in January and February (56.5 cm and 38.3 cm, respectively), while most rainfall occurred in October and November (127.7 mm and 158.9 mm, respectively) (ECCC, 2022a).

Wind speed and direction data (2012-2022) were also obtained from the Western Head (Climate ID 8206240), the nearest meteorologic station with current wind data, located approximately 19 km southeast of the Project (Table 7.2).

Table 7.2: Wind Data from the Western Head Meteorological Station (2012-2022)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Maximum Hourly Speed (km/h)	109	107	96	90	77	76	91	65	91	91	111	119
Most Frequent Direction	NW	NW	NW	SW	SW	SW	SW	SW	SW	SW	SW	NW

Source: ECCC 2022b

The maximum hourly wind speeds recorded at the Western Head meteorological station between 2012 and 2022 ranged from 76 km per hour (km/h) to 119 km/h. The wind directions most observed at the meteorological station were from the northwest and southwest. It should be noted that although wind directions may occur in all direction, during calm wind flows, the direction not recorded at the meteorological station (ECCC, 2022b). A windrose plot provided for the Western Head meteorological station by Iowa State University (2022) demonstrates the wind directions from 2012 to 2022 (Figure 7.1). Figure 7.1 demonstrates that between January 1, 2012, and December 30, 2022, wind speeds above 12 m/s (3.2 km/h) occurred the most frequently from the southwest.

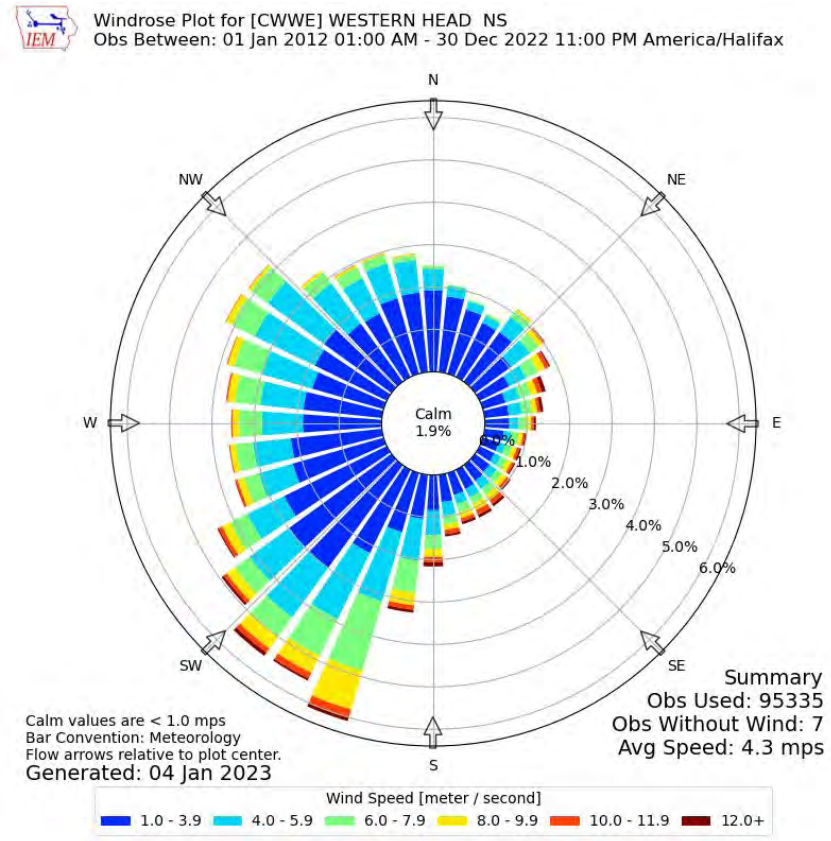

Figure 7.1: Windrose Plot for Western Head Meteorological Station – January 1, 2012, through December 30, 2022 (Iowa State University, 2022)

Air Quality

The Canadian Council of Ministers of the Environment (CCME) has established Canadian Ambient Air Quality Standards (CAAQS) for fine particulate matter [≤2.5 micrometres (µm) ($PM_{2.5}$) or ≤10 µm (PM_{10}) in size], ozone (O_3), sulphur dioxide (SO_2), and nitrogen dioxide (NO_2) over select averaging time periods (CCME, u.d.). The Government of Nova Scotia has legislated Air Quality Regulations, N.S. Reg. 8/2020 (NSAQR) 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, 2022b).

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
Sulphur 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) [*NSAQR*].
[2] Proposed Ambient Air Quality Standards (subject to change) (NSECC, 2022).
[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:

- carbon monoxide (CO)
- ground-level ozone (O_3)
- nitrogen oxides (NO_x)
- nitric oxide (NO)
- nitrogen dioxide (NO_2)
- particulate matter ($PM_{2.5}$)
- sulphur dioxide (SO_2)
- total reduced sulphur (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 Kentville, NS, approximately 115 km northeast of the Project at 45.0717° N, 64.4797° W.

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 and vehicles (Table 7.4). While this may occur during all phases of the Project, fugitive dust and exhaust emissions will be highest during the construction phase.

Table 7.4: 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 (Drawing 2.2). The RAA for the atmospheric environment 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 particulate matter (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 microns (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 particles (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. Particulate matter 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, 2022a).

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, 2022a):

- 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 nearest turbine to a residential receptor is greater than 2 km away and the nearest Project road is greater than 350 m away, therefore receptors are located far from the main construction area of 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 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 nearest turbine to a residential receptor is greater than 2 km away and the nearest Project road is greater than 350 m away, therefore receptors are located far from the main construction area of 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 personal protective equipment (PPE) in the event of significant fugitive emissions events (i.e., wind storms, 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-sulphur 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
Due to 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 (Greenhouse Gases)

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.

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* (*CEPA*)
  - Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations, SOR 2010-201
  - Heavy-duty Vehicle and Engine Greenhouse Gas Emission Regulations, SOR/2013-24
- Ozone-depleting Substances and Halocarbon Alternatives Regulations, SOR/2016-137

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 NSECC 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 tonnes 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 burning carbon-containing fossil fuels (i.e., coal, oil, and natural gas) and deforestation/land clearing activities.

Site preparation and construction of 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 or 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). As these activities are intermittent and short-term, the GHG contributions from operations are negligible and are not considered further.

Methane
Methane (CH_4) 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 different heavy- and light-duty equipment, contributing to methane emissions. Alterations of wetlands for the construction of access roads and wind turbine laydowns, 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 different heavy- and light-duty equipment, which can contribute to nitrous oxide emissions. Land restoration activities (i.e., soil amendments and reclamation) following construction will also contribute nitrous oxide 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. Air conditioning units will be used during the Project's construction phase. Fire-extinguishing agents (containing halocarbons) may also be used at the Project site 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 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 Project consists of 33 turbines with a capacity of 148.5 MW of renewable energy. Based on the wind turbine design capacity and an capacity rating of 33.35% (Hatch, 2008), the Project will be capable of producing approximately 433,836,810[1] kilo Watts per hour per year (kWh/year). The lifespan of the Project is estimated at a minimum of 20 years.

Quantifying GHGs in terms of tCO_2eq requires using emission factors published in the NSECC Standards for Quantification, Reporting, and Verification of Greenhouse Gas Emissions (2020) and current electricity generating practices (Figure 7.2).

[1] 4.5 MW/Turbine×33 Turbines×0.3335×365 days/year×24 hours/day×1000 kW/MW=433,836,810 kWh/year

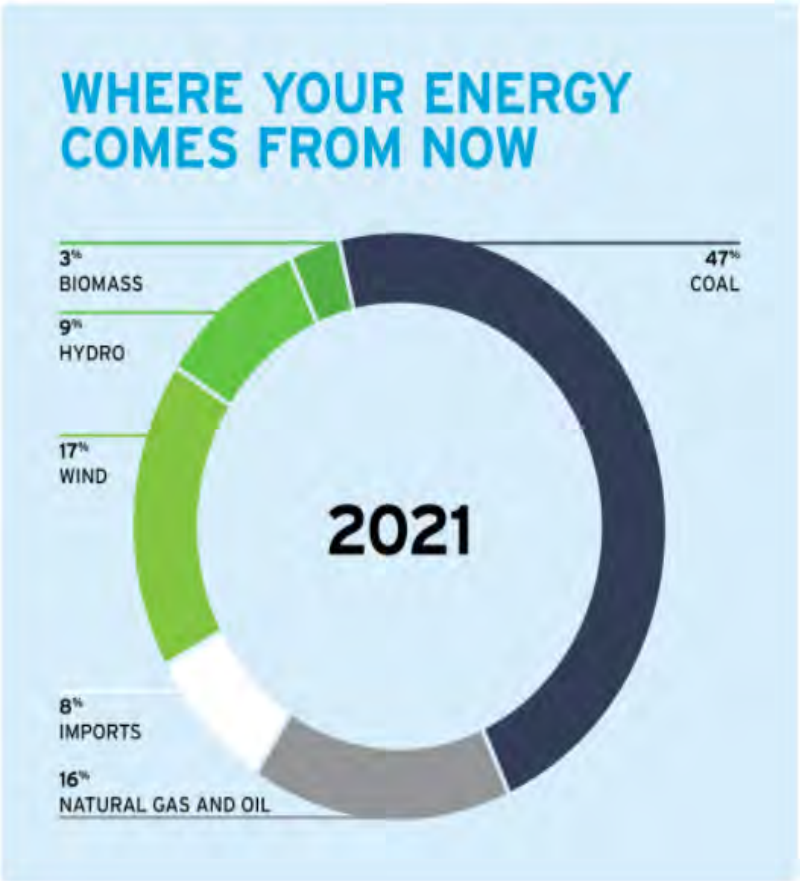

Figure 7.2: NS Power 2021 Energy Statistics (NS Power, 2022)

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 the purpose of 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 the majority of renewable energy is generated from wind, quantification considered wind at 29%.

Table 7.5 summarizes the GHG emission factors for the different types of electricity generated in Nova Scotia.

Table 7.5: 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: US EIA 2022

Given the current electricity generation methods and the fuel source emission factors (Table 7.5), Table 7.6 summarizes the baseline GHG emissions.

Table 7.6: Baseline Quantification Summary

Electricity Fuel Source	Electricity Generation (kWh/yr)	Emissions (tCO_2e)
Coal	212,580,037	217,919.83
Natural Gas	47,722,049	20,996.97
Oil	47,722,049	52,817.09
Wind	125,812,675	0
Total	**433,836,810**	**291,733.90**

The total annual GHG emissions generated in Nova Scotia for the same electrical capacity of the Project is **291,733.90 tCO_2e.**

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 area 120 m x 120 m = 14,400 m^2 each) are intended to store equipment temporarily, turbine pad foundation, and the crane pad. These areas will be prepped

by removing the vegetation and overburden and placing competent soils. Note that most of the laydown areas were previously cleared and now consist of early-stage regenerating forests; as a result, minimal clearing will be required in the future. 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 Base
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 were assumed for GHG quantification purposes.

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 9 km from the Project Area. Given the turbine locations are scattered across the Project Area, transportation distances range from 12 km to 28 km (Table 7.7).

Table 7.7: Distance from the Nearest Known Concrete Supplier to Individual Wind Turbine Locations

Wind Turbine	Approximate Distance (km)
1	12.16
2	12.41
3	12.72
4	14.14
5	14.41
6	14.10
7	15.20

Wind Turbine	Approximate Distance (km)
8	15.88
9	16.64
10	17.16
11	17.72
12	19.12
13	20.04
14	15.84
15	17.46
16	16.46
17	17.34
18	18.66
19	19.13
20	19.75
21	20.56
22	22.06
23	22.03
24	22.73
25	23.52
26	24.80
27	24.85
28	25.78
29	27.17
30	25.77
31	22.27
32	21.84
33	23.52
Total	**633.23**

Based on Table 7.7, the total distance between the wind turbines and the nearest concrete supplier is 633.23 km. Assuming 140 truckloads per wind turbine, the total one-way distance travelled is 88,652.63 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 tonnes[2] of concrete per delivery for a total of 2,500 tonnes of concrete per wind turbine.

Table 7.8 summarizes the GHG emission factors for the different components used for concrete-related activities.

[2] 2,500 (Tonnes of Concrete)/Turbine÷140 Trucks/Turbine=17.86 (Tonnes of Concrete)/Truck

Table 7.8: 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 7.8), the CO_2e emissions are expected to be approximately **25,061.76 tCO_2e** for constructing all the tower foundations and pedestals.

Detailed CO_2e calculations are provided in Appendix D.

Turbine
The Project will require wind turbines to be manufactured and delivered to the Project Area. The wind turbine for the Project is the Vestas V150. This turbine has a rotor diameter of 150 m and can generate up to 4.5 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.
- 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: Brighton, Colorado, USA
- Nearest US Shipping Port: Norfolk, Virginia, USA
- Nearest NS Shipping Port: Brooklyn, NS, CA

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

- Blade (three)
- Drive Train
- 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 4.5 MW, the total weight of a wind turbine is approximately 540,000 kg.

GHG emission factor for wind turbine manufacturing is provided in Table 7.9.

Table 7.9: 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 7.9), the CO_2eq emissions from the manufacturing of all the wind turbines are expected to be approximately **26,730 tCO_2e**.

Vestas American Wind Technology (Vestas) occupies an onshore turbine manufacturing plant in Brighton, CO (Vestas, 2023). For the purposes of this assessment, Project turbines are assumed to be manufactured at this location, then travel to Norfolk, VA, by heavy diesel hauler (transport), where they will be shipped via diesel cargo vessel to the Port Mersey Commercial Park, Brooklyn, NS. Table 7.10 summarizes the transportation distances from the manufacturer to the Project.

Table 7.10: Wind Turbine Transportation Distances

Originating Destination	Final Destination	Distance (km)
Brighton, CO	Norfolk, VA	2,900 (Land)
Norfolk, VA	Brooklyn, NS	1,300 (Marine)
Brooklyn, NS	Mersey (Project)	11 (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 Brighton, Colorado to Norfolk, Virginia (total of 38,800 km per turbine).
    - 12 components per turbine to travel from Brooklyn, NS to 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 7.11.

Table 7.11: Land Distance from the Manufacturer to Individual Wind Turbine Locations

Wind Turbine	Approximate Distance (km)
1	34,966.32
2	34,969.33
3	34,972.99
4	34,990.14
5	34,993.33
6	34,989.64
7	35,002.81
8	35,010.94
9	35,020.07
10	35,026.33
11	35,032.99
12	35,049.85
13	35,060.86
14	35,010.44
15	35,029.96
16	35,017.93
17	35,028.44
18	35,044.28
19	35,049.93
20	35,057.45
21	35,067.11
22	35,085.15
23	35,084.70
24	35,093.14
25	35,102.68
26	35,117.96
27	35,118.65
28	35,129.82
29	35,146.40
30	35,129.64
31	35,087.67
32	35,082.47
33	35,102.58
Total	**1,156,672.00**

Based on Table 7.11, the total land transportation distance between the wind turbine manufacturer and the wind turbine laydowns (not including marine transportation) is **1,156,672 km**. The total marine transportation distance associated with getting the wind turbines from Norfolk, VA, to Brooklyn, NS, is **42,900 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 7.12.

Table 7.12: 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 7.12), the CO_2e emissions from land transportation of the wind turbines are expected to be approximately **7,026.78 tCO_2e**. In addition, the marine transportation distances required to deliver the wind turbines from the United States to Canada will contribute **349.81 tCO_2e**.

Detailed CO_2e calculations are provided in Appendix D.

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 rating of 33.35% (Hatch, 2008), the Project will be capable of producing approximately 433,836,810 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. (u.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 **1,103.85 tCO_2e** (Appendix D).

7.1.2.8 Effects Assessment

Project-GHG Interactions

Project activities will emit GHGs during all phases of the Project (Table 7.13).

Table 7.13: 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 (Drawing 2.2). 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 7.14).

Table 7.14: Project GHG Emission Summary

Component	Emissions (tCO_2e)
Baseline	
Electricity Generated from Coal	217,919.83
Electricity Generated from Natural Gas	20,996.97
Electricity Generated from Oil	52,817.09
Electricity Generated from Wind	0
Total	**291,733.90**
Construction Phase	
Concrete Production and Transportation	25,061.76
Wind Turbine Manufacturing	26,730.00
Wind turbine Transportation	7376.59
Total	**59,168.35**
Operations Phase	
Electricity Generated from Wind	0

Component	Emissions (tCO_2e)
Wind Turbine Maintenance	1,103.85*
Total	**1,103.85**

*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 **291,733.90 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 **59,168.35 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 **1,103.85 tCO_2e**.

Following the commissioning of the Project, the annual Project GHG emission reduction is expected to be **291,733.90 tCO_2e**. A one-time **1,103.85 tCO_2e** may be subtracted from any annual reduction; however, the annual reduction rate will be applied for the lifespan of the Project (20+ years). The Project is anticipating a 0.2-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.
- Recycle and compost workforce waste (i.e., food waste). Diverting this waste will reduce methane generated in landfills as it decomposes.

3 $\frac{Construction\ Emissions}{Offset\ Emissions} = \frac{59{,}168.35tCO2e}{291{,}733.90tCO2e/year} = 0.2years$

- 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

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:

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

7.2.4 Assessment Results

Topography

The Study Area lies within the Rossignol (750) and Sable (760) Ecodistricts of the Western Ecoregion, see Drawing 7.1 for locations (Neily et al., 2017). Topography associated with lowlands is found within the Rossignol Ecodistrict, comprised primarily of low/small hills, drumlins, flutes, and glacial till ridges. In addition, topographic depressions found throughout the landscape support the development of peatlands, which account for approximately 5% of the ecodistrict. Elevations here are typically around 75 metres above sea level (masl), with the highest point at only 160 masl (Neily et al., 2017). The Sable Ecodistrict spans Shelburne, Yarmouth, and Queens counties covering an area of approximately 2,945 km^2. Topography within this ecodistrict is characteristic of a low elevation plain containing gentle hills and hummocks. There are an abundance of small depressions throughout the ecodistrict which support the largest concentration of wetlands/peatlands in Nova Scotia. The mean elevation in

the Sable Ecodistrict is approximately 60 masl, with its highest point at only 135 masl (Neily et al., 2017).

Within the Study Area specifically, topography ranges from rolling to flat, with an abundance of surface boulders sporadically throughout the landscape (NSNRR, 2021a) (Drawing 7.3).

Surficial Geology
Surficial geology within the Study Area is dominated by a stony/sandy till plain ranging in thickness between 2 m and 20 m (Drawing 7.4) (NSNRR, 2021a). This till is derived from local bedrock material that was released/deposited at the base of melting ice sheets centered over Nova Scotia. Based on its stony/sandy nature, these areas are rapidly draining and typically have a high water table which can affect use for construction. Other surficial geology units within the Study Area include:

- Kame fields and esker systems (glaciofluvial deposits)
- Glacially scoured basins and knobs (exposed bedrock)
- Organic deposits (wetlands/peatlands)
- Hummocky ground moraines
- Silty drumlins

Kame fields and esker systems are steep-sided, narrow, winding ridges of stratified sediment that formed as a result of deposition from glacial meltwater streams. These surficial features can range in thickness between 3 m and 30 m and are typically composed of silt, sand, and gravel (NSNRR, 2021a).

Glacially scoured basins and knobs are areas of exposed bedrock (of various types depending on underlying material), overlain by a discontinuous and thin veneer of till. These geologic units are formed from glacial erosion and/or non-deposition (NSNRR, 2021a).

Areas of organic deposits (i.e., wetlands/peatlands) are developed due to topographic depressions and infilling of ponds/watercourses with vegetation. Within the Study Area, the wetlands/peatlands range in depth from 1 m to 5 m (NSNRR, 2021a).

Hummocky ground moraines are formed as a result of material released from within, or the tops, of stagnant melting ice sheets. These features typically range from 2 m to 25 m in thickness, comprised of loose stony/sandy till (mixture of sand, gravel, and mud) that often contain inclusions of waterlain sediment. The stoniness, high water table, and rapidly draining nature of this feature can pose construction issues (NSNRR, 2021a)

One small area containing silty drumlins was identified within the southeast extent of the Study Area. These drumlins range from 4 m to 30 m in thickness and are dominated by silty material with a high percentage of red clay material from distant sources. Silty drumlins were formed as a result of glacial deposition (NSNRR, 2021a).

Bedrock Geology

The Study Area is primarily underlain by the Goldenville Formation of the Meguma Group, comprised of metasandstone dating back to the Cambrian – Ordovician period (Drawing 7.5) (NSNRR, 2021a). Dominant rock types in this formation include slate, sandstone turbidites, gneiss, and schist. In addition, the southeastern extent of the Study Area has occurrences of the Halifax Formation (also part of the Meguma Group) which is composed predominantly of siltstone and slate. Both the Goldenville and Halifax Formations are known to contain sulphide-bearing slates (i.e., acid generating rock) that, when disturbed, have the potential to result in acid rock drainage (ARD) (NSNRR, 2021a). Additionally, areas of contact between the Goldenville and Halifax Formations may have planes of weakness in interbedded rocks.

General Hydrogeologic Conditions

The Mersey River and associated watershed are significant freshwater resources within Nova Scotia that have also undergone extensive historical alteration (dams, forestry, etc.).

The nearest protected water area is the Town Lake Watershed located near the community of Liverpool, NS (Drawing 7.6) (Province of Nova Scotia, 2009). This watershed provides water to the Town of Liverpool and is defined, designated, and protected under the *Environment Act*, SNS 1994-95, c 1, specifically the Town Lake – Designation, NS Reg. 248/2007. The Town of Liverpool owns 100% of the 182 hectare (ha) protected watershed (which includes Town Lake). A study of Town Lake and its watershed was undertaken in 1977 which found that Town Lake is primarily recharged via groundwater and is able to store up to approximately 738 million litres (or 195 million gallons) (NSECC, 1977).

Groundwater Quality and Quantity

The Study Area is underlain by metamorphic rocks which carry groundwater through fractures and cracks within the bedrock. Groundwater sourced from metamorphic rock is typically associated with lower quantities of groundwater and consequently lower well yields compared to other regions. Wells located in metamorphic rock typically have lower dissolved solids, hardness, and metamorphic rock is often associated with naturally occurring trace metals (e.g., arsenic, uranium, iron, etc.) (NSECC & NSNRR, 2009).

Groundwater Wells

According to the NSECC Well Logs Database (2022c), a total of 170 individually drilled and/or dug wells are located within 2 km of the Study Area. Water well use for these wells is classified as domestic (158), industrial (one), other (one), or unspecified (10). A summary of well properties within 2 km of the Study Area is presented in Table 7.15, and a complete characterization log of wells within 2 km is provided in Appendix E.

Table 7.15: 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	1964	3.04	2.13	0.61	0.91	0.45
Maximum	2020	121.80	39.58	21.32	18.27	317.80
Average	n/a	52.13	8.42	4.60	3.84	21.34

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 21.34 Lpm (litres per minute) with an average well depth of approximately 52.13 m. These measurements represent very short-term yields estimated by the driller at the completion of well construction (NSECC, 2022c).

Five of the 170 water wells identified are located within the Study Area (one of which is within the Assessment Area), which are summarized in Table 7.16 (Drawing 7.7).

Table 7.16: 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)
141198	Milton	Domestic	91.35	13.40	6.09	3.04	31.78	357898	4882203	0.02
770863	Greenfield	Domestic	42.63	23.75	21.32	n/a	13.62	352299	4878924	0.35
871181	Milton	Other	65.47	n/a	n/a	n/a	227.00	356500	4880500	0.51
911750	Moose Hill	Domestic	86.78	9.14	7.00	n/a	11.35	357914	4882155	within AA
970288	Milton	Domestic	48.72	12.18	6.09	6.09	36.32	357500	4882500	0.23

*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 test well located approximately 1.5 km east of the Study Area in the community of Milton (Pumping Test ID QUE-3) indicates a long-term safe yield (Q20) of 29.1 Lpm and an apparent transmissivity of 1.4 m^2/day. This well was drilled 65.5 m through metamorphic bedrock of the Halifax Formation and was tested for the NS Housing Commission (Riverside Apartments) in 1980 (NSNRR, 2022a).

NSECC maintains the Nova Scotia Groundwater Observation Well Network (2015a). The nearest provincial observation well to the Study Area is the Hayden Lake Well (Station #059), located approximately 40 km southwest near Lighthouse Route, East Jordan, NS. Hayden Lake Well (ID# 059) was drilled to a depth of 48.8 m through greywacke bedrock. This well has been monitored since 1987 and water levels appear to have remained relatively consistent (NSECC, 2015a).

7.2.5 Effects Assessment

Project-Geophysical Interactions

Project activities will primarily interact with the geophysical environment during earth moving activities (Table 7.17).

Table 7.17: 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 apply 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:

- Sulphide-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 (sulphide minerals such as pyrite and pyrrhotite) that, when disturbed, can result in the production of ARD. ARD occurs when sulphide-bearing rocks are disrupted and exposed to air or water, producing sulphuric acid and metal oxides that are subsequently mobilized/leached through freshwater systems (NSNRR, 2021c). Sulphide-bearing slates are known to occur within the Goldenville and Halifax Formations which underlay the Assessment Area (NSNRR, 2002). The presence of sulphide-bearing minerals and likelihood of ARD will be determined following the results of the geo technical evaluation.

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

Radon potential mapping (Drawing 7.9) shows the Assessment Area is primarily located in “Low Risk” to “Medium Risk” area 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. Risk mapping shows that the Assessment Area is situated in a region that has a “High Risk” of arsenic (Drawing 7.10) and “Low Risk” of uranium containing bedrock (NSNRR, 2021b). 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 blasting activities require monitoring per NSECC's Procedure for Conducting a Pre-Blast Survey (1993). One well was identified within the Assessment Area and 20 groundwater wells were identified within 800 m of the Assessment Area. The groundwater well within the Assessment Area (ID 911750) is along the transmission corridor located within the existing Milton substation property (owned by NS Power) and is already crossed by several existing transmission lines. The requirement for blasting and a pre-blast survey will be confirmed and assessed further during geotechnical investigations.

Mitigation
Avoidance of geologic hazards and groundwater resources during the Project's design and development was the priority. Sulphide-bearing rock and the risk of ARD were the key geologic hazards identified during this assessment and will be subsequently assessed during upcoming geotechnical investigations. 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 overall geologic environment.

The following general mitigation measures related to the geophysical environment are recommended:

- 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 sulphide bearing rock 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 sulphide potential will conform to the Sulphide Bearing Material Disposal Regulations, NS Reg. 57/95 and any requirements from relevant regulatory departments.
- Store all soils 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

onsite 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
Based on the presence of the Goldenville and Halifax Formations within the Study Area, the potential for acid generating rock/ARD will be assessed during detailed geotechnical investigations. If acid generating rock is discovered, a management and monitoring plan will be developed and implemented prior to construction.

If blasting is required for the construction of Project, wells within 800 m of 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, short-term duration, intermittent, reversible, and not significant.

7.3 Aquatic Environment

7.3.1 Waterbodies and Watercourses

7.3.1.1 Overview
The overall 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 approaches:

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

7.3.1.2 Regulatory Context
Under the *Nova Scotia Environment Act,* 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

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

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

A review of the NS Topographic Database – Water Features (GeoNOVA, 2022) identified 64 watercourse feature segments within the Study Area and 330 segments within 5 km of the Study Area. Several named watercourses were identified within the Study Area including:

- Mersey River
- Five Rivers
- Kempton Meadow Brook
- West Deep Brook
- Bon Mature Brook
- Eagle Lake Brook
- East Broad River
- Hagen Meadow Brook
- De Wolfe Brook

The Study Area is located along the southern side of the Mersey River. The Mersey River has been heavily influenced by anthropogenic activities over the past decade, with the most notable being the installation of the Mersey River system. The Mersey River system is the second largest hydroelectric system in Nova Scotia, containing a collection of dams, power houses, and generating units spanning between Kejimikujik Lake and Liverpool, NS. With a combined catchment area of 1,996 km^2, water levels and flow within this river system are largely controlled by the dams, and as a result, are highly variable (NS Power, 2018).

The Project is located within the Mersey River Watershed (1ED), which is one of the largest primary watersheds in Nova Scotia spanning approximately 2,993 km^2 (Drawing 7.13) (NSECC, 2011). Drainage on the site mainly flows through Bon Mature Brook to the north, and Five Rivers to the south. There are also several secondary watersheds the Project intersects including Mersey River (1ED-1), Five Rivers (1ED-2), and Broad River (1ED-3). There are six tertiary watersheds (i.e., 1ED-1-LL, 1ED-1-PPP, 1ED-1-NN, 1ED-1-QQQ, 1ED-2-C, and 1ED-3-B) that control and direct localized drainage within the Study Area. The primary, secondary, and tertiary watersheds all eventually discharge southeast into the Atlantic Ocean (NSNRR, 2021b).

Throughout the Study Area, WAM data shows groundwater ranges from 0 m to >10 m of the surface, with the majority being 0.51 m to 2 m of the surface on account of the area being moderately-well to imperfectly 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, 2012a).

According to the Significant Species and Habitats Database, the Mersey River is recorded to contain Bald Eagle (*Haliaeetus leucocephalus*) and/or their habitat (NSNRR, 2018) (Drawings 7.15A-C). 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 the Mersey River.

Waterbodies

A review of the federal CanVec Database – Hydrographic Features (2022) identified seven named and seven unnamed waterbodies within the Study Area, along with 17 named and 30 unnamed features within 5 km. Big Bon Mature Lake is the largest open body of water within the Study Area, approximately 440 ha in size, located roughly in the centre. Evidence of recreational fishing was observed at Big Bon Mature Lake during field surveys. A complete list of named waterbodies located within 5 km of the Study Area is provided in Table 7.18.

Table 7.18: Named Waterbodies Within 5 km of Study Area

Name of Waterbody	Distance (km)
Waterbodies Within the Study Area	
Big Bon Mature Lake	--
Little Bon Mature Lake	--
Solnow Pond	--
Solnow Lake	--
Toney Lake	--
Eagle Lake	--
Trout Pond	--
Waterbodies Within 5 km of Study Area*	
Duck Pond	0.15
Kempton Lake	0.62
Upper Great Brook	0.77
First Beaverdam Lake	1.16

Name of Waterbody	Distance (km)
Johns Millpond	1.18
Lower Great Brook	1.26
Second Beaverdam Lake	2.35
Charlotte Lake	2.81
Northeast Lake	3.21
First Lake	3.24
Lake Rossignol	3.35
Second Lake	3.51
Broad River Lake	3.65
Town Lake	4.24
Georges Lake	4.28
Lily Pond	4.28
Nickersons Pond	4.51
Herring Cove Lake	4.88
Little Ten Mile Lake	4.91

*Measurement from the nearest point of the Study Area boundary.

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 surveyed the Assessment Area, which included a 25 m area on either side of existing/proposed roadways, a 10 m area on either side of proposed transmission line routes, and a 100 m radius around the center of proposed turbine locations. Watercourses identified were delineated (until their extent reached the buffer/boundary end or the watercourse terminated) and assessed for general watercourse characteristics. Supplementary information on fish/fish habitat and incidental observations of species of conservational interest (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 (including watercourses), the turbine layout underwent several further iterations and changes to minimize potential interactions and the number of required crossings. Information collected on watercourses was also used to guide further freshwater species assessments (i.e., fish and herpetofauna), as discussed in sections below.

An additional survey was created for drainage features which are characterized as a natural landscape feature such as a gully, depression, or other water-channeling feature that impacts the directionality of overland flow during and immediately after rainfall events (as per the Queensland *Survey and Mapping Infrastructure Act,* 2003). Recordings were made by making note of the observed topography, type of drainage feature, and presumed direction of flow, and also included a representative GPS-recorded polyline. The inclusion of this additional survey was intended to better the understanding of the localized hydrology as a means of facilitating hydrologically-informed decision making.

7.3.1.5 Field Assessment Results

Nine watercourses were identified within the Assessment Area (Appendix F and Drawings 7.12A-O), including small permanent (5), large permanent (2), ephemeral (1), and intermittent (1) watercourses ranging in bankfull width from 1.12 m to 12.3 m.

Permanent watercourses see water 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 watercourses include streams, brooks, and creeks. These watercourses 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 watercourses at their confluence. Large permanent watercourses often exhibit lower flow path gradients, larger channel dimensions, and an increased flow (US EPA, 2013).

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 watercourses during periods of heavy rain, or after significant snowmelt. During drier times of the year, flow velocity within these watercourses may reduce to pools of standing water, or eventually dry stream beds (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.

A total of 12 drainage features were identified within the Assessment Area. Despite a confined overland flow similar to ephemeral watercourses, these topographical features lack a

hydroperiod sufficient for the creation of a riverine environment. The data for these features will be provided to Project engineers to facilitate Project Area refinement, providing a better understanding of the hydrological tendencies of the area, and an increased awareness of overland flow.

Of the nine identified watercourses, seven are located along pre-existing roads and have evidence of alteration including metal culverts, plastic culverts, and clear span bridges. The remaining two watercourses do not have crossing structures along the surveyed reaches. There were no incidental observations of aquatic SOCI identified during the watercourse assessments.

7.3.1.6 Effects Assessment

A GIS suitability analysis was conducted to design a Project Area that would optimize the placement of Project infrastructure to avoid waterbodies and watercourses, to the greatest extent possible. The Assessment Area has considered multiple options/configurations of infrastructure components such as roads, transmission lines, a substation, and a laydown area. Further, the Project design utilizes as many pre-existing roads as possible. The Project's detailed design phase may see additional refinements to the Project Area and accompanying placement of infrastructure which could further reduce interactions with field-identified watercourses within the Assessment Area. Currently, there are no identified interactions between the Project and waterbodies.

Watercourse Interactions

Project activities, primarily those that involve earth moving, vegetation removal, and road construction have the potential to impact watercourses (Table 7.19). These potential impacts could include habitat loss, changes to hydrology, and/or displacement of sediment.

Table 7.19: 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 (Drawing 2.2). The RAA for watercourses includes the Mersey River Primary Watershed (2, 993 km^2) (Drawing 7.13).

Assessment Criteria

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

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

Direct Effects

Direct effects to watercourses such as habitat loss and altered hydrology 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

Watercourse alterations required for the Project 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

Many of the 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.

None of the alterations are expected to result in the diversion, redistribution, or realignment of the respective watercourse. Each alteration will be executed as a means of retrofitting the current or natural conditions to facilitate Project developments.

A summary of the watercourses identified within the Assessment Area and how they are expected to interact with Project infrastructure is provided in Table 7.20.

Table 7.20: Watercourse Alteration Summary

Watercourse	Existing Alteration Present?	Forecasted Alteration
WC1	Yes, plastic culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC2	Yes, plastic culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.

Watercourse	Existing Alteration Present?	Forecasted Alteration
WC3	Yes, wooden bridge spanning crossing.	Bridge to be assessed and potentially replaced during road upgrades.
WC4	No, watercourse was in an undisturbed area.	No alteration expected as watercourse can be avoided.
WC5	Yes, two metal culverts installed for road crossing. One culvert seemed older than the other.	Culverts to be assessed and potentially replaced during road upgrades.
WC6	Yes, plastic culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC7	Yes, plastic culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC8	Yes, wooden bridge spanning across.	Bridge to be assessed and potentially replaced during road upgrades.
WC9	No, watercourse was in an undisturbed area.	No alteration expected as transmission line can span across watercourse.

Road Upgrades
If required, all alterations will be upgrades to existing watercourse crossings and will take place during road upgrades. Many of the current watercourse crossings (5/7) have flow being directed through decaying infrastructure such as rusted culverts. Furthermore, when paired with the current buildup of sediment, organic material, and both natural and artificial debris, many of the observed crossings may be seen as a barrier to fish passage in their current state.

Additional alterations (2/7) may arise from upgrades to clear span bridges (WC3 and WC8). Given that these bridges provide safe crossing for logging machinery and logging trucks, it is expected the bridges will be sufficient for the Project, as they exist in their current state. Furthermore, should the bridges need to be replaced, open-bottom structures 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.

No new watercourse crossings are required for this Project.

Transmission Line
One watercourse (WC9) is situated along a proposed transmission line route. However, this crossing is not anticipated to impact the respective watercourse, as the transmission lines will span the watercourse without making contact. Further, any activity related to the installation of poles or structures to elevate, string, or pull the transmission lines will be restricted to the areas above the ordinary high-water mark and will ensure a sufficient vegetative buffer is preserved along the riparian zone.

Indirect Effects
Indirect effects such as erosion and sedimentation, or changes in water quantity and quality can

be far 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 primarily related to the construction and upgrading of access roads, and the installation or upgrading of crossing structures. Furthermore, 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 following specific mitigative measures will be implemented to avoid and mitigate any potential effects on watercourses. 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. The EPP will incorporate proven BMPs that have demonstrated success in mitigating such effects.

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

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.
- 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, 2015b; NSECC, 2015c).

Altered Hydrology
- Plan any activities to align with low-flow periods.
- 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.

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.
- 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, 2015b; NSECC, 2015c).
- 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, 2015b; NSECC, 2015c).
- Utilize rock material that is clean, coarse granular, non-ore-bearing, non-watercourse-derived, and non-toxic to aquatic life (NSECC, 2015b; NSECC, 2015c).

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 (NSECC, 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, may include hydrological, sediment, and stability assessments upstream, downstream, and at the crossing of the watercourse. An example is included in Table 7.21.

Table 7.21: 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
Project effects to watercourses are expected to be of low magnitude such that there will be no loss of aquatic habitat, with minimal potential for altered hydrology. 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 overall 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 approaches:

- 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 (SAR), said species and/or their dwellings are provided protection provincially under the NS *ESA* and *Biodiversity Act*, and federally under *SARA*. Throughout this report, SOCI are defined as follows:

- Species listed under *SARA* as "Endangered", "Threatened", or "Special Concern" (Government of Canada, 2022).
- Species listed under Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as "Endangered", "Threatened", or "Special Concern" (Government of Canada, 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, 2023).

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 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 (Open Data, 2022)
- WAM (NSNRR, 2012)
- Aquatic Species at Risk Map (2022)
- 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.

The Aquatic Species at Risk Map is a federal database showing the distribution of species listed under *SARA* and their associated critical habitat within Canadian waters (DFO, 2022a). A review of this database determined that there are no water features within the Study Area that contain SAR. The nearest SAR watercourse is the Mersey River (head of tide, approximately 3.2 km west). The tidal portion of the Mersey River is known to contain Northern wolffish, Spotted wolffish, and other non-fish SAR including Fin whale, Blue whale, North Atlantic right whale, Leatherback sea turtle, and White shark (DFO, 2022). Based on the inland nature of the Project and distance from the coastline, impacts on marine species are not assessed further.

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

- One “Other Habitat” record relating to a marine mussel known as the Ribbed mussel (*Geukensia demissa*).
- One “Species of Concern” record relating to a freshwater mussel known as the Delicate lampmussel (*Lampsilis cariosa*).
- One record relating to Atlantic lobster (*Homarus americanus*).

The ACCDC Data Report (2023) identified 12 fish and aquatic invertebrate SOCI within a 100 km of the Study Area (Table 7.22).

Table 7.22: 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 cod	*Gadus morhua*	Endangered Special Concern Data Deficient	---	---	SNR
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
Atlantic whitefish	*Coregonus huntsmani*	Endangered	Endangered	Endangered	S1
Brook Trout	*Salvelinus fontinalis*	---	---	---	S3
Striped bass	*Morone saxatilis*	Endangered Special Concern	---	---	S2S3
Striped bass – Bay of Fundy pop.	*Morone saxatilis pop. 2*	Endangered	---	---	S1B
Aquatic Invertebrates					
Brook floater	*Alasmidonta varicosa*	Special Concern	Special Concern	Threatened	S3
Eastern pearlshell	*Margaritifera margaritifera*	---	---	---	S2
Tidewater mucket	*Leptodea ochracea*	---	---	---	S1

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

In addition, the ACCDC database identified five marine mammals within a 100 km radius of the Study Area (Appendix G). Again, marine mammals were not assessed as part of this EA as the Project is located inland and is not anticipated to have any impacts on the marine environment.

Of the 12 fish and aquatic invertebrate SOCI identified within a 100 km radius of the Study Area, the ACCDC database identified Atlantic salmon – Nova Scotia Southern Upland (NSSU) population (*Salmo salar pop. 6*) and Striped bass (*Morone saxatilis*) 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 observations 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). Locations selected also considered the position of the watercourse within the watershed and attempted to utilize notable, permanent features that offer 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 are:

- *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
  Watercourse was 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
  Watercourse was 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
  DO fluctuates in response factors such as plant biomass, substrate, velocity, and temperature. Optimal DO concentrations should be >6.5-8 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 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, 2022b).

Electrofishing Surveys
Electrofishing is a standard fish capture measure used to capture 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 done in tandem with fish habitat assessments and was conducted over 200 m stretches along each target watercourse. For each watercourse, assessments were targeted at the 0 m, 100 m, and 200 m point (downstream, crossing, and upstream, respectively), with notes, photos, and fork length measurements taken for any fish caught during the survey. Field staff also 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 conducted within the Study Area (Section 7.3.1). During the watercourse assessments, notes on visual observations of fish were recorded along with fish habitat characteristics such as pool/riffle sequences, substrate composition, and barriers to fish passage (e.g., elevated culverts). Detailed descriptions and characteristics for each watercourse are provided in Appendix F. A summary of the fish and fish habitat results are shown in Table 7.23.

Table 7.23: Fish and Fish Habitat Assessment Results

Watercourse	Surveyed Reach	Possible Barriers to Passage	Fish Seen[1]	Habitat Characteristics			Ranking of Fish Presence
				Overwintering[2]	Spawning[3]	Rearing[4]	
001/ WC3	Downstream	No	Yes	Abundant	Trace	Abundant	High
	Crossing	No	Yes	Trace	Trace	Moderate	High
	Upstream	No	Yes	Trace	Trace	Trace	High
002/ Bon Mature Brook	Downstream	No	Yes	Trace	Trace	Moderate	High
	Crossing	No	Yes	Trace	Trace	Moderate	High
	Upstream	No	Yes	Trace	Trace	Moderate	High
003/ Mersey River	Downstream	No	No	Trace	Trace	Moderate	High
	Crossing	No	No	Trace	Trace	Moderate	High
	Upstream	No	No	Trace	Trace	Moderate	High
004/ East Broad River	Downstream	Yes	No	Trace	Trace	Moderate	High
	Crossing	Yes	No	Trace	Trace	Moderate	High
	Upstream	Yes	No	Trace	Trace	Moderate	High

[1]Includes observations from watercourse assessments and electrofishing surveys
[2]Overwintering Habitat = contains deep pools
[3]Spawning Habitat = gravel to cobble dominant substrates
[4]Rearing Habitat = riffle-pool sequences

Electrofishing Surveys

Electrofishing was conducted during summer 2022 along WC3, Bon Mature Brook, a portion of the Mersey River, and a tributary of East Broad River (Drawing 7.16). Due to environmental circumstances and permitting limitations, only two of the four targeted watercourses had conditions sufficient for qualitative electrofishing. Watercourse 001 was electrofished upstream for the entire reach, and ~100 m of the downstream reach with the remainder of the reach having inadequate water levels. Further, the crossing of this watercourse was unable to be electrofished due to the water temperature being above the DFO permitted limit of 22 °C. Watercourse 002 was electrofished at the downstream reach only, with the crossing and upstream reaches having inadequate water levels. Neither the downstream, crossing, or upstream reaches were electrofished for watercourse 003 or 004 due to water temperatures being too high.

The electrofishing surveys resulted in three individual fish being caught across two of the four surveyed watercourses. Detailed results of the electrofishing survey are provided in Appendix H, with a summary provided in Table 7.24.

Table 7.24: Electrofishing Survey Results

Watercourse	Count	Common Name	Scientific Name	COSEWIC Rank[1]	*SARA* Rank[2]	NS *ESA*[3]	S-Rank[4]
001/ WC3	2	American eel	*Anguilla rostrata*	Threatened	---	---	S3N
002/ Bon Mature Brook	1	American eel	*Anguilla rostrata*	Threatened	---	---	S3N
003/ Mersey River	0	---	---	---	---	---	---
004/ East Broad River	0	---	---	---	---	---	---

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

The results of the qualitative electrofishing surveys identified on SOCI – the American eel. American eels identified had fork lengths from 12 cm to 43 cm. The eels appeared to be in good health, exhibiting vigorous movement when captured and showing no obvious signs of illness, parasites, or injury.

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 below:

- Atlantic salmon
- Striped bass
- American eel

Atlantic salmon
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 (SFA) 20, 21, and part of 22 (DFO, 2013).

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 prefer 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 in particular 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 ACCDC observation of Atlantic salmon NSSU subspecies is 5.1 ± 1.0 km from the Study Area (ACCDC, 2023).

Note that the Atlantic salmon - Inner Bay of Fundy (IBoF) subspecies is listed as 'Endangered' by SARA and COSEWIC and as "S1" by ACCDC (2023). IBoF Atlantic salmon are a genetically distinct population of Atlantic salmon that encompass 48 rivers and possess their own unique localized migration strategy (COSEWIC, 2011). As this subspecies is said to be contained to Bay of Fundy rivers draining into the Minas Basin and Chignecto Bay, it is unlikely that the population would interact with the Project (DFO, 2014).

The closest ACCDC observation of Atlantic salmon IBoF subspecies is 79.2 ± 1.0 km from the Study Area (ACCDC, 2023).

Striped Bass

Striped bass is listed as "Endangered, Special Concern" by COSEWIC and as "S2S3" by ACCDC (2023). Striped bass is known to occur across the North American Atlantic coastline from Newfoundland to Florida (COSEWIC, 2012a). This species uses a collection of habitats throughout their life stages, with most populations occurring in slightly brackish to fresh water. During adult and juvenile stages, Striped bass are typically associated with marine or estuarine environments but move to freshwater during late fall through winter. In the spring months, Striped bass will return to their spawning sites located typically in freshwater to slightly brackish water. Feeding, spawning, and overwintering periods for this species are largely dictated by water temperatures, with feeding and spawning occurring when water temperatures are above 10°C, and overwintering occurring once temperatures fall below 10°C. There is only one known spawning location in Nova Scotia which is located in the Shubenacadie River, roughly 120 km to the northeast of the Study Area (COSEWIC, 2012a).

The closest ACCDC observation of Striped bass is 5.1 ± 1.0 km from the Study Area (ACCDC, 2023).

American Eel

The American eel is listed as 'Threatened' under COSEWIC and 'S3N' by ACCDC (2023). American eels are migratory species with life stages in freshwater, estuary, and marine environments (COSEWIC, 2012b). Though much is still unknown about the American eel,

several studies have shown a temperature preference of around 16.7° C (Blakeslee et al., 2018). Spawning and maturation occurs in the marine environment, where adults migrate inland to freshwater habitats. Within freshwater habitats, this species of eel is typically found in rivers and lakes, and will readily burrow into mud, sand, fine gravel, cobble, and woody debris. Within marine environments, American eels are commonly associated with protected shallow waters containing submerged vegetation (e.g., eelgrass) and woody debris (COSEWIC, 2012b).

The closest observation of American eel is within WC3 and Bon Mature Brook, where field staff recorded three individuals during electrofishing surveys.

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 7.25). These potential impacts could include habitat removal, disruptions to hydrology, and/or displacement of sediment.

Table 7.25: 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 is the Assessment Area (Drawing 2.2). The RAA for fish and fish habitat includes the Mersey River Primary Watershed (Drawing 7.13).

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 to fish behaviour expected.
- Low – small loss of fish habitat or impact to 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, such as habitat loss, 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, 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). 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 seven watercourse alterations that may impact fish and fish habitat. These alterations include upgrades to existing roads and associated crossings (five), if required. Many of the current watercourse crossings have flow being directed through decaying infrastructure such as rusted culverts. Furthermore, when paired with the current buildup of sediment, organic material, and both natural and artificial debris, many of the observed crossings may be seen as a barrier to fish passage in their current state. Therefore, for many of these crossings, proposed upgrades will improve flow and fish passage. Furthermore, as the Project will utilize preexisting roads for the entirety of the Project Area, no new watercourse crossings are required.

The remaining potential watercourse alterations (two) may result from upgrades to clear span bridges located along pre-existing logging roads (Table 7.26). Given that these bridges provide safe crossing for logging machinery and logging trucks, it is expected that the bridges will be sufficient for Project developments. Should the bridges need to be replaced, open-bottom structures will be utilized to ensure watercourse characteristics stay as true to pre-construction conditions as possible. Project engineers will make the determination as to whether to upgrade the pre-existing crossing infrastructure during the detailed design phase.

No wetlands that offer fish habitat within the Assessment Area are expected to be altered.

Table 7.26: Summary of Alterations to Features that May Support Fish and Fish Habitat

Feature ID	Existing Alteration Present?	Forecasted Alteration
Watercourses		
WC1	Yes, plastic culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC2	Yes, plastic culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC3	Yes, wooden bridge spanning crossing.	Bridge to be assessed and potentially replaced during road upgrades.
WC5	Yes, two metal culverts installed for road crossing. One culvert seemed older than the other.	Culverts to be assessed and potentially replaced during road upgrades.
WC6	Yes, plastic culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC7	Yes, plastic culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC8	Yes, wooden bridge spanning across.	Bridge to be assessed and potentially replaced during road upgrades.

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 primarily related to the construction and upgrading of access roads and crossing structures. Furthermore, 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 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 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, resulting in no expected new crossings. 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 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 to avoid and mitigate any potential effects on fish and fish habitat.

Habitat Loss

- Ensure watercourses 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.
- Redesign existing watercourse crossings to facilitate habitat upgrades, including unblocking culverts and making waterways more conducive to fish passage.
- 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, 2015b).

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.

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.

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, ensure it is pre-cast and cured for at least one week prior to use at a crossing site (NSECC, 2015b; NSECC, 2015c).
- 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, 2015b; NSECC, 2015c).
- Utilize rock material that is clean, coarse granular, non-ore-bearing, non-watercourse-derived, and non-toxic to aquatic life (NSECC, 2015b; NSECC, 2015c).

Monitoring

A monitoring plan, if required as part of the permitting phase, will be completed in tandem with the watercourse monitoring. This may include hydrological, sediment, and stability assessments upstream, downstream, and at the crossing of the watercourse. An example is included in Table 7.27.

Table 7.27: 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

Monitoring Parameter	Tasks	Method of Assessment	
		General Monitoring	Detailed Monitoring
	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
The effects to fish and fish habitat are expected to be of low magnitude. 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 are not 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 information collected to inform Project design (e.g., avoid/minimize impacts to wetlands) and establish an Assessment Area.
- Ground-truth and delineate wetland habitat within the Assessment Area.
- Complete functional assessments for a selection of representative 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 Nova Scotia *Environment Act.*

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:

- Satellite and Aerial Photography
- Provincial Landscape Viewer (NSNRR, 2017)
- Wetlands Inventory (NSNRR, 2021d)
- NS 10k Topographic Database – Hydrographic Network (Open Data NS, 2021)
- WSS Database (NSNRR, 2014)
- WAM (NSNRR, 2012a)

The NSNNR Wetland Inventory (2021d) identified 148 wetland features within the Study Area. These were classified as either a swamp (106), bog or fen (33), fen (7), or marsh (2), ranging in size between 0.1 and 106 ha (Drawing 7.17). According to the WSS Database (2014), three WSS are located within the Study Area. Two contain SAR and one is located within a protected area. The Project will not interact with these WSS.

The WAM layer identified potential wet areas and predicted flow within the Study Area based on the assumed depth-to-water generated from digital elevation data (Drawing 7.14) (NSNRR, 2012a). The depth-to-water ranged from 0.2 m to 1.0 m from the surface across the Study Area.

The results of the desktop review were subsequently used to refine turbine/road siting locations to avoid known wetland features and to scope field studies.

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 for potential turbine siting and road placement. This approach resulted in several layout modifications as the Project Area was optimized to minimize interactions with wetlands. Although all delineated wetlands are shown in Drawings 7.12A-O, only wetlands within the current Assessment Area are discussed as part of the effects assessment.

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 identifications. Throughout the surveys, all incidental observations of SOCI were noted and recorded for inclusion in reporting as detailed in their respective sections.

Field Delineations
The Assessment Area was surveyed and all identified wetlands were delineated. 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 produce 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 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 US Fish and Wildlife Service National List of Vascular Plant Species that Occur in Wetlands: NE Region (Region 1) (Reed,

1988) (Table 7.28). 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 7.28: Classification of Wetland-Associated Plant Species

Plant Species Classification	Abbreviation[1]	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.

Source: (Reed, 1988)

[1] 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.

Soil pits were excavated to a maximum depth of 40 cm or until 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 7.29). Wetland habitat is assessed for signs of hydrology via visual observations across the area and through the assessment of soil pits.

Table 7.29: 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

Eight representative wetlands were identified to be assessed for their functionality based on their geographic locations, as well as their variety in terms of landform, type, and characteristics therein. 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 provinces. 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 the summer of 2021 and 2022 identified 66 wetlands either partially within or fully within the Assessment Area (Drawings 7.12A-O). Detailed results are provided in Appendix I.

Of the 66 identified wetlands, the most prominent wetland type was treed swamps (22). 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 offer 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).

Given the extensive microtopography of the Study Area, the abundance of treed swamps was expected. This mosaic of topographical depressions, when paired with the low depth-to-water, forestry-altered evapotranspiration levels, and softwood dominant land cover, offers ideal conditions for not only the formation of treed swamps, but other wetland types.

Most treed swamps are situated in a basin landscape position with signs of historic forestry activity (i.e., moss covered tree stumps). Typical species composition consisted of black spruce (*Picea mariana*), balsam fir (*Abies balsamea*), black huckleberry (*Gaylussicia baccata*), sheep laurel (*Kalmia angustifolia*), and cinnamon fern (*Osmunda cinnamomea*). Surface water was typically not observed, though saturation was often present as identified through the excavation of small soil pits.

Shrub swamps (19) were also identified within 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 woolgrass (*Scirpus cyperinus*), three-seeded sedge (*Carex trisperma*), rhodora (*Rhododendron canadense*), speckled alder (*Alnus incana*), and red maple (*Acer rubrum*). Surface water was more common than within treed swamps, though the temporal extent of the surficial hydroperiod seemed to be seasonal.

Bogs (12) were also observed throughout the Assessment Area. These wetlands are characterized by their poor drainage, accumulation of peat, and dense coverage of either sphagnum moss or grass-like sedges (Province of NS, 2018). Typical species composition observed included cinnamon fern (*Osmunda cinnamomea*), swamp dewberry (*Rubus hispidus*), sheep laurel (Kalmia angustifolia), leatherleaf (*Chamaedaphne calyculata*), and black spruce (*Picea mariana*). The majority of the observed bogs were in a basin landform that had been intersected by a roadway, as could be observed by the continuation of bog habitat extending laterally from the adjacent side of the roadway, and the pooling of water near roadway shoulders. Trees, when present, were often stunted and scattered throughout.

Seven 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 woolgrass (*Scirpus cyperinus*), Canada rush (*Juncus canadensis*), and broad-leaved cattail (*Typha latifolia*).

Six 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 woolgrass (*Scirpus cyperinus*), fringed sedge (*Carex crinita*), and cinnamon fern (*Osmunda cinnamomea*).

Functional Assessments

Functional assessments were completed during summer 2022 for eight representative wetlands within the Assessment Area (Drawings 7.12A-O). 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 many of the 66 identified wetlands, more in-depth analysis and functional assessments will be completed for any wetland deemed to require alteration. Detailed WESP-AC results are found in Appendix I, and a summary is provided in Table 7.30.

None of the wetlands were determined to be WSS, as dictated by the Functional WSS Interpretation Results within the WESP-AC spreadsheet calculator. All but three wetlands were determined to be in higher ecological condition, with 5 of 8 wetlands receiving this result. However, all 8 wetlands 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.

As previously mentioned, wetlands known to support at-risk species as designated under *SARA* or the NS *ESA* are considered WSS under the Wetland Conservation Policy. The results of the desktop and field assessments show no at-risk lichen or plant species within field-delineated wetlands within the Assessment Area. Furthermore, the results of the wetland field assessments were also cross referenced with breeding bird survey (BBS) results, specifically for avian SAR with wetland habitat requirements. Again, these results show no at-risk bird species within field delineated wetlands within the Assessment Area.

Table 7.30: 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]
WL4	1ED-1-PPP	Bog/Treed Swamp	No	Higher	Higher
WL7	1ED-1-PPP	Bog	No	Higher	Higher
WL14	1ED-2-C	Marsh	No	Higher	Higher
WL17	1ED-1-PPP	Bog/Marsh	No	Moderate	Higher
WL25	1ED-1-LLL	Bog	No	Higher	Higher
WL33	1ED-1-NN	Treed swamp	No	Higher	Higher
WL38	1ED-2-C	Treed swamp	No	Moderate	Higher
WL50	1ED-2-C	Shrub swamp	No	Moderate	Higher

[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

A GIS suitability analysis was conducted to design a Project Area to optimize the placement of Project infrastructure to avoid and minimize loss of wetland area and function, to the greatest extent possible.

In areas where wetland alteration is unavoidable, the detail design phase will refine the layout to have wetland crossings along wetland edges or narrow portions of the wetland to 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. Specific details of each crossing will be finalized during the detailed design phase and will be included in the application for alteration.

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 7.31).

Table 7.31: 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 as well. 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 lifetime 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). A 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 as well.

A summary of the wetlands identified within the Assessment Area and how they may be affected by the Project is provided in Table 7.32 and shown on Drawings 7.12A-O.

Table 7.32: Effects Assessment for Wetlands within the Assessment Area

ID	Wetland Type	Delineation Extent[1]	Delineated Area (m^2)	Area of Potential Alteration[2] (m^2)	Activity
WL1	Vernal pool	Full	148.15	0	Road upgrade – no impact expected
WL2	Vernal pool	Full	11.32	0	Road upgrade – no impact expected
WL3	Vernal pool	Full	35.16	0	Road upgrade – no impact expected
WL4	Bog / Treed swamp	Partial	1220.6	0	Road upgrade – no impact expected
WL 5	Vernal pool	Full	136.57	0	No impact
WL6	Shrub swamp	Partial	711.1	649.07	Road upgrade
WL7	Bog	Partial	1845.82	941.65	Road upgrade
WL8	Vernal pool	Full	54.15	0	Road upgrade – no impact expected
WL9	Treed swamp / Shrub swamp	Full	124.34	0	Road upgrade – no impact expected
WL10	Shrub swamp / Treed swamp	Partial	1156.67	0	Road upgrade – no impact expected

ID	Wetland Type	Delineation Extent[1]	Delineated Area (m^2)	Area of Potential Alteration[2] (m^2)	Activity
WL11	Shrub swamp	Full	58.03	0	Road upgrade – no impact expected
WL12	Treed swamp / Shrub swamp	Partial	5984.5	0	Turbine pad – no impact expected
WL13	Shrub swamp	Full	201.23	0	Road upgrade – no impact expected
WL14	Marsh	Full	337.92	337.92	Road upgrade
WL15	Bog	Full	102.77	102.77	Road upgrade
WL16	Bog	Full	317.1	0	Road upgrade – no impact expected
WL17	Bog / Marsh	Full	468.04	0	Road upgrade – no impact expected
WL18	Shrub swamp	Full	268.63	268.63	Substation
WL19	Marsh	Full	84.02	0	Road upgrade – no impact expected
WL 20	Vernal pool	Full	94.22	0	Turbine pad – no impact expected
WL21	Treed swamp / Shrub swamp	Partial	2893.37	2731.04	Road upgrade
WL22	Treed swamp	Full	160.53	160.53	Road upgrade
WL23	Bog	Full	261.39	261.39	Road upgrade
WL24	Shrub swamp	Partial	546.55	546.55	Road upgrade
WL25	Bog	Partial	2028.61	0	Road upgrade – no impact expected
WL26	Bog	Partial	674.33	0	Turbine pad – no impact expected
WL27	Treed swamp	Partial	530.17	528.23	Road upgrade
WL28	Bog	Partial	1481.24	1481.24	Road construction
WL29	Bog	Full	1186.84	1186.84	Road construction
WL30	Bog	Partial	449.79	0	Turbine pad – no impact expected
WL31	Treed swamp / Bog	Partial	4185.59	0	Turbine pad – no impact expected

ID	Wetland Type	Delineation Extent[1]	Delineated Area (m^2)	Area of Potential Alteration[2] (m^2)	Activity
WL32	Shrub swamp/ Marsh	Partial	226.58	226.58	Road upgrade
WL33	Treed swamp	Partial	1642.83	0	Road upgrade – no impact expected
WL34	Marsh / Shrub swamp	Full	111.86	0	Road upgrade – no impact expected
WL35	Marsh / Treed swamp	Partial	450.36	0	Road upgrade – no impact expected
WL36	Treed swamp	Partial	207.03	0	Turbine pad – no impact expected
WL37	Treed swamp / Marsh	Full	500.95	0	Turbine pad – no impact expected
WL38	Treed swamp	Partial	512.01	0	Road upgrade – no impact expected
WL39	Shrub swamp / Treed swamp	Partial	576.32	0	Road upgrade – no impact expected
WL40	Shrub swamp	Full	339.38	0	Turbine pad – no impact expected
WL41	Shrub swamp / Treed swamp	Partial	9651.68	0	Turbine pad – no impact expected
WL42	Marsh	Partial	512.06	0	No impact
WL43	Treed swamp / Shrub swamp	Full	1251.49	0	Turbine pad – no impact expected
WL44	Shrub swamp / Treed swamp	Full	2248.87	0	Turbine pad – no impact expected
WL45	Marsh	Partial	362.07	362.02	Road upgrade
W46	Treed swamp	Partial	423.62	335.45	Road upgrade
WL47	Treed swamp	Partial	2162.47	0	Road upgrade – no impact expected
WL48	Treed swamp	Partial	2239.5	1112.18	Road upgrade
WL49	Treed swamp / Shrub swamp	Partial	1575.69	1323.67	Road upgrade
WL50	Shrub swamp	Partial	1356.64	1356.64	Road upgrade
WL51	Treed swamp / Shrub swamp	Partial	2724.74	1314.1	Road upgrade

ID	Wetland Type	Delineation Extent[1]	Delineated Area (m^2)	Area of Potential Alteration[2] (m^2)	Activity
WL52	Shrub swamp	Full	181.82	0	Road upgrade – no impact expected
WL53	Bog / Treed swamp	Partial	1807.85	0	Road upgrade – no impact expected
WL54	Shrub swamp	Partial	1519.76	0	Road upgrade – no impact expected
WL55	Treed swamp	Partial	960.55	0	Road upgrade – no impact expected
WL56	Shrub swamp	Partial	176.72	176.72	Road upgrade
WL57	Treed swamp	Partial	653.69	0	No impact
WL58	Marsh	Partial	219.75	0	No impact
WL59	Treed swamp	Partial	19943.58	6470.07	Road upgrade
WL60	Shrub swamp / Treed swamp	Partial	689.11	0	No impact
WL61	Shrub swamp	Full	1568.47	0	No impact
WL62	Treed swamp	Full	138.35	0	Road construction – no impact expected
WL63	Treed swamp	Full	558.63	558.63	Road construction
WL64	Shrub swamp / Treed swamp	Full	735.79	735.79	Road construction
WL65	Shrub swamp	Partial	713.91	709.45	Road construction
WL66	Treed swamp	Full	2163.01	2163.01	Substation

[1]Wetlands were delineated until their extent reached the buffer/boundary end or the wetland terminated
[2] The area of potential alteration was calculated via GIS by assuming a conservative road disturbance width of 25 m. As detail 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 estimates here.

The results of the desktop analysis and field assessments indicate a total of 2.6 ha of delineated wetland habitat that may be directly altered by Project activities. Significant effort was made to maximize existing disturbed areas, with only 8.4 km of new road being constructed, and 37.6 km of previously existing road being utilized. As such, 18 of the 25 potential wetland alterations would be from upgrades to existing roads (if determined to be required during the detailed design phase). As for the remaining seven potential wetland alterations, five would stem from the construction of new roads, and two would stem from the construction of an electrical substation.

Provincial wetland data supplied by NSNRR (2021d) was used to estimate the total amount of wetland habitat within the 8,852 ha Study Area. An estimated 788 ha of wetland habitat was identified, which equates to approximately 8.9% of the total Study Area. Field delineated wetland habitat that may be directly impacted comprises approximately 0.03% of the total area within the Study Area, approximately 0.33% of the potential wetland habitat within the Study Area, and approximately 0.79% of the total area within the 326 ha Assessment Area. The final Project Area and subsequent area of impact will be determined following the detailed design phase.

Indirect Effects

The temporal and spatial extent of indirect effects such as erosion and sedimentation, dust, invasive species, and compaction can be farther 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 (Farmer, 2003). Further, larger particulate can result in lacerations in plant tissues, thus jeopardizing the health of the plant.

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 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.

Habitat Loss

- Ensure wetlands are clearly marked to avoid interference with wetland habitat to the extent possible.
- 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

- Ensure wetland crossings will not result in 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 geotextile matting, time work to occur during frozen ground conditions, or travel through the drier portions of the wetland, as appropriate.
- Ensure surface run-off containing suspended materials or other harmful substances is minimized.
- 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, where required.
- Enforce site speed limits to minimize dust generation.

Invasive Species

- Use of quarried, crushed materials for road construction to reduce the introduction of invasive vascular plant species.
- Clean and inspect work vehicles prior to use to prevent the introduction of invasive/non-native species.

Compaction

- Ensure wetland delineation tape is in place and visible to avoid unnecessary compaction within wetlands.
- Hold pre-construction site meetings to educate staff on the sensitivity of wetlands.
- Avoid travel through wetlands.
    - If travel through wetlands is required, use geotextile matting, time work to occur during frozen ground conditions, or travel through the drier portions of the wetland, as appropriate.

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 7.33).

Table 7.33: 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 other positive indicators of hydrology (e.g., drainage patterns, water-stained leaves, saturated surfaces, raised tree roots, development of a hydrogen sulphide 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

Monitoring Parameter	Tasks	Method of Assessment	
		General Monitoring	Detailed Monitoring
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. 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 avoiding these habitats. Note that wetlands 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 7.4.3-7.4.5.

The Study Area is a relatively remote swathe of land that is most frequently used for forestry operations and light recreation during all months of the year. These activities have established a

relatively expansive road and trail network that allows for access to most areas of the Assessment Area.

To assess the terrestrial habitat within the Study Area, a desktop review was conducted prior to the commencement of field activities to identify different habitats and any key areas of interest. The findings informed and shaped the design of targeted field surveys with the goal of assessing all habitat types, including the natural and anthropogenic environment. Ground-truthing was a major component of this assessment, as the Nova Scotia wetland and forest inventories are not always accurate in determining habitat features and/or the extent of these features.

Results of the desktop and field studies informed the placement of wind turbines and associated roads. This was an iterative process, with the layout being refined as additional field data was available to ultimately avoid sensitive habitat. 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, 2022b) 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, on which the Assessment Area lies, and guidance for avoiding development within 100 m of a confirmed old-growth stand.

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

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, 2018)
- Old-Growth Policy Layer (Province of NS, 2022)

The Study Area is located in the Western Ecoregion, and more specifically, the site predominantly lies within the Sable Ecodistrict, with northern stretches into the Rossignol Ecodistrict. The Sable Ecodistrict is a low elevation plain, characterized by poorly drained soils and an abundance of wetland habitat. This ecodistrict contains the largest concentration of peatlands within the province of Nova Scotia, with treeless bogs and stunted black spruce (*Picea mariana*) forests accounting for approximately one-quarter of the ecodistrict. The Sable Ecodistrict has also been significantly influenced by hurricanes, fire, acidic soil loading, and soil cementation which has resulted in spruce-pine woodlands and/or barren conditions. The Rossignol Ecodistrict is characterized by its abundance of surface water, containing both the Mersey and Medway River watersheds along with the largest freshwater lake in the province (Lake Rossignol). Forests in this ecodistrict are predominantly late successional softwood stands dominated by eastern hemlock (*Tsuga canadensis*), red spruce (*Picea rubens)*, and white pine (*Pinus strobus*) (Neily et al., 2017).

The Provincial Landscape Viewer was reviewed to identify the land cover within the Study Area (Table 7.34, Drawing 7.18). Land cover within the Study Area is varied, including wet areas, harvests, and softwood and mixed wood forested area (NSNRR, 2017). 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 (72.29% cover) (Province of NS, 2021). The Nova Scotia Forest Inventory is based on aerial imagery from 2010 and 2011, and more recent imagery shows that the majority of these previously natural forest stands have since been harvested. Therefore, the percentage of land cover made up of natural, untreated forest stands is much lower.

Table 7.34: Land Cover Types within the Study Area and their Respected Percent Cover as Determined by the Provincial Landscape Viewer and NSDRR Forest Inventory

Land Cover Type	% Coverage
Softwood	58.41
Hardwood	0.84
Mixed Wood	22.10
Bog or Wetland	8.37
Harvests	9.92
Utility Corridor	0.20
Water	0.066
Urban, Landfill, Quarry, or Transport Corridor	0.091

The Old-Growth Policy layer (Province of NS, 2022) and an Old-Growth Potential Index layer provided by NSNRR through a data sharing agreement were also reviewed. There are 14 stands of protected forest under the Old-Growth Forest Policy (2022) within the Study Area, 12 of which are confirmed old-growth (Drawing 7.19). While none of these forest stands will be intersected by the Project, there are five confirmed old-growth stands within 100 m of the Assessment Area. Three of these stands are within 100 m of a proposed road upgrade, and two of these stands are within 100 m of turbine pads (but not within 100 m of the proposed turbine location). One

additional stand, which does not fall within the Study Area, is within 100 m of a proposed new road.

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

- Six records classified as 'Other Habitat' which relate to beaches (two), lakes (two), a bay (one), and an esker (one).
- One record classified as 'Species of Concern' which relates to a lake.

None of these records are located within the Study Area; the closest record is a lake 27 km from the Study Area.

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

- Lower Mersey Nature Reserve (Pending designation)
- Long Lake Bog Nature Reserve (Pending designation)
- Long Lake Bog Conservation Lands
- Mersey River Provincial Park (Pending designation)

Long Lake Bog Nature Reserve and Long Lake Bog Conservation Lands are outside the Study Area and will therefore have no direct interactions with the Project. Some components of the pending Lower Mersey Nature Reserve are within the Study Area, with 3.2 ha overlapping the Assessment Area. The Lower Mersey Nature Reserve is bisected by a 50 m swath centered on an existing forestry road to be used by the Project. The Project will not impact the nature reserve.

A small area (5.8 ha) of the pending Mersey River Provincial Park also overlaps with the Assessment Area; however, the entire area of overlap is in areas of pre-existing roads or powerlines. The Project will use the same approach as the nature reserve, limiting all impacts to a 50 m (maximum width) swath along the active forestry road or adjacent to active transmission lines.

7.4.1.4 Field Assessment Methodology

Terrestrial habitats were confirmed through field investigations targeting watercourses, wetlands, rare plants and lichen, moose, birds, and bats. Terrestrial habitats of note that were targeted during the field surveys include potential mature/old-growth forest, caves/mines, and concentrations of species (i.e., maternity colonies or other nesting sites).

Identification of important terrestrial habitat features guided further field assessments and siting of proposed wind turbines and roads with the goal of avoiding these features altogether.

7.4.1.5 Field Assessment Results

The native vegetation in and around the Assessment Area includes mainly softwood stands, with extensive wetland habitat throughout. Forestry work has been ongoing in the Study Area for decades, and this work has included clearcutting, selective cutting of hardwood stands, and repeated monoculture planting. Given the extent and intensity of forestry activities in the Assessment Area, there are very few areas that have gone untouched by industrial operations. Natural, undisturbed forest was found to be less abundant than desktop data would suggest, as the data that were reviewed are not up to date (aerial imagery is from 2007), and therefore do not adequately reflect recent forestry activity.

Primary native tree species include red maple (*Acer rubrum*), red spruce (*Picea rubens*), eastern hemlock (*Tsuga canadensis)*, and black spruce (*Picea mariana*). Softwood forests were observed in greatest abundance, followed by mixed wood forests of varying ages, including regenerating stands and selectively cut patches. Balsam fir (*Abies balsamea*) and black spruce dominate the poorly drained slopes, while black spruce, tamarack (*Larix laricina*), and yellow birch (*Betula alleghaniensis*) dominate the treed swamps and riparian zones around watercourses and wetlands. Hardwood forests were uncommon, as most deciduous trees were found in understory layers of young, regenerating mixed-wood stands or as minority species in mature mixed wood stands.

Hemlock Wooly Adelgid (*Adelges tsugae*), a sapsucking invasive insect known in southwestern Nova Scotia, was observed in a large area along the proposed transmission line. The presence of Hemlock Wooly Adelgid (*Adelges tsugae)* in Nova Scotia has resulted in significant deaths to Eastern hemlock trees, sometimes resulting in the deaths of entire forests.

Areas supporting flora SOCI, such as wetlands or mature forests were surveyed to determine the capacity for these areas to support SOCI and whether any SOCI were present. No such habitat was found within the Assessment Area, as any areas of important habitat identified within the Study Area were avoided during the Project design phase. Furthermore, as the majority of the Assessment Area utilizes pre-existing roads surrounded by managed forest, the extent of unfragmented, undisturbed forested areas was limited. The Assessment Area was found to be highly fragmented in its current state, with most natural, untreated forest stands or wetlands existing within 25 m of a road.

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” (Province of NS, 2022). The Policy protects these forest stands on Crown land. One forest stand protected by the Old Growth Forest Policy was visually assessed, as well as the areas surrounding this stand. Based on observed old-growth characteristics such as large diameter climax species (i.e., Eastern hemlock), uneven age stand structure, and significant cover of lichen and moss, the Project was designed to avoid this entire area.

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 7.35). These activities could result in habitat removal or alteration.

Table 7.35: 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 – 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 is the most recognizable effect associated with the terrestrial habitat. Habitat to consider includes critical habitat for flora SOCI, old-growth forest, priority habitat features, areas of special concern for conservation or protection, and unfragmented, undisturbed areas.

No habitat for flora SOCI was identified within the Assessment Area through the NSNRR Significant Species and Habitat Database (2018) and field surveys; however, old-growth forest stands were found through desktop review and field surveys. No old-growth forest stands overlap with the Project Area, therefore, no old-growth forest will be directly impacted by the Project. Four confirmed old-growth forest stands within 100 m of the Assessment Area will be completely avoided by adjusting the Project Area to either limit construction to the opposite side of the pre-existing road of the old-growth stand, or limiting infrastructure to further than 100 m from the old-growth stand. The access road to Turbine 33 is a new road within the 100 m buffer. As per the Old growth Forest Policy, when proposed development will occur in close proximity (i.e. within 100 m) of a confirmed old-growth stand, a Regional Integrated Resource Management (IRM) team, together with the Old-Growth Forest Coordinator, will apply professional judgement and knowledge of local ecological circumstances to assess the expected consequences of the proposed activity on the Crown land ecosystems in question (Province of NS, 2022). Should the IRM team determine that this ecosystem will be significantly impacted by the proposed location of the road leading to Turbine 33, alternative options will be proposed to avoid this area.

Pending or designated conservation areas, wilderness areas, or otherwise protected areas were found within the Study Area. The pending Lower Mersey Nature Reserve within the Study Area is configured to exclude the existing and active forestry roads, which will be used for the Project. The 50 m gap in the nature reserve is sufficient for all Project infrastructure to avoid the nature reserve.

The impact to the pending Mersey River Provincial Park depends on the final configuration of the park parcels. A 50 m gap, like the adjacent nature reserve, is sufficient for all Project infrastructure to avoid the park lands.

The configuration of the proposed protected areas, registered and potential archaeological sites, and stands of old growth forest precludes alternative site access. Using existing infrastructure is the least impactful and poses the smallest threat to important archeological resources.

The majority of land cover within the Study Area is softwood forest, 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 suggested. In addition, a large amount of forested habitat exists within 25 m of a pre-existing road or otherwise cleared area. The Project Area will consist of 8.4 km of new roads and utilize 37.6 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, and more generally across the Study Area, will undergo changes. Although the majority of the Project Area consists of existing roads, these roads may require widening and additional infrastructure added in the rights-of-way (ditches,

transmission line). New gravel roadsides may become preferred nesting habitat for herpetofauna, and the new and widened roads may become basking habitat for snakes or wildlife corridors for terrestrial mammals. 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, habitat fragmentation, and habitat isolation by utilizing pre-existing roads and previously altered areas (i.e., clearcuts).
    - Desktop and field assessments identified important habitat features to be avoided during the design phase, such as old-growth forest. Where small areas of overlap exist between protected stands or their buffers under the Old-Growth Forest Policy and the Assessment Area, the Project Area will utilize only the pre-existing road and the area opposite the road from the buffer. For the road to Turbine 33, the IRM team will be consulted.
- Restore cleared areas as much as possible to reduce impacts from habitat loss, primarily through revegetation of road rights-of-way.

Habitat Creation
- Revegetate as much cleared area as possible using native seed mixes.
- Minimize road salting to avoid attracting ungulates to roadsides.

Monitoring
No monitoring programs specific to the terrestrial habitat are recommended.

Conclusion
Through the implementation of proposed mitigation strategies, effects to terrestrial habitat, including both habitat loss and creation, are expected to be of low magnitude. Residual effects may occur within the LAA, persist long-term until natural successional process can occur, 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.
- Identify important and sensitive habitat features that support terrestrial flora SOCI on/near the Project.
- Target field program efforts at collecting information on 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 more information on terrestrial flora SOCI present during field programs.
- Use the information collected to inform and refine project design – i.e., avoid known locations of terrestrial flora SOCI or the habitat that supports them through constraints assessment.
- Use the information collected to inform mitigation and management practices.

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 species at risk receive protection under *SARA* and/or the 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 (NSNR, 2018). 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, 2012b)

ACCDC Data Report (2023) identified 377 flora species within 100 km of the Study Area (Appendix G). Of the 377 species, 211 are vascular plants and 166 are non-vascular plants. A summary of plant and lichen SOCI identified by the ACCDC records as being known to occur within the Study Area is provided in Table 7.36.

Table 7.36: ACCDC Plant and Lichen SAR/SOCI Identified within the Study Area

Common Name	Scientific Name	COSEWIC[1]	*SARA*[2]	NS *ESA*[3]	S-Rank[4]
Plants (Vascular)					
Long's bulrush	Scirpus longii	Special Concern	---	Vulnerable	S3
Michaux's dwarf birch	Betula michauxii	---	---	---	S3
Appalachian polypody	Polypodium appalachianum	---	---	---	S3
Swamp loosestrife	Decodon verticillatus	---	---	---	S3S4
Long-leaved panicgrass	Coleataenia longifolia	---	---	---	S3S4
Philadelphia panicgrass	Panicum philadelphicum	---	---	---	S3S4
Lichens (Non-vascular)					
A lichen	Chaenotheca hygrophila	---	---	---	S1S3
Acadian jellyskin lichen	*Leptogium acadiense*	---	---	---	S3S4
Black-foam lichen	*Anzia colpodes*	Threatened	Threatened	Threatened	S3
Blistered jellyskin lichen	*Leptogium corticola*	---	---	---	S3S4
Blue felt lichen	*Pectenia plumbea*	Special Concern	Special Concern	Vulnerable	S3
Blue-gray moss shingle lichen	*Moelleropsis nebulosa ssp. frullaniae*	---	---	---	S2S3
Blue-gray moss shingle lichen	*Moelleropsis nebulosa*	---	---	---	S2S3
Corrugated shingles lichen	*Fuscopannaria ahlner*	---	---	---	S3
Crumpled bat's wing lichen	*Collema leptaleum*	---	---	---	S2S3
Elegant fringe lichen	*Heterodermia leucomel*	---	---	---	S1
Fringe lichen	*Heterodermia neglecta*	---	---	---	S3S4
Frosted glass-whiskers (Atlantic population)	*Sclerophora peronella (Atlantic pop.)*	Special Concern	Special Concern	---	S3S4
Ghost antler lichen	*Pseudevernia cladonia*	Not at Risk	---	---	S2S3
Graceful felt lichen	*Erioderma mollissimum*	Endangered	Endangered	Endangered	S1
Naked kidney lichen	*Nephroma bellum*	---	---	---	S3
Pale-bellied pelt lichen	*Peltigera ponojensis*	---	---	---	S1S2
Peppered moon lichen	*Sticta fuliginosa*	---	---	---	S3S4
Powdered fringe lichen	*Heterodermia speciosa*	---	---	---	S1
Red beard lichen	*Usnea rubicunda*	---	---	---	S2S3
Salted shell lichen	*Coccocarpia palmicola*	---	---	---	S3S4
Shaggy fringed lichen	*Anaptychia palmulata*	---	---	---	S3S4
Warty beard lichen	*Usnea ceratina*	---	---	---	S2S3
White-rimmed shingle lichen	*Fuscopannaria leucosticta*	Threatened	---	---	S3
Wrinkled shingle lichen	*Pannaria lurida*	Threatened	Threatened	Threatened	S2S3

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

Four of the lichen reported by ACCDC (2023) are located in areas that may interact with the Assessment Area.

Blue felt lichen (*Pectenia plumbea)* is a lichen listed in the At-Risk Lichens – Special Management Practices (NSNR, 2018), where it is granted a buffer. This buffer restricts new construction within 100 m of the lichen; however, road upgrades may be permitted subject to review by an IRM team. One record of blue felt lichen was found within 100 m southwest of a currently existing road in 2007. Blue felt lichen was designated as Nova Scotia's provincial lichen in 2022 (CBC News, 2022). Just under half of the North American population of this lichen occurs in Nova Scotia. Blue felt lichen require mature hardwood or mixed wood trees with high humidity, where several successional stages are present. Air pollution and acid rain are major threats to the survival of this species, and many areas of Nova Scotia currently receive acid deposition greater than the critical load for blue felt lichen. The construction of roads and logging associated with wind farm construction are also considered threats to this species, for the potential to remove the lichen itself, to remove the availability of host trees, and to alter hydrology and therefore impose edge effects such as drying and blow down (ECCC, 2022d). Concerted efforts were made to survey habitat that may support blue felt lichen within the Assessment Area to identify any additional occurrences of this species, as discussed in Section 7.4.2.5.

Frosted glass-whiskers lichen (*Sclerophora peronella*) is a rare, cryptic lichen species designated as 'Special Concern' under COSEWIC in 2014 and *SARA* in 2006, and has an S-Rank of 'S3S4' (ACCDC, 2022; Government of Canada, 2022). There were 13 known occurrences of this species in Nova Scotia as of 2013, and these observations were in upland deciduous forests as well as in forested wetlands. This species is thought to only be found on trees where previous damage has allowed the heartwood to be exposed yet protected within cracks and crevices, which is where the lichen will colonize. Observations of this species have only been found on such exposed heartwood of red maple trees (COSEWIC, 2013a). Forestry and land clearing, particularly in old-growth forests, poses a serious threat to the survival of this species. This lichen is listed in the At-Risk Lichens – Special Management Practices (NSNR, 2018), where it is granted a buffer. This buffer restricts new construction within 100 m of the lichen; however, road upgrades may be permitted subject to review by an Integrate Resource Management team. One record of this lichen was found within 100 m of the Assessment Area, southwest of a pre-existing road.

White-rimmed shingle lichen (*Fuscopannaria leucosticte*), listed as 'Threatened' by COSEWIC in 2019 and 'S3' by ACCDC (2022), was recorded once within the Assessment Area, southwest of a pre-existing road. This lichen can be found growing on the bark of trees in wet forests of Eastern Canada. These forests may exist in open swamps with standing water year-round, in more densely vegetated riparian habitat, or in transitional areas near peatlands. This cyanolichen is particularly sensitive to atmospheric conditions such as acid rain, and loss of host from blowdown or logging activities. In Nova Scotia, the main host tree for White-rimmed Shingle lichen is red maple (*Acer rubrum)* (COSEWIC, 2019).

One record of salted shell lichen (*Coccocarpia palmicola)* was found within the Assessment Area. This species can be found on the bases of deciduous trees such as red maple, or on moss covered rocks or soil, and prefers shady areas in moist to mesic hardwood or mixed wood forests. Climate change and forestry activities may pose direct threats to this lichen's survival (Nash et al., 2002b; Minnesota DNR, 2022). This record, from 2007, can now be seen overtop a road that was constructed at some point between 2010 and 2022, as determined by aerial imagery. As this area has since been harvested for the construction of this road, the habitat supporting this lichen is no longer present.

The Boreal Felt Lichen Layer (provided to Strum by NSNRR) was reviewed to identify potential habitat for boreal felt lichen within the Study 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 (*Abies balsamea)* trees in peatland and in close proximity (<30 km) to the Atlantic Ocean (NSNRR, 2012b). Boreal felt lichen – Atlantic population (*Erioderma pedicellatum*) is a rare species listed as "Endangered" under Schedule 1 of *SARA* and NS *ESA* and is also listed as "S1" by ACCDC (2022). The Boreal Felt Lichen Layer identified 233.62 ha of suitable boreal felt lichen habitat across the Study Area, and 2.56 ha of suitable habitat overlapping with the Assessment Area (Drawing 7.20).

7.4.2.4 Field Assessment Methodology

Plant surveys were completed across the Assessment Area on July 20 and 21, 2021, and July 24, 2022. Targeted transects were conducted by Mr. Chris Pepper, an expert botanist with extensive experience in Nova Scotia botany. The transects were spaced out through different habitats and positioned evenly throughout the Assessment Area to ensure survey coverage of all representative habitats was obtained (Drawing 7.21). 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 searched as well.

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

Concurrent with the plant surveys, lichen surveys were conducted by Mr. Pepper who is also an expert lichenologist. The presence of a certain lichen species is highly dependent upon the vegetation in the area; therefore, vegetative cover was considered when surveying for lichen SOCI. In addition to surveying the predetermined transects, proposed road and turbine areas were also assessed for presence of lichen SOCI to inform the final placement of this infrastructure.

7.4.2.5 Field Assessment Results

During the plant and lichen surveys, 134 flora species were identified, including one plant SOCI, and six lichen SOCI (Drawings 7.12A-O). A complete list of plant and lichen species identified

during targeted surveys and incidental observations is provided in Appendix J. Additional species were added to this list from observations made in winter and fall of 2021 during bird surveys, as well as wetland plants observed in summer 2022 during wetland surveys. All SOCI plants and lichen are summarized in Table 7.37. Five exotic plants were encountered during surveys (Table 7.38).

Table 7.37: Flora SOCI Encountered During Flora Surveys

Common Name	Scientific Name	SAR/SOCI	Habitat Found
Blue-gray moss shingle lichen	*Moelleropsis nebulosa*	S2S3[1]	Softwood dominant stand with White pine (*Pinus strobus)*, as well as in a mixed wood forest with majority Red maple
Corrugated shingles lichen	*Fuscopannaria ahlneri*	S3[1]	Softwood dominant stand with majority Black spruce and Red maple trees present
Eastern blue-eyed-grass	*Sisyrinchium atlanticum*	S3S4[1]	Marshes, meadows, fields, and edges of wetlands
Frosted glass-whiskers lichen	*Sclerophora peronella*	Special Concern (Atlantic population) (COSEWIC, SARA)[2,3], S3S4[1]	Softwood dominant stand with Red maple trees present
Salted shell lichen	*Coccocarpia palmicola*	S3S4[1]	Softwood dominant stand with majority Red spruce (*Picea rubens)* and Red maple trees present
White-rimmed shingle lichen	*Fuscopannaria leucosticta*	Threatened (COSEWIC)[2], S3[1]	Softwood dominant stand with Red maple (*Acer rubrum)* trees present
Wrinkled shingle lichen	*Pannaria lurida*	Threatened (COSEWIC, SARA, NS *ESA*)[2,3,4], S2S3[1]	Softwood dominant stand with majority Black spruce (*Picea mariana* and Red maple trees

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

Table 7.38: Exotic Flora Encountered During Flora Surveys

Common Name	Scientific Name	Exotic Status[1]	S-Rank[2]
Common hawkweed	*Hieracium lachenalii*	Widespread	SNA
Common plantain	*Plantago major*	Widespread	SNA
Common st john's-wort	*Hypericum perforatum*	Widespread	SNA
False st john's-wort	*Hypericum gentianoides*	Locally Common	SNA
Tiny allseed	*Radiola linoides*	Locally Common	SNA

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

Eastern blue-eyed grass (*Sisyrinchium atlanticum),* the only plant SOCI observed during terrestrial flora assessments, is listed as 'S3S4' by ACCDC (2022). This iris can be found growing in wetlands, lakeshores, fields, or estuaries amongst other similar blue-eyed grasses, however its native range within Canada is limited to Nova Scotia (MTRI, 2011). This plant was found in various locations along pre-existing roads within the Assessment Area.

Many common species of lichen were observed throughout the Study Area but were not recorded due to their abundance. Six different lichen SOCI, all identified in ACCDC reports, were found within the Study Area.

White-rimmed shingle lichen (*Fuscopannaria leucosticte*) was found in four different locations across the Study Area, but not within the Assessment Area.

Blue-gray moss lichen (*Moelleropsis nebulosa*), is listed as 'S2S3' by ACCDC (2022). This lichen was observed in two locations across the Study Area, and one is within the Assessment Area, east of a pre-existing road and will be avoided. This species is rare in distribution, with its range covers temperate regions in the Northern Hemisphere. It can be found growing on substrates such as sandy, well-drained soil, or as early successional pioneer species on disturbed soils. When colonizing disturbed soils as pioneer species, this lichen is often short-lived (Nash et al., 2002a).

Wrinkled shingle lichen (*Pannaria lurida*) is listed as 'Threatened' under COSEWIC, *SARA*, and NS *ESA*, and has an S-Rank of S1S2 (Government of Canada, 2022; Government of Canada, 2022; Government of NS, 2022; ACCDC, 2022). This lichen is listed in the At-Risk Lichens – Special Management Practices (NSNR, 2018), where it is granted a buffer. This buffer restricts new construction within 100 m of the lichen. Occurrences of this lichen were observed in five locations across the Study Area, none of which were within 100 m of the Assessment Area. As of 2016, this species had 49 known occurrences in Nova Scotia, and can be found colonizing mature deciduous trees, particularly red maple, growing near imperfectly draining habitats. As this lichen has a preference for growth in the vicinity of wet habitats such as trees swamps and floodplains, it is sensitive to the effects of climate change and forestry practices, which have led to the reduction of suitable habitat and moist climates (COSEWIC, 2016).

Frosted glass whiskers lichen [designated as 'Special Concern' under COSEWIC in 2014 and *SARA* in 2006, and has an S-Rank of 'S3S4' (ACCDC, 2022)] was observed in three locations within the Study Area, each of which were within 100 m of the Assessment Area. One observation was along a pre-existing road. One observation was in an undisturbed area; however, it is 90 m from the Assessment Area. A final observation was within 55 m from a proposed turbine pad location. Micro-siting was completed to ensure the buffer is maintained for two of the three lichen. For the location along the pre-existing road, the Project Area will utilize only the pre-existing road and the area opposite the road to avoid any removal of vegetation within the buffer.

Salted shell lichen (*Coccocarpia palmicola*) has an S-Rank of 'S3S4' (ACCDC, 2022). This species can be found on the bases of deciduous trees such as red maple, or on moss covered rocks or soil, and prefers shady areas in moist to mesic hardwood or mixed wood forests. Climate change and forestry activities may pose direct threats to this lichen's survival (Nash et al., 2002b; Minnesota DNR, 2022). This species was found in two locations across the Study Area, one of which was in the same location as an observation of blue-gray moss lichen. This observation was within the Assessment Area, east of a pre-existing road, and will be avoided.

Corrugated shingles lichen (*Fuscopannaria ahlneri*) has an S-Rank of 'S3' (ACCDC, 2022). It was observed only once in the Study Area, but outside of the Assessment Area, in the same location as one sighting of white-rimmed shingle lichen. This lichen can be found growing on plant surfaces such as trunks, branches, or twigs, or on siliceous or acidic rocks (Botanische Staatssammlung München, 2022). Although global in distribution, this species in known to be generally confined to old-growth softwood forests in coastal, boreal areas such as oceanic spruce forests (Global Fungal Red List Initiative, u.d.).

Modeled BFL habitat was identified through desktop reviews, and these areas were surveyed during targeted lichen surveys. No BFL was observed during these surveys.

Given the sensitivity of some plant and lichen SOCI, avoiding locations where these species are known to occur, along with establishing a vegetation buffer around these locations, is recommended. 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 7.39). 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 7.39: 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 by a qualified biologist to identify locations of plant and lichen SOCI across the Study Area. The Project design was modified to avoid areas where plant and lichen SOCI were found, and in areas where the Assessment Area overlaps with flora SOCI records or buffers associated with these SOCI, the Project Area will be constricted to pre-existing infrastructure or areas on the opposite side of the road from flora SOCI records. Therefore, no loss of plant and lichen SOCI is expected.

Habitat Loss

Rare plants often become rare because they require specialized habitats (BCECC, 2018; CPC, 2020). Although most of the Project Area is on pre-existing roads (approximately 8.4 km of new roads will be required compared to 37.6 km or pre-existing road), road widening may be required. For example, Boreal felt lichen polygons and habitat that may be suitable to support blue felt lichen were surveyed. 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 final design will also incorporate relevant buffers for known locations of individual species, if applicable. Effects to terrestrial flora from habitat loss is 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 clear land with non-native seed mixes.
- Increased access to remote areas with equipment carrying seeds, spores, or other reproductive materials from non-native species.

A number of exotic plants have already been found across the Study Area; however, most areas would not be considered remote as access is already widespread. Although the magnitude of effects is expected to be negligible to low, mitigation strategies to minimize the risk of introducing and/or spreading invasive species across the Study Area are provided.

Mitigation Measures

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

Loss of SOCI

- Minimize overall area to be cleared by utilizing pre-existing roads and previously altered areas (i.e., clearcuts).
- Minimize loss 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.
    - As required, buffers will be enforced around known locations of terrestrial flora SOCI within close proximity to the Assessment Area.
    - Where flora SOCI or their buffers overlap with the Assessment Area, the Project Area will utilize only the pre-existing road and the area opposite the road from the flora/buffer to avoid any removal of vegetation within the buffer.
    - Consultation with the IRM team will be undertaken to uphold the regulations in the ‘At-Risk Lichens – Special Management Practices’ and other plant-specific management practices and maintain ecological integrity for flora SOCI.

- 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 SAR/SOCI is encountered.
    - Transplantation or seed collection will be suggested as a contingency plan during consultation if flora SOCI are unexpectedly encountered and cannot be avoided.
    - A separate plan for transplantation will be developed along with a monitoring protocol to determine the success of this mitigation measure if it is determined to be required.

Habitat Loss

- Minimize overall area to be cleared by utilizing pre-existing roads and previously altered areas (i.e., clearcuts).
- Minimize loss of important habitat which supports terrestrial flora SOCI during the design.
- Restore as much habitat as possible through revegetation 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 exotic 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 is recommended.

Conclusion

Through the implementation of proposed mitigation and monitoring strategies, effects to terrestrial flora are expected to be of low magnitude within the LAA. Effects may persist long-term for habitat loss but be negligible for individual species; 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:

- Inventory fauna species present within/near the Study Area and Assessment Area.
- Identify locations of fauna SOCI and use that information to identify additional habitat features and types where additional SOCI may exist.
- Use information collected to inform and refine the Project design (i.e., avoidance of fauna SOCI and associated habitats).
- Use information and data collected to inform mitigation and BMPs.

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)] include the following:

- *SARA*
- NS *ESA*
- *Canada Wildlife Act*
- *Wildlife Act,* RSNS. 1989, c. 504
- *Biodiversity Act*
- *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 Nova Scotia *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. This act also includes a clause for the protection of den/habitation of a furbearer [48(3)]. The Nova Scotia *Biodiversity Act* provides a framework for the creation of Biodiversity Management Zones used for conservation and sustainable biodiversity values. Lastly, *CEPA* and *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 (2018) and ACCDC Data Report (2023) for mammal, herpetofauna, butterfly, and Odonate species recorded within a 100 km radius 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 (*Alces alces americanus)* was conducted to identify important moose habitat within the Study Area.

Mammals

The NSNRR Significant Species and Habitat Database (2018) contains 43 unique species and/or habitat records pertaining to terrestrial mammals within a 100 km radius of the Study Area. These records include:

- One record of "Deer Wintering" related to White-tailed deer (*Odocoileus virginianus*).
- Eight records of "Other Habitat" relating to Black bear (*Ursus americanus*) (three), Grey seal (*Halichoerus grypus*) (two), Harbour seal (*Phoca vitulina*) (two), and American beaver (*Castor canadensis*) (one).
- Eight records of "Species of Concern" relating to a Fisher (*Martes pennanti*) (four), Muskrat (*Ondatra zibethicus*) (one), River otter (*Lutra canadensis*) (one), Pygmy shrew (*Sorex hoyi*) (one), and Maritime shrew (*Sorex maritimensis*) (one).
- 26 records of "Species at Risk" relating to an American marten (*Martes americana*) (21), Fisher (*Martes pennanti*) (two), and Southern flying squirrel (*Glaucomys volans*) (three).

Two records for American marten are located within the Study Area; these records correspond with trapping data from 1996. The next closest record is from a female fisher trapped 4 km from the Study Area in 1994 (NSNRR, 2018).

The ACCDC Data Report (2023) indicates that six terrestrial mammal SOCI (excluding bats) have been recorded within a 100 km radius of the Study Area (Table 7.40).

Table 7.40: Mammal 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]
American marten	*Martes americana*	---	---	Endangered	S2S3
Canada lynx	*Lynx canadensis*	Not at Risk	---	Endangered	S2S3
Fisher	*Pekania pennanti*	---	---	---	S3
Maritime shrew	*Sorex maritimensis*	---	---	---	S3
Mainland moose*	*Alces alces americanus*	---	---	Endangered	S1
Southern flying squirrel	*Glaucomys volans*	Not at Risk	---	---	S3S4

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

There are two records of American marten within the Study Area according to ACCDC (2023).

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 was 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, 2021e) and a variety of other sources to determine characteristics of high-quality moose habitat (NSEL, 2002; NSNRR, 2021e; NWF, u.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 important calving areas as they provide protection and nutrients for calves and cows. Wetlands were defined as bog, fen, swamp, pond, or high-water table/flood prone regions based on the Nova Scotia Wetlands Inventory (NSNRR, 2021d) and Forest Inventory (Province of Nova Scotia, 2021).

Mixed wood forests were also a required component in this model for 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 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 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 (*Betula alleghaniensis*), paper birch (*Betula papyrifera*), sugar maple (*Acer saccharum*), red spruce (*Acer rubrum)*, balsam fir (*Abies balsamea)*, and eastern hemlock (*Tsuga canadensis)*. Because of this rich nutrient regime and fresh moisture regime common in mixed wood forests, there is also a high abundance of understory vegetation which provide moose with foraging opportunities. Most mixed wood areas also met the criteria provided in the Recovery Plan for each Mainland moose habitat component (summer forage area, winter forage area, summer cover, winter cover, calving area) (NSNRR, 2021e).

Mainland moose are considered a generalist species, which indicates that they are able to survive in wide variety of habitats outside of their preferred habitat types. The Mainland Moose Recovery Plan (NSNRR, 2021e) 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 behaviour 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 a distance of 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 7.41), in 5 ha hexagons spanning the RAA (as defined in Section 7.4.3.6).

Table 7.41: 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

Score	Distance Between Wetland and Mixed Wood Forest
72	over 160 m but no more than 180 m
66	Upper limit of 200 m specified in recovery plan (over a 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 determined that 25.62% of the Assessment Area is not suitable habitat for Mainland moose, and the mean suitability score for moose habitat in the Assessment Area is 66.82, corresponding with the upper limit of suitable habitat as defined in the Mainland Moose Recovery Plan. Furthermore, the areas surrounding the Assessment Area feature a gradient of habitat quality, indicating important areas requiring connectivity that will not be impacted by Project infrastructure. Because Mainland moose are a "location-sensitive" species, the results of this model have not been provided within this EA. The exact location for records of species deemed "location-sensitive" are not provided by species databases such as ACCDC, as mandated by NSNRR to reduce the risk of exploitation of these species (ACCDC, 2022c). Potential impacts to this habitat and connectivity are discussed in Section 7.5.3.6.

Herpetofauna
The NSNRR Significant Species and Habitat Database (2018) contains 83 unique species and/or habitat records pertaining to reptiles and amphibians within a 100 km radius of the Study Area. These records include:

- 83 records of "Species at Risk" relating to Wood turtle (*Glyptemys insculpta*) (11), Eastern ribbon snake (*Thamnophis saurita*) (11), Blanding's turtle (*Emydoidea blandingii*) (50), Snapping turtle (*Chelydra serpentina*) (one).

None of the aforementioned habitat records for herpetofauna are located within the Study Area. The closest record is of a Blanding's turtle 2 km from the Study Area, followed by Eastern ribbon snake 17 km from the Study Area.

Data from ACCDC (2023) indicate that seven herpetofauna SOCI have been recorded within a 100 km radius of the Study Area (Table 7.42).

Table 7.42: Herpetofauna Species Recorded by ACCDC 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]
Blanding's turtle	*Emydoidea blandingii*	Endangered	Endangered	Endangered	S1
Eastern painted turtle	*Chrysemys picta picta*	Special Concern	Special Concern	---	S4
Eastern ribbonsnake	*Thamnophis*	Threatened	Threatened	Threatened	S2S3
Four-toed salamander	*Hemidactylium scutatum*	---	Not at Risk	---	S3
Painted turtle	*Chrysemys picta*	Special Concern	Special Concern	---	S4
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]NS *ESA* 2022; [4]ACCDC 2022

There is one record of Eastern ribbonsnake within the Study Area according to ACCDC (2023). This record occurs along West Deep Brook, a tributary of the Mersey River that will experience no direct impacts from the Project. Furthermore, this record is over 600 m from the nearest Project-related infrastructure, which is a pre-existing road.

Butterflies and Odonates
The NSNRR Significant Species and Habitats (2018) database identifies five significant habitat features relating to butterflies and Odonates within a 100 km radius of the Study Area. These records include:

- Two records of "Other Habitat" relating to Sphagnum sprite (*Nehalennia gracilis*) and Elfin skimmer (*Nannothemis bella*).
- Three records of "Species of Concern" relating to a Seaside dragonlet (*Erythrodiplax berenice*).

None of the aforementioned habitat records for butterflies and Odonates are located within the Study Area, and the nearest record are the sphagnum sprite and elfin skimmer, both 7 km from the Study Area (NSNRR, 2018).

The ACCDC Data Report (2023) contains records of 39 unique butterfly and Odonate SOCI within a 100 km radius of the Study Area (Table 7.43), none of which have been recorded within the Study Area.

Table 7.43: 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]
Aphrodite fritillary	*Speyeria aphrodite*	---	---	---	S3S4
Banded hairstreak	*Satyrium calanus*	---	---	---	S3
Black meadowhawk	*Sympetrum danae*	---	---	---	S3S4
Blue dasher	*Pachydiplax longipennis*	---	---	---	S1
Bog elfin	*Callophrys lanoraieensis*	---	---	---	S3
Brook snaketail	*Ophiogomphus aspersus*	---	---	---	S3
Compton tortoiseshell	*Nymphalis l-album*	---	---	---	S2S3
Delicate emerald	*Somatochlora franklini*	---	---	---	S3S4
Early hairstreak	*Erora laeta*	---	---	---	S1
Eastern comma	*Polygonia comma*	---	---	---	S1?
Eastern red damsel	*Amphiagrion saucium*	---	---	---	S3S4
Eastern tailed blue	*Cupido comyntas*	---	---	---	S3S4
Ebony boghaunter	*Williamsonia fletcheri*	---	---	---	S2S3
Elfin skimmer	*Nannothemis bella*	---	---	---	S3S4
Extra-striped snaketail	*Ophiogomphus anomalus*	---	---	---	S1
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
Kennedy's emerald	*Somatochlora kennedyi*	---	---	---	S2S3
Lance-tipped darner	*Aeshna constricta*	---	---	---	S3S4
Maine snaketail	*Ophiogomphus mainensis*	---	---	---	S3
Milbert's tortoiseshell	*Aglais milberti*	---	---	---	S2S3
Monarch	*Danaus plexippus*	Endangered	Endangered	Special Concern	S2?B, S3M
Monarch	*Danaus plexippus plexippus*	---	Endangered	Special Concern	S2?B, S3M
Mottled darner	*Aeshna clepsydra*	---	---	---	S3S4
Ocellated darner	*Boyeria grafiana*	---	---	---	S3S4
Pepper and salt skipper	*Amblyscirtes hegon*	---	---	---	S3S4
Prince baskettail	*Epitheca princeps*	---	---	---	S3
Question mark	*Polygonia interrogationis*	---	---	---	S3B
Rusty snaketail	*Ophiogomphus rupinsulensis*	---	---	---	S3
Satyr comma	*Polygonia satyrus*	---	---	---	S1?
Seaside dragonlet	*Erythrodiplax berenice*	---	---	---	S3S4
Silvery checkerspot	*Chlosyne nycteis*	---	---	---	SH

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
Skimming bluet	*Enallagma geminatum*	---	---	---	S2S3
Spot-winged glider	*Pantala hymenaea*	---	---	---	S2?B
Vesper bluet	*Enallagma vesperum*	---	---	---	S3S4
Zebra clubtail	*Stylurus scudderi*	---	---	---	S2S3

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

7.4.3.4 Field Assessment Methodology

Mammals

Winter tracking and pellet surveys were conducted to assess the presence and distribution of mammals across the Study Area, and trail cameras were also placed across the Study Area to capture the presence of wildlife without any interference from human disturbance (Drawing 7.21; Table 7.44). The goal of the surveys was to cover all relevant habitat types present across the Study Area, including roadways, wetlands, various forested habitats, riparian areas along watercourses and waterbodies, and previously disturbed areas (i.e., clearcuts).

Table 7.44: Mammal Assessment Survey Information

Survey Type	Dates	Transect Number/Location	Transect Length (km)
Winter Tracking	February 2, 2022	2	3.7
		3	3.7
		6	3
	February 15, 2022	1	3
		2 (cont.)	3.7
		4	3
		5	2.5
		7	2.5
Pellet Surveys	March 21, 2022	2	3.93
		3	3.8
		4	3.5
		6	5
		7	2.55
	March 22, 2022	1	8.43
		5	4.32
Trail Camera Deployment	December 2021 – February 2022	Big Bon Mature Lake	n/a
	July 2021 – November 2021	Dead End Road	n/a
	July 2021 – June 2022	Overgrown Road	n/a
	August 2021 – October 2021	Southside Auxiliary Road	n/a
	June 2021 – October 2021	Solnow Brook Stillwater	n/a
	June 2021 – August 2021	Woods off South Road	n/a

Methods were adapted from those recommended by the NSNRR Wildlife Division (2012c; 2022c). Winter wildlife tracking surveys were completed in February 2022, within 7 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 March 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 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 Global Positioning System (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 vehicle (ATV) (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 animals were observed, the observation was also recorded. All observations were recorded and georeferenced in the field using GPS 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 Study Area from June 2021 to June 2022. Locations were selected to include various habitat types, and to capture more information from locations previously found to have signs of wildlife (Drawing 7.22). 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 used 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 June 8, 2022, before temperatures became too high. A desktop review of the Study Area was undertaken before conducting field surveys to identify areas of preferred turtle habitat. No records of wood turtles within 10 km of the Study Area were identified; therefore, survey locations were selected based on presence of appropriate habitat. 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. 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. 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.

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 a GPS and field notes. Any additional incidental observations of herpetofauna made during wetland or watercourse surveys, as well as observations of suitable turtle habitat, were also recorded.

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

7.4.3.5 Field Assessment Results

Mammals
Eight species were identified during field assessments (including incidental observations) conducted within the Study Area (Table 7.45, photo log provided in Appendix K).

Table 7.45: 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*	Not at Risk	---	---	S5
Bobcat	*Lynx rufus*	---	---	---	S5
North American deer mouse	*Peromyscus maniculatus*	---	---	---	S5
Eastern coyote	*Canis latrans*	---	---	---	S5
Fisher	*Pekania pennanti*	---	---	---	S3
Mainland moose	*Alces alces americana*	---	---	Endangered	S1
Snowshoe hare	*Lepus americanus*	---	---	---	S5
White-tailed deer	*Odocoileus virginianus*	---	---	---	S5
Unknown rodent species	*n/a*	---	---	---	---

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

Five mammals were recorded by trail cameras (Table 7.46, photo log provided in Appendix K).

Table 7.46: Summary of Trail Camera Results

Trail Camera Location	Dates Employed	Animals Observed	Number of Observations*
Big Bon Mature Lake	December 14, 2021 – February 2, 2022	White-tail deer	1
Dead End Road	July 6, 2021 – November 16, 2021	White-tail deer	10
		American black bear	2
Overgrown Road	July 6, 2021 – June 1, 2022	White-tail deer	67
		American black bear	3
		Eastern coyote	6
		Bobcat	1
Southside Auxiliary Road	August 8, 2021 – October 4, 2021	White-tail deer	10
Solnow Brook Stillwater	June 17, 2021 – October 4, 2021	White-tail deer	19
		American black bear	1
		Striped skunk	1
Woods off South Road	June 19, 2021 – August 10, 2021	White-tail deer	9
		American black bear	3
		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 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 (*Alces alces americanus*) – Endangered (NS *ESA),* S1 (S-Rank)
- Fisher (*Pekania pennanti*) – S3 (S-Rank)
- American marten (*Martes americana*) – Endangered (NS *ESA*), S2S3 (S-Rank)

Mainland moose (*Alces alces americanus)* are 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; loss of habitat connectivity due to the increased placement; and density of roads (NSNRR, 2021e). 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.

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. Mid-aged forest stands in the Study Area's interior provide escape cover and relief from deep snows and hot summer temperatures, especially along south facing slopes, while regenerating cutovers provide suitable forage as they age. Evidence of Mainland moose was observed in the Study Area during wetland and watercourse surveys in August 2021. Tracks were observed along a road, south of Big Bon Mature Lake, in an area of moderate-high habitat quality as determined by the moose habitat suitability model. No other evidence of moose activity was observed.

The fisher and American marten have similar habitat requirements; these species prefer dense, mature to old-growth forests with continuous overhead cover (Allen 1983; Ellis, 1999). Generally considered forest-interior species (OMNR, 2000), fishers and martens 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 57 fishers have been harvested from Queens County since 2010, representing just 3.64 % of the provincial total during that time. American marten is almost completely limited to the western region of Nova Scotia, in Digby, Shelburne, and Yarmouth counties. Only one marten has been harvested in Queens County since 2010, representing 2.17% of the provincial total during that time (NSNRR, 2021f). A fisher was observed running across a road during plant and lichen surveys in summer 2022. Mature and potential old-growth forest stands nearby may provide suitable canopy closure and coarse woody debris of sufficient diameter for fishers on site, and these areas will not be directly impacted by the Project. Historic trapping records of American marten exist within the Study Area; however, no observations were made during field surveys.

Herpetofauna

Table 7.47 lists the herpetofauna species identified in the Study Area during the 2021 and 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.

Table 7.47: Summary of the Herpetofauna Field Assessments

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
Maritime garter snake	*Thamnophis sirtalis*	---	---	---	S5
Snapping turtle	*Chelydra serpentina*	Special Concern	Special Concern	Vulnerable	S3

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

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

- Snapping turtle – “Special Concern” (SARA), “Vulnerable” (NS *ESA*), “Special Concern” (COSEWIC), “Sensitive” (NSNRR), “S3” (ACCDC)

A Snapping turtle observation was made on River Road, at the entrance to the site in June of 2022. An additional observation of unidentified turtle eggs was seen less than a kilometre away (Drawing 7.12A-O). Snapping turtle, despite its conservation status, is considered relatively common in Mainland Nova Scotia (Davis & Browne, 1996). The species has a widespread distribution across Nova Scotia, including the central mainland region within which the Study Area is located (COSEWIC, 2008). Preferred Snapping turtle habitat includes slow-moving watercourses featuring soft, muddy bottoms and densely vegetated water columns, as well as vegetated riparian habitat (ECCC, 2016a). Established populations are typically found in ponds, lakes, and river edges (COSEWIC, 2008). The presence of an established population of Snapping turtles inhabiting the Mersey River hydro system reservoirs was noted in passing conversations with local hunters, forestry workers, and NS Power. staff. No Snapping turtles were observed within the Assessment Area and it is unlikely that activities related to the Project will impact this population.

Butterflies and Odonates

There were no incidental observances of SOCI butterfly and Odonates 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.

7.4.3.6 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 behaviour, 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 7.21).

Assessment Criteria

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

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

Effects

Mainland Moose

Habitat Loss
The Mainland Moose Recovery Plan (NSNRR, 2021e) identifies three localized groups of Mainland moose within the province, none of which are contained within the Study Area. The Recovery Plan has defined Core Habitat of each group through habitat suitability modeling. Mainland moose Core Habitat is dependent on a number of 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, 2021e). 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.

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 of the 24,153 ha within RAA was developed to assess the quality of Mainland moose habitat within the RAA. Of the 16,235 ha of habitat determined to be suitable for Mainland moose within the RAA, 242 ha lie within the Assessment Area, representing 1.49% of suitable moose habitat within the RAA. Most of this area is associated with upgrading the 37.6 km of existing roads that have been incorporated into the Project design. Only 8.4 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 tracks observed during field surveys were found along a road, indicating that existing road construction has not excluded moose from the Project Area or restricted movement across the Study Area.

A total of 16 turbines have been located in previously disturbed areas, thus further minimizing new habitat loss. Furthermore, following turbine construction, most of the vegetation around the turbine base will naturally regenerate.

The Mainland moose habitat analysis also indicates that the majority of suitable habitat within the RAA is considered moderately high quality. The average habitat score within the RAA is 72.13, while the average score within the LAA is 66.82. The Project Area will therefore be located in areas that are less than statistically averaged quality for moose habitat in the RAA, as the Project design has maximized the use of pre-existing roads and lower quality habitat, thereby avoiding areas of particularly high-quality habitat. 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, 2021e). 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.

The majority of the Project Area will utilize pre-existing roads, thus minimizing habitat fragmentation with only 8.4 km of new roads needing to be constructed (while the remaining 37.6 km of roadways will utilize existing road). The length of roads will increase slightly in the LAA, and the Project may have a small effect on habitat fragmentation in the LAA. 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 moderately high-quality moose habitat (i.e., habitat with a mean distance of more than 160 m but no more than 180 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 only observed in one location within the Study Area, in an area with multiple pre-existing roads.

Based on the abundance of moderately high-quality moose habitat, low density of moose evidence, and high density of pre-existing roads, the magnitude in which habitat fragmentation will affect Mainland moose within the LAA and RAA is expected to be low.

Disruption of Life History

Indirect effects to Mainland moose from wind farms 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, 2021e).

There was no evidence of age or sex diversity within the Study Area, nor was there any indication of reproduction being supported by or occurring in the Study Area. An analysis of Mainland moose habitat quality within the RAA has shown that large areas of suitable habitat exist around the Assessment Area and will not be directly impacted (a maximum of 1.49% of suitable habitat within the RAA will be impacted by the Project).

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, 2021e). 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.

The Study Area is already accessible to white-tailed deer, and numerous signs of deer were seen throughout the Study Area during all survey periods. It is unlikely that the new and upgraded roads will increase access for white-tailed deer. Furthermore, there was only one sign of Mainland moose in the Study Area, so there is little concern that the Project will lead to increased disease prevalence in moose. 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, 2021e). 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 and minimal evidence of Mainland moose in the Study Area, poaching is not expected to affect Mainland moose within the LAA or RAA as a result of this Project.

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, 2021e). The development of wind farms 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.

Fisher and American Marten

Habitat Loss
Fishers and martens 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, while martens prefer coniferous forest habitat. Other important factors associated with these species' 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 for fishers, while martens prefer hollow trees, crevices, or ground burrows (Ellis, 1999; Meyer, 2007).

There is very little mature hardwood cover within the Assessment Area, and the observed fisher was found along a road surrounded by large patches of mature forest that will remain intact, which can also support marten habitat. Concerted efforts have been made to avoid potential and confirmed old-growth forest within the Study Area, thus conserving high quality mustelid habitat.

Habitat Fragmentation
Fishers and martens have large home ranges, and are capable of moving long distances; however, they may exhibit sensitivity to habitat fragmentation. When suitable habitat is bisected by a large tract (10-20 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 mainly use pre-existing roads (i.e., where a fisher was observed), and infrastructure to be constructed in intact habitats will be smaller than 10 km in length, effects of habitat fragmentation for fishers and martens resulting from the Project are expected to be low.

General Effects to Terrestrial Mammals

Road Traffic
Increased road traffic is a potential concern with the construction of new roads and an increase in road density within the LAA. Both small and large terrestrial mammals are known to use the roadways within the Study Area, as evidence by trail camera footage and winter tracking/pellet survey results. An increase in road traffic will increase chances of collision and mortality to those

animals using the roadways. The majority of 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. Only 8.4 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. 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, excess light, removal of habitat required for breeding, and reduced habitat connectivity separating interbreeding populations. 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 behaviour, 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 density and traffic may affect herpetofauna within the LAA. 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 (see Section 8.3 Traffic and Transportation), 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. Because additional roads will be constructed, new habitat may be created in the form of gravel roadsides. Although this new habitat may serve as a potential benefit to herpetofauna species. Because no 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. One (potentially two) herpetofauna SOCI were observed within the Study Area (one Snapping turtle, one turtle nest containing eggs), both of which were next to pre-existing roads that do not require upgrades. Therefore, no direct effects to herpetofauna related to habitat fragmentation are expected within the LAA.

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 behaviour, 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 (see Sections 7.3.1 and 7.3.3).

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 a number of 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:

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.

Habitat Fragmentation
- Minimize fragmentation and habitat isolation by utilizing pre-existing roads and previously altered areas during the design phase.
- Augment connectivity by creating/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 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 to 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 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
    - American marten – June to August
    - Snapping Turtle – October to April (hibernation) and late May to early June (nesting)
- Minimize loss of important habitat required by priority species for reproduction events or hibernation, including:
    - Mainland moose – wetlands and isolated islands/peninsulas
    - Fisher and American marten – large snags, large woody debris, or live, hollow standing trees in intact forests
    - Snapping turtle – muddy substrate of permanent water bodies for hibernation, sunny, well-drained areas for nesting
- Minimize overall area to be cleared to maintain refugia and cover for protection from predators.
- Maintain all equipment and machinery on site so that a level of good working condition is kept to reduce noise and vibration emissions. 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, 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 may include:

- Install trail cameras in areas identified through field surveys as supporting high biodiversity to identify and understand how Project-related activities such as construction, vehicular traffic, and turbine operation, as well as changes to the landscape in the Study Area are impacting species of concern.
    - Placing trail cameras in areas that have been identified through geospatial modelling as high-quality habitat to Mainland moose or important wildlife

corridors through can allow for ground truthing and improvement of these models.
- Conduct snow tracking and pellet surveys to continue monitoring the presence of priority wildlife species.
    - Pellet surveys will be prioritized over winter tracking, as evidence of moose activity in the Study Area has only been found outside of winter to date.
    - Winter tracking and pellet surveys will be important tools to monitor the presence of deer in the Study Area and provide insight regarding the potential for disease to spread to moose in the Study Area.
- Conduct turtle surveys in areas of high-quality turtle habitat to be impacted by the Project to continue monitoring the presence and/or impacts to turtle species.
- Monitor changes to habitat within the Study Area and greater RAA that may occur as an indirect result of the Project.

These strategies can help to provide a qualitative understanding of population dynamics and changes to the population post-construction.

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 to terrestrial fauna are expected to be of low magnitude 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).
- Identify nearby hibernacula for potential overwintering 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, three of which 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, 2013b).

All three migratory bat species are currently undergoing a status assessment by COSEWIC, which is scheduled to be released in April 2023 (COSEWIC, 2022).

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, 2021a)
- Significant Species and Habitats Database (NSNRR, 2018)
- 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. Identification of ideal habitats from terrestrial mapping was 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 the location and use of these sites (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 one 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 (km)*	Direction
The Ovens	55	NE

*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).

The Ovens, the closest known hibernaculum, is a series of active sea caves near Lunenburg, NS (Moseley, 2007). This site is considered to be a minor hibernaculum, suspected of supporting <10 over-wintering bats. All three resident bat species were documented as using this hibernaculum in the 1960s; however, this is prior to White-nose syndrome and is considered out of date (Moseley, 2007).

Abandoned Mine Openings
There are no recorded abandoned mine openings located within the Study Area; however, there are several clusters of mine openings documented to the southwest (6 km) and northeast (10 km) (NSNRR, 2021a). These recorded abandoned mine openings are listed as gold shafts, trenches, and pits. See Drawing 7.23 for locations.

Significant Species and Habitat Records
The Significant Species and Habitats Database contains no unique species/habitat records pertaining to bats and associated habitat within 100 km radius of the Study Area (NSNRR, 2018).

ACCDC Records
The ACCDC Data Report indicated four bat SOCI recorded within 100 km 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.*	---	---	---	S1S2
Little brown myotis	*Myotis lucifugus*	Endangered	Endangered	Endangered	S1
Northern myotis	*Myotis septentrionalis*	Endangered	Endangered	Endangered	S1
Tri-colored bat (Eastern pipistrelle)	*Perimyotis subflavus*	Endangered	Endangered	Endangered	S1

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

Bat species that have been recorded within a 100 km radius of the Study Area were screened against the criteria outlined in 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 throughout 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 over-winters from September to early or mid-May in abandoned mines or caves (Fenton & Barclay, 1980; Mosely, 2007). ACCDC data (2023) indicates that the closest Little brown myotis observation to the Study Area is 6.7 ± 0.0 km away.

Northern myotis, although once considered uncommon throughout Nova Scotia, is likely ubiquitous in the forested regions of the province (Moseley, 2007; 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 the closest Northern myotis observation to the Study Area is 8.8 ± 0.0 km away.

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, 2013b). 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, 2013b). ACCDC data indicates that the closest Tri-colored bat observation to the Study Area is 6.7 ± 0.0 km away.

7.4.4.4 Field Assessment Methodology

Field surveys and monitoring conducted within the Study Area include the following:

- Incidental Observations (2021 and 2022)
- Passive Bat Assessment (2021)

Incidental Observations

Incidental observations of significant bat habitat features were recorded throughout the 2021 and 2022 field assessments conducted within the Study Area. Features of note that qualified field biologists searched for include:

- Large diameter (≥25 cm) snags and downed trees.
- Large diameter 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 cm diameter breast height and >10 snags per ha) for potential maternity colony habitat (as per OMNR, 2022).
- Cave and abandoned mines (for potential hibernacula/overwintering habitat).

Several ideal habitat features for bats (i.e., wetlands and old growth forests) are captured and 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 7.23). Monitoring stations were chosen based on habitat mapping and accumulated knowledge from field studies to represent various habitats types present within the Study Area along with ideal bat habitat for the bat species present in Nova Scotia. The passive acoustic bat monitoring program was conducted using Anabat SD2 Detectors from Titley Scientific. The detectors were programed to monitor between 19:00 to 7:00, corresponding with nightly bat activity. Photos, GPS points, and supplementary information (i.e., habitat descriptions) of each monitor location and detector set up were recorded (see Appendix L for a photo log).

Acoustic monitoring data (i.e., sonograms) was processed using Analook software from Titley Electronics, complementary to the detectors used within the Study Area. Sonograms were manually processed for potential bat generated ultrasonic vocalizations and speciated where possible. Identification codes for Nova Scotia bat species are listed below:

- MYOT Myotis (Little brown myotis and 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, so these calls are typically not identified to species (O'Farrell et al., 1999). 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 134 consecutive days within the Study Area between the dates of July 6 and November 16, 2021; encompassing 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 001 was deployed along the eastern shoreline of Big Bon Mature Lake in the western portion of the Study Area. Detector 002 was deployed along a softwood forested edge of a clear cut located on the northern road of the Study Area. Detector 003 was set up along Stillwater Brook in a section containing open wetland habitat. Detector 004 was deployed at the location of the radar trailer (Drawing 7.23, Table 7.51).

Table 7.51: Monitoring Periods for Each Detector.

Detector Location	Habitat	Monitoring Duration (2021)	Consecutive Days	# Of Recordings
Detector 001: Big Bon Mature Lake	Riparian zone, mixed wood	July 6 – November 16	134	1292
Detector 002: Forest Edge – N Road	Softwood forest edge, clearcut	July 6 – November 16	134	748
Detector 003: Stillwater Brook	Riparian zone, wetland	July 6 – November 16	134	12,639
Detector 004: Radar Trailer	Clearcut	August 9 – November 16	100	3733

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; primarily in bogs, treed swamps, and riparian areas where waterlogged sediments resulted in the decay of large diameter trees. These freshwater habitats (i.e., waterbodies, watercourses, wetlands, and riparian areas) 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 (e.g., each snag) within these freshwater habitats were not recorded because they are delineated and described in Section 7.3 (see Drawings 7.12A-O for wetland/watercourse locations).

No areas of significant bat habitat (i.e., hibernacula, maternity colonies, or migration stopovers) were identified/incidentally observed during the 2021 and 2022 field assessments.

Passive Bat Assessment

In total, 18,412 files were recorded by the four Anabat Detectors, of which 217 were determined to be bat generated ultrasound using complementary Analook software. The remaining files were determined to be caused by extraneous noise from sources such as vegetation, wind, or precipitation. There was 134 Myotis species, 21 Eastern red bats, nine Hoary bats, six Tri-colored bats, and 44 unknown calls identified (Table 7.52).

Table 7.52: Results of the Passive Acoustic Bat Survey (2021)

Detector	MYOT	LABO	LACI	PESU	UKWN	Calls per Detector
001: Big Bon Mature Lake	97	0	5	6	36	**144**
002: Forest Edge – N Road	9	12	0	0	3	**24**
003: Stillwater Brook	16	4	1	0	5	**26**
004: Radar Trailer	12	5	3	0	0	**20**
Calls per Species	**134**	**21**	**9**	**6**	**44**	***Survey Total* = 214**

The detector located along the riparian zone of Big Bon Mature Lake recorded much higher call counts compared to the other detectors. Riparian zones are important foraging grounds for bats as a result of high insect activity. In addition, this detector's position over open water may have experienced reduced background noise associated with vegetation and increased detection range, resulting in a higher number of recorded and identifiable bat calls. The remaining detectors recorded significantly less bat calls. These detectors were in habitats often associated with travel corridors that likely did not experience the highly concentrated bat activity seen at Big Bon Mature Lake. In addition, the detector positioned at the radar trailer was also located in a more frequently visited area that experienced increased road traffic and possible disturbance from radar monitoring equipment.

Across the entire Study Area (including all monitors), a total of 214 bat calls were detected over a 134-day period resulting in an average of 1.60 bat calls/day. It should be noted that the 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:

- 001 Big Bon Mature Lake 1.07 bat calls/day
- 002 Forest Edge – N Road 0.18 bat calls/day
- 003 Stillwater Brook 0.19 bat calls/day
- 004 Radar Trailer* 0.20 bat calls/day

**Note that only 100 days of monitoring was conducted at the radar trailer, compared to 134 at all other detector locations.*

Bat calls were also assessed hourly throughout the night (Figure 7.3). Peak hourly bat activity was observed near dusk (20:00), just before midnight (23:00), 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).

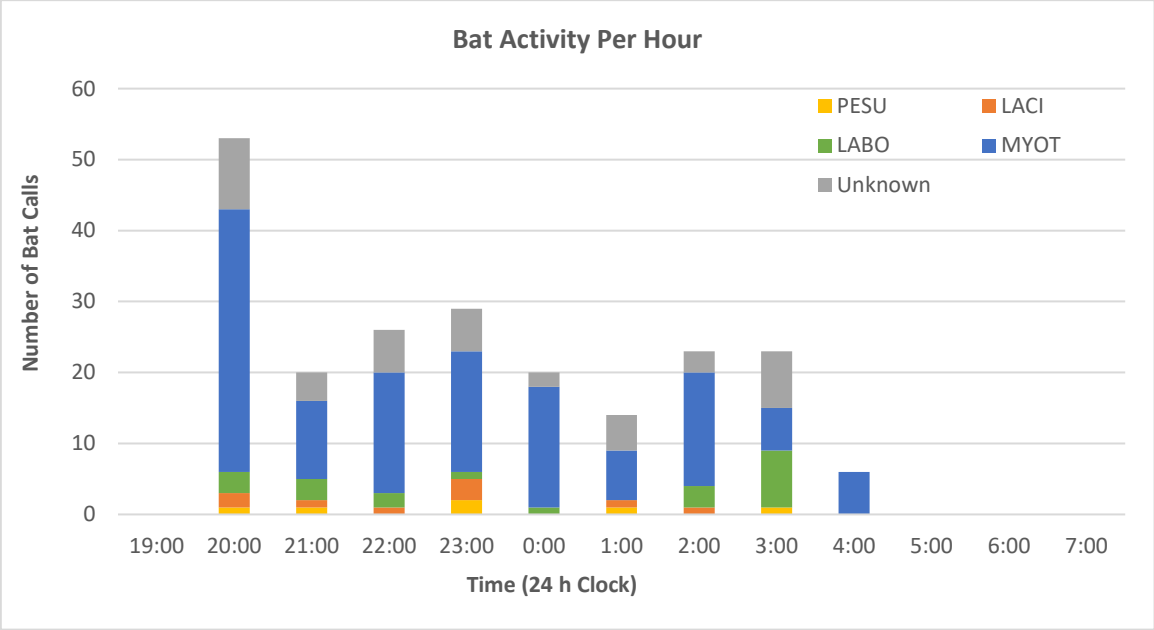

Figure 7.3: Bat Activity Per Hour Observed During the Passive Acoustic Survey (2021)

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).

Calls persisted throughout the summer and early fall months, with significantly less calls recorded during the month of October followed by no recorded calls in November of 2021. Decreased acoustic activity seen during the later months is likely a result of migratory bats beginning to migrate south for the winter and resident species congregating near hibernacula for over-wintering. At a species level, echolocation calls from Myotis bat species were most frequently recorded during the months of July and August, which sharply dropped in late September through November. The two migratory species recorded (i.e., Eastern red bat and Hoary bat) were almost exclusively detected during the months of August and September. Lastly, the Tri-colored bat was recorded in low numbers throughout the survey from July to October (Figure 7.4).

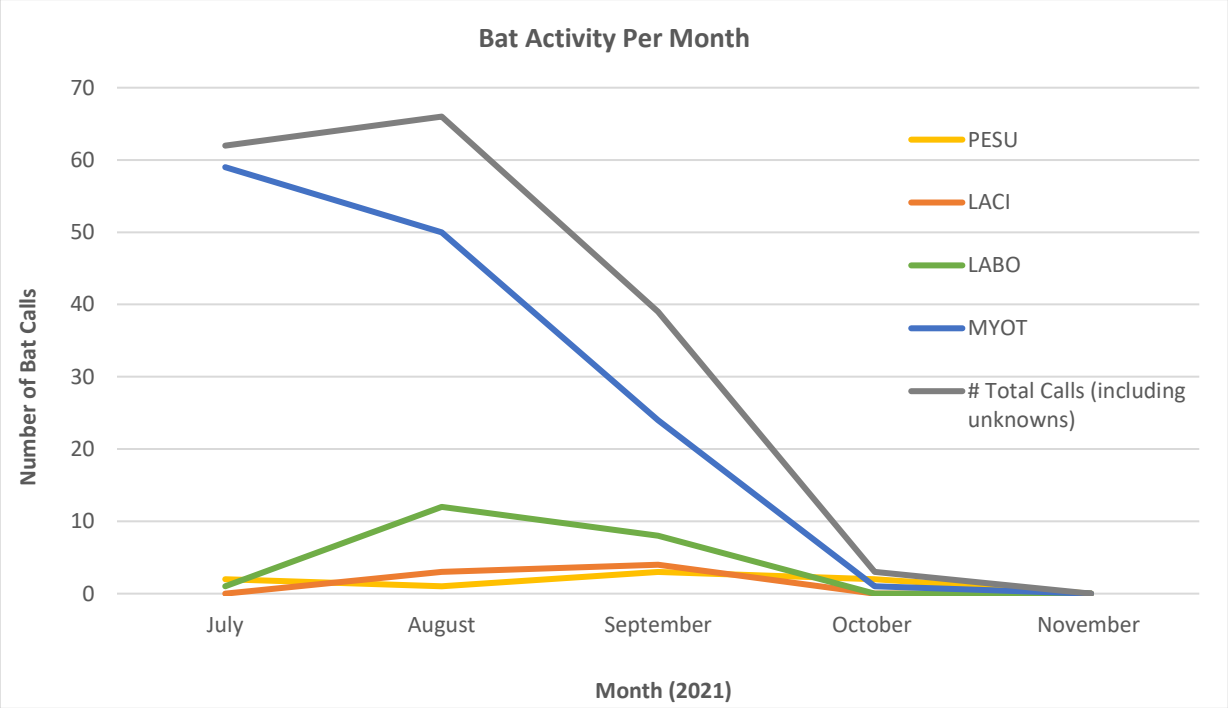

Figure 7.4: Bat Activity Per Month Observed During the Passive Acoustic Survey (2021)

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
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 to 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 to 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.) and/or disrupt corridors between important habitat features (foraging grounds, birthing areas, etc.). 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. Alternatively, suitable habitat for Northern myotis bats decreased, likely due to this species' preference to forage in forested areas and around canopy covered streams. 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 field surveys, it was observed that the Assessment Area is already fragmented and disturbed from previous developments, primarily from active/previous forestry and hydroelectric development. Field assessments identified no 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, snags/downed trees 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 minimal based on the widespread existing disturbance/fragmentation in the Study Area along with the Project's maximized use of existing roadways (utilizing 37.6 km of existing roads). Habitat fragmentation and removal will be associated with newly constructed roads within the Project Area (totaling 8.4 km in length). Further, areas where new road construction is proposed were not found to contain significant bat habitat during field and desktop assessments.

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 compared to 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 and 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 rotating blades due to their 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 can be 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 done 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; Government of Canada, 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 developed by the Government of Canada (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 spring, summer, and fall.

Bat activity and use of habitat within the Study Area was assessed through incidental observations and passive acoustic monitoring. Bat species identified during field studies include Myotis species, Hoary bats, Tri-colored bats, and Eastern red bats. Myotis resident bats were the most frequently recorded species within the Study Area representing 63% of species recorded. Another resident bat, the Tri-colored bat, accounted for 3% of total calls recorded. Myotis and Tri-colored bats both have a lower risk for turbine related injuries and mortalities due to lower flight patterns. Migratory bat species, which are at a higher risk due to higher flight patterns and longer migration routes, comprised 14% of calls identified: Hoary bats (4%) and Eastern red bats (10%). Roughly 20% of bat calls were not speciated based on the poor quality of the recordings and/or the calls were too short to definitively ID. Individual bat injury/mortality from wind turbine operation is possible, as a result of Project construction (i.e., during vegetation removal) and operation within the Study Area. Impacts to bat SOCI populations at a regional scale or population level are not anticipated based on no desktop identified hibernacula within 50 km and no significant habitat identified within the Study Area during field assessments. Further, bat activity recorded across the Study Area was generally low, with the exception of concentrated activity at Big Bon Mature Lake/its shorelines. As a result, Project infrastructure was designed to utilize existing road networks avoid turbine placement within close proximity (~100 m) of Big Bon Mature Lake.

Strum Consulting has completed numerous post-construction bat mortality surveys for wind turbine developments and has identified minimal/negligible levels of bat mortality across the Province of Nova Scotia. These reports/results are client-confidential, but copies were submitted to and are accessible by NSECC in accordance with the EA Approvals 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 behaviors and/or impede movement, foraging, flight activity, and habitat use. Based on the pre-existing traffic loads, forestry, and hydroelectric development within the Study Area, and minimal traffic associated with the Project, effects on bat behaviour are not anticipated within the LAA. In addition, turbine lighting will be restricted to minimums required for safety and potential impacts to bat behavior and movements are negligible/low.

Mitigation
To address effects to bat and bat habitat, the following mitigation measures will be implemented:

Habitat Fragmentation and 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 (e.g., 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 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/Morality
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 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 species composition, species diversity and habitat utilization 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).
- 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)
- Important Bird Areas (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 predominantly softwood dominated stands, with some hardwood and mixed wood stands present, especially near water bodies. 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 Canada (IBA Canada, 2016) is NS004: South Shore (Port Joli Sector), approximately 7 km south of the Project (Drawing 7.24). This IBA is a long stretch of shoreline

from Hunts Point near Summerville Beach to Lockeport Harbour. At low tide, vast areas of mud and sand flats, and salt marshes are exposed. Numerous Canada Geese, American Black Ducks, and other waterfowl overwinter in the area, feeding in the tidal flats. The area also supports large numbers of breeding Piping Plovers, a nationally endangered and globally vulnerable species (IBA Canada, 2016). Due to the distance between this IBA and the Study Area, no interactions with the Project expected.

The majority of the Assessment Area is contained within the map squares 20LP48, 20LP58, 20LP57 of the MBBA, and to a lesser extent, 20LP47 (Bird Studies Canada, 2016). In the most recent edition of the MBBA (2006-2010), 89 species were identified as being possible, probable, or confirmed breeders for squares 20LP48, 20LP58, and 20LP57. The following SOCI are considered possible, probable, or confirmed breeders within these map squares:

- American Kestrel (*Falco sparverius*) – "S3B" (ACCDC)
- American Robin (*Turdus migratorius*) – "S5B, S3N" (ACCDC)
  Baltimore Oriole (*Icterus galbula*) – "S2S3B, SUM" (ACCDC)
  Barn Swallow (*Tyrannus tyrannus*) – "Threatened" (SARA), "Special Concern" (COSEWIC), "Endagered" (NS ESA), "S3B" (ACCDC)
- Brown-headed Cowbird (*Molothrus ater*) – "S2B" (ACCDC)
- Chimney Swift (*Chaetura pelagica*) – "Threatened" (SARA and COSEWIC), "Endangered" (NS ESA), "S2S3B, S1M" (ACCDC)
- Common Nighthawk (*Chordeiles minor*) – "Threatened" (SARA), "Special Concern" (COSEWIC), "Threatened (NS ESA), "S3B" (ACCDC)
- Downy Woodpecker (*Picoides pubescens*) – "SU" (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)
- Great Crested Flycatcher (*Myiarchus crinitus*) – "S1B" (ACCDC)
- Hairy Woodpecker (*Picoides villosus*) – "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)
- Rose-breasted Grosbeak (*Pheucticus ludovicianus*) – "S3B" (ACCDC)
- Spotted Sandpiper (*Actitis macularius*) – "S3S4B" (ACCDC)
- Tennessee Warbler (*Oreothlypis peregrina*) – "S3S4B" (ACCDC)
- Winter Wren (*Troglodytes troglodytes*) – "SU" (ACCDC)

The NSNRR Significant Species and Habitats (2018) database contains 1249 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:

- 148 records classified in the database as “Other Habitat”, most of which relate to Bald Eagle (*Haliaeetus leucocephalus*) (40) or Osprey (*Pandion haliaetus*) (97).
- 324 records classified as “Species of Concern” which mostly relate to Shorebirds and Waterfowl, including Common Loon (*Gavia immer*) (60), and unclassified Tern (123).
- 389 records classified as “Migratory Bird” which mostly relate to Shorebirds and Waterfowl, including American Black Duck (*Anas rubripes*) (53), unclassified Cormorant (31), Double-crested Cormorant (*Phalacrocorax auritus*) (52), Great Blue Heron (*Ardea herodias*) (28), Canada Goose (*Branta canadensis*) (28), and Common Eider (*Somateria mollissima*) (one).
- 388 records classified as “Species at Risk” which relate to Piping Plover (*Charadrius melodus*) (81), Roseate Tern (*Sterna dougallii*) (36), and unclassified tern (47), among others.

The NSNRR Significant Species and Habitats database (2018) contains 38 unique records pertaining to birds and/or bird habitat within a 10 km radius of the Project. These records include:

- 13 records classified in the database as “Other Habitat”, which relate to Bald Eagle (*Haliaeetus leucocephalus*) (four), Osprey (*Pandion haliaetus*) (eight), and unclassified tern (one).
- Four records classified as “Species of Concern” which relate to Common Loon (*Gavia immer*) (one), Osprey (one), Common Tern (*Sterna hirundo*) (one) and unclassified gull (one).
- 10 records classified as “Migratory Bird” including unclassified Cormorant (one), Double-crested Cormorant (*Phalacrocorax auritus*) (two), Great Black-backed Gull (*Larus marinus*) (three), Herring Gull (*Larus argentatus*) (three), and unclassified shorebirds (one).
- 388 records classified as “Species at Risk” which relate to Piping Plover (*Charadrius melodus*) (seven), Arctic Tern (*Sterna paradisaea*) (one), Harlequin Duck (*Histrionicus histrionicus*) (one) and Common tern (*Sterna hirundo*) (two).

The ACCDC Data Report (2023) contains records of 116 bird species within a 100 km radius of the Study Area. Table 7.54 lists these species as well as their respective provincial and national conservation status ranks.

Table 7.54: ACCDC Recorded Avian Species within 100 km of the Study Area

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* 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
Arctic Tern	*Sterna paradisaea*	---	---	---	S3B
Atlantic Puffin	*Fratercula arctica*	---	---	---	S2B
Baltimore Oriole	*Icterus galbula*	---	---	---	S2S3B,SUM
Bank Swallow	*Riparia riparia*	Threatened	Threatened	Endangered	S2B
Barn Swallow	*Hirundo rustica*	Special Concern	Threatened	Endangered	S3B
Barrow's Goldeneye	*Bucephala islandica*	Special Concern	Special Concern	---	S1N,SUM
Bay-breasted Warbler	*Setophaga castanea*	---	---	---	S3S4B,S4S5M
Bicknell's Thrush	*Catharus bicknelli*	Threatened	Threatened	Endangered	S1B
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*	Special Concern	Threatened	Vulnerable	S3B
Boreal Chickadee	*Poecile hudsonicus*	---	---	---	S3
Brant	*Branta bernicla*	---	---	---	S3M
Brown Thrasher	*Toxostoma rufum*	---	---	---	S1B
Brown-headed Cowbird	*Molothrus ater*	---	---	---	S2B
Buff-breasted Sandpiper	*Calidris subruficollis*	Special Concern	Special Concern	---	SNA
Canada Jay	*Perisoreus canadensis*	---	---	---	S3
Canada Warbler	*Cardellina canadensis*	Special Concern	Threatened	Endangered	S3B
Cape May Warbler	*Setophaga tigrina*	---	---	---	S3B,SUM
Chimney Swift	*Chaetura pelagica*	Threatened	Threatened	Endangered	S2S3B,S1M

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
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 Murre	*Uria aalge*	---	---	---	S1?B
Common Nighthawk	*Chordeiles minor*	Special Concern	Threatened	Threatened	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
Eastern Whip-Poor-Will	*Antrostomus vociferus*	Special Concern	Threatened	Threatened	S1?B
Eastern Wood-Pewee	*Contopus virens*	Special Concern	Special Concern	Vulnerable	S3S4B
Evening Grosbeak	*Coccothraustes vespertinus*	Special Concern	Special Concern	Vulnerable	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	Special Concern	Endangered	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*	Threatened	---	---	S3B

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
	leucorhous				
Least Bittern	*Ixobrychus exilis*	Threatened	Threatened	---	SUB
Least Sandpiper	*Calidris minutilla*	---	---	---	S1B,S4M
Lesser Yellowlegs	*Tringa flavipes*	Threatened	---	---	S3M
Long-eared Owl	*Asio otus*	---	---	---	S2S3
Marsh Wren	*Cistothorus palustris*	---	---	---	S1B
Nelson's Sparrow	*Ammospiza nelsoni*	Not At Risk	---	---	S3S4B
Northern Bobwhite	*Colinus virginianus*	Endangered	Endangered	---	SNR
Northern Gannet	*Morus bassanus*	---	---	---	SHB
Northern Goshawk	*Accipiter gentilis*	Not At Risk	---	---	S3S4
Northern Mockingbird	*Mimus polyglottos*	---	---	---	S1B
Northern Pintail	*Anas acuta*	---	---	---	S1B,SUM
Northern Shoveler	*Spatula clypeata*	---	---	---	S2B,SUM
Northern Shrike	*Lanius borealis*	---	---	---	S3S4N
Olive-sided Flycatcher	*Contopus cooperi*	Special Concern	Threatened	Threatened	S3B
Pectoral Sandpiper	*Calidris melanotos*	---	---	---	S3M
Peregrine Falcon - anatum/tundrius	*Falco peregrinus pop. 1*	Not At Risk	Special Concern	Vulnerable	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
Prothonotary Warbler	*Protonotaria citrea*	Endangered	Endangered	---	SNA
Purple Martin	*Progne subis*	---	---	---	SHB
Purple Sandpiper	*Calidris maritima*	---	---	---	S3S4N
Razorbill	*Alca torda*	---	---	---	S2B
Red Crossbill	*Loxia curvirostra*	---	---	---	S3S4
Red Knot rufa subspecies	*Calidris canutus rufa*	Endangered, Special Concern	Endangered	Endangered	S2M
Red Phalarope	*Phalaropus fulicarius*	---	---	---	S2S3M
Red-breasted Merganser	*Mergus serrator*	---	---	---	S3S4B,S5M,S5N
Red-headed Woodpecker	*Melanerpes erythrocephalus*	Endangered	Threatened	---	SNA
Red-necked Phalarope	*Phalaropus lobatus*	Special Concern	Special Concern	---	S2S3M

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
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	Special Concern	Endangered	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*	Threatened	Special Concern	---	S1B
Spotted Sandpiper	*Actitis macularius*	---	---	---	S3S4B,S5M
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
Yellow-Breasted Chat	*Icteria virens*	Endangered	Endangered	---	SNA

Source: ACCDC (2023): [1]Government of Canada 2022; [2]NS *ESA* 2022; [3]COSEWIC 2022; [4]ACCDC 2022

7.4.5.4 Field Assessment Methodology

Several 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 all species that are present in the Study Area through all seasons. Point count surveys were standardized to 10-minute

observation intervals at specific predetermined locations to inventory species within view or that are audible from the given survey location. 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 conducted 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.

Nightjar and Owl Surveys
Nightjar and owl surveys were based on the Canadian Nightjar Survey Protocol (Knight et al., 2019). Like point counts, surveys were conducted in 6-minute intervals at predetermined locations where nightjar and owl habitat are present within the Study Area. 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 conducted to quantify the movement of birds through the regions of Study Area during the day, as well as how different species or flocks behave around specific habitat features throughout the Study Area, such as the Mersey River or Little and Big Bon Mature lakes. These surveys were conducted during the day for a period of 120 minutes. Each target observed was identified as specifically as possible, including bearing from the observer, distance to the target, the direction that the target was moving, its passing height, and any other behaviour notes.

Each of the above surveys was employed at different times of year to inventory avian species throughout the Study Area year-round. Seasonal survey programs are detailed below.
Breeding Bird Surveys (2021 and 2022)
BBS were conducted 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. BBS were conducted using point counts throughout the Study Area. The point counts were completed twice throughout the breeding survey, and any evidence of breeding as outlined by the MBBA was recorded. A primary round of surveys was conducted in 2021, with follow-up surveys conducted in 2022 to study new areas that were added to the scope of work during 2021 Fall Migration Surveys.

Nightjar and Nocturnal Bird Surveys (2022)
Nightjar and nocturnal bird surveys were conducted to inventory Nightjar species and other nocturnal birds, including owls. These surveys were conducted during the breeding season to gain an understanding of both resident and migratory species.

Fall Migration Season Bird Surveys (2021)
Fall migration surveys were used in tandem with spring migration surveys to determine the migratory species that are moving through the Study Area, though at a different time of year. In Nova Scotia, the fall migration period runs from late August through late October for most species. These surveys included point counts and diurnal hawk watches.

Winter Bird Surveys (2021-2022)
Winter bird surveys were conducted to establish the species composition and distribution of resident birds through the winter season. These surveys were conducted from mid-December through late March and included point counts.

Spring Migration Season Bird Surveys (2022)
Spring migration surveys were conducted to inventory all species that are migrating through or over the Study Area. The spring migratory period included point count surveys and diurnal/hawk watches.

7.4.5.5 Habitat Modelling Methodology
Habitat modelling for SOCI observed during 2021 and 2022 BBSs was conducted to establish habitat throughout the Study Area that are likely or possible to be used by those species. Each species had its specific habitat needs established, and relevant GIS data was used to model the habitats where those species are most likely to be breeding. Only species with ranks of “Endangered”, "Threatened”, “Special Concern” or “Vulnerable” under SARA, COSEWIC, or NS ESA were targeted for modelling purposes.

Chimney Swift (Chaetura pelagica)
Habitat characteristics that are preferred for Chimney Swift are mainly urban areas that have access to chimneys, grain towers, or other form 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). Dead trees with developed cavities may also exist within wetlands due to the elevated water table, including those along the Mersey River hydro system.

Common Nighthawk (Chordeiles minor)
Forestry inventory data was filtered to identify areas with bare ground, including clear cuts, ditched areas (confirmed by Digital Elevation Model - DEM), roadsides, laydown areas, and other corridors where vegetation has been removed or is kept cut. Nesting habitats throughout these existing modelled habitats were identified.

Eastern Wood-Pewee (Contopus virens)
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 (Coccothraustes vespertinus)
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 (Contopus cooperi)
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

Avian Radar Assessment
Avian radar assessments were undertaken during the fall 2021 and spring 2022 migratory bird periods. The objective of the avian radar assessment was to assess migratory bird activity in the airspace above the Study Area. Avian radar systems (ARS) were deployed from August 16 to October 18, 2021, for the fall 2021 monitoring campaign, and from April 11 to June 16, 2022, for the spring 2022 monitoring campaign. The ARS can be configured with different radar orientations. During the fall 2021 monitoring campaign, the ARS consisted of one Simrad Halo 6 pulse compression marine surveillance radar at 15° above horizontal to scan slightly above horizontally, as well as one Simrad Halo 20+ pulse compression marine surveillance radar at 90° to scan vertically. Both orientations allow for a 180° scan of the airspace around the radar, though with the angled orientations, the 180° behind or below the radar is blanked.

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.

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 horizontal radar was mounted off the ground (approximately 5 m) to eliminate ground noise interference and lessen the impacts of local microtopography on data collection and clarity. The diagonal radar was mounted closer to the ground but was angled to view the airspace above-ground with no direct obstructions.

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. Another important factor in the detection of targets is the interference associated with weather systems and precipitation. Fog, rain, low cloud cover, and snow are detectable by the radar (similarly to weather radar), which lowers the effectiveness of the system, and may cause false positive- BT identifications. As such, any data collected when the nearest weather station (in this case, ECCC's Western Head Weather Station) indicates a minimum hourly rainfall of 0.5 mm are excluded from this analysis.

Gaps in data are due in part to a combination of radar settings not being optimized for the conditions, poor weather conditions, and downtime associated with the radar's power system. Being off-grid, the system relies on sunlight for power, and with poor weather and/or shorter days the batteries can be drained, resulting in a period of downtime before the system can be reset.

Avian Acoustic Assessment

A Wildlife Acoustics SM4 acoustic monitor was deployed within the Study Area in tandem with the radar system during the fall 2021 (August 16 to October 18, 2021) and spring 2022 (April 11 to June 16, 2022) monitoring campaigns. These monitors were programmed to record nocturnally 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 8 pm and 5 am with the goal of finding 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*

Common Name	Scientific Name
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 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*

Common Name	Scientific Name
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*
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*

Common Name	Scientific Name
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 center to include outputs in cluster.csv
- 10.67 ms FFT window
- 12 maximum states
- 0.5 maximum distance to cluster center for building clusters
- 500 maximum clusters

Once the clusters were generated by Kaleidoscope, the output was vetted for the presence of bird calls. Every cluster was manually scanned to a minimum of 5% of its contents to determine whether it contained avian calls or singing, or noise including any 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. Some clusters were investigated more thoroughly for avian acoustics than the 5% minimum threshold. Any avian acoustics 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 Breeding Bird Surveys

Two BBS were conducted within the Study Area in 2021 (June 17 and July 5). In total, 34 10-minute point counts were conducted covering a wide range of habitat types and a wide spatial distribution (Drawing 7.25). A total of 507 individual birds, representing 50 species, were observed during these point counts (Table 7.56; Tables 1/2, Appendix M). The most abundant and frequently observed species were the Common Yellowthroat (*Geothlypis trichas*), Hermit Thrush (*Catharus guttatus*), Ovenbird (*Seiurus aurocapilla*), and Palm Warbler (*Dendroica palmarum*). Migrant passerines accounted for 84% of the species and 93.7% of the individual birds observed.

Table 7.56: Total Observations by Bird Group – 2021 Breeding Bird Point Count Surveys

Bird Group	Group #	# Individuals	# Species
Waterfowl	1	0	0
Shorebirds	2	0	0
Other Waterbirds	3	1	1
Diurnal Raptors	4	1	1
Nocturnal Raptors	5	0	0
Passerines	6	475	42
Other Landbirds	7	30	6
Total		**507**	**50**

SOCI observed during the 2021 breeding surveys include American Robin (*Turdus migratorius*), Downy Woodpecker (*Picoides pubescens*), Eastern Wood-Pewee (*Contopus virens*), Gray Jay (*Perisoreus canadensis*), Hairy Woodpecker (*Picoides villosus*), Northern Parula (*Parula americana*), Olive-sided Flycatcher (*Contopus cooperi*), Rose-breasted Grosbeak (*Pheucticus ludovicianus*), Red Crossbill (*Loxia curvirostra*), and Winter Wren (*Euphagus carolinus*).

2021 Fall Migration Surveys

Fall migration surveys were conducted on September 5, 8, and 19 and October 3, 19, and 20, 2021. The surveys included 80 10-minute point counts and two 180-minute hawk watches.

A total of 56 species, comprising 779 individual birds, were observed during the fall migration point count surveys (Table 7.57; Tables 3/4, Appendix M). Dark-eyed Junco (*Junco hyemalis*), Black-capped Chickadee (*Poecile atricapillus*), Palm Warbler (*Dendroica pinus*), and Yellow-rumped Warbler (Dendroica coronata) were the most abundant and frequently observed species.

Table 7.57: Total Observations by Bird Group – 2021 Fall Migration Point Count Surveys

Bird Group	Group #	# Individuals	# Species
Waterfowl	1	1	1
Shorebirds	2	3	3
Other Waterbirds	3	3	1
Diurnal Raptors	4	10	5
Nocturnal Raptors	5	2	1
Passerines	6	718*	40
Other Landbirds	7	42	5
Total		**779**	**56**

*10 observations were not identifiable to the species level

SOCI observed during the fall migratory point count surveys include American Kestrel (*Falco sparverius*), American Robin (*Turdus migratorius*), Double-Crested Cormorant (*Phalacrocorax auritus*), Downy Woodpecker (*Picoides Pubescens*), Eastern Wood-Pewee (*Contopus virens*), Gray Jay (*Perisoreus canadensis*), Hairy Woodpecker (*Picoides villosus*), Northern Harrier

(*Circus cyaneus*), Northern Parula (*Parula americana*), Red Crossbill (*Loxia curvirostra*), and Winter Wren (*Troglodytes troglodytes*).

A total of 11 species, comprising 31 individual birds, were observed during fall migration diurnal watch surveys (Table 7.58; Tables 5/6, Appendix M). Diurnal watch surveys were conducted on October 3, 19, and 20, 2021 at a location central to the Study Area with an adequate view of Big Bon Mature and Little Bon Mature lakes (Drawing 7.26). Bald Eagle (*Haliaeetus leucocephalus*) and Common Raven (*Corvus corax*) were the most abundantly observed species.

Table 7.58: Total Observations by Bird Group – 2021 Fall Migration Diurnal Watch Surveys

Bird Group	Group #	# Individuals	# Species
Waterfowl	1	2	1
Shorebirds	2	1	1
Other Waterbirds	3	0	0
Diurnal Raptors	4	9	2
Nocturnal Raptors	5	0	0
Passerines	6	19*	7*
Other Landbirds	7	0	0
Total		**31**	**11**

*4 observations were not identifiable to the species level

SOCI observed during 2021 fall migration diurnal watch surveys included American Kestrel (*Falco sparverius*), Double-crested cormorant (*Phalacrocorax auritus*), Gray Jay (*Perisoreus canadensis*) and Red Crossbill (*Loxia curvirostra*).

2021-2022 Winter Surveys
Winter surveys were conducted on December 27 and 30, 2021, and January 23, February 1, and March 7 and 15, 2022. The surveys included 89 10-minute point counts across 31 locations. A total of 22 species, comprising 184 individual birds, were observed (Table 7.59; Tables 7/8, Appendix M). Black-capped Chickadee (*Poecile atricapilla*), Common Raven (*Corvus corax*), Golden-crowned Kinglet (*Regulus satrapa*), and Red-breasted Nuthatch (*Sitta canadensis*) were the most abundant and commonly observed species.

Table 7.59: Total Observations by Bird Group – 2021-2022 Winter Bird Surveys

Bird Group	Group #	# Individuals	# Species
Waterfowl	1	6	1
Shorebirds	2	8	1
Other Waterbirds	3	0	0
Diurnal Raptors	4	0	0
Nocturnal Raptors	5	1	1
Passerines	6	123	12
Other Landbirds	7	46*	7
Total		**184**	**22**

*10 observations were not identifiable to the species level

The four SOCI observed during the 2021-2022 winter surveys included American Robin (*Turdus migratorius*), Black-backed Woodpecker (*Picoides arcticus*), Downy Woodpecker (*Picoides pubescens*), Gray Jay (*Perisoreus canadensis*), Hairy Woodpecker (*Picoides villosus*), and Red Crossbill (*Loxia curvirostra*).

Throughout winter 2021 bird surveys, species diversity was observed to be quite low. Those SOCI observed are generally consistent with SOCI observed during migration and BBS and are not expected to be breeding during the winter months.

2022 Spring Migration Surveys
Spring migration surveys were completed within the Study Area on April 11 and 12; and May 2, 13, 26, and 29, 2022. The surveys included 93 10-minute point counts, and 9 60-minute diurnal watches.

A total of 1365 individual birds, representing 69 species, were observed during spring migration point count surveys (Table 7.60; Tables 9/10, Appendix M). Dark-eyed Junco (*Junco hyemalis*), Hermit Thrush (*Catharus guttatus*), Palm Warbler (*Dendroica palmarum*), and Yellow-rumped Warbler (*Dendroica coronata*) were the most abundant and frequently observed species during spring migration surveys. Migrant passerines accounted for 69.6% of the species and 87.5% of the individual birds observed.

Table 7.60: Total Observations by Bird Group – 2022 Spring Migration Point Count Surveys

Bird Group	Group #	# Individuals	# Species
Waterfowl	1	3	2
Shorebirds	2	2	3
Other Waterbirds	3	9	2
Diurnal Raptors	4	6	6
Nocturnal Raptors	5	0	0
Passerines	6	1194	48
Other Landbirds	7	151*	8
Total		**1365**	**69**

*7 observations were not identifiable to the species level

SOCI observed during the spring migration point count surveys included American Kestrel (*Falco sparverius*), American Robin (*Turdus migratorius*), Common Tern (*Sterna hirundo*), Downy Woodpecker (*Picoides pubescens*), Evening Grosbeak (*Coccothraustes vespernicus*), Hairy Woodpecker (*Picoides villosus*), Northern Parula (*Parula americana*), Olive-sided Flycatcher (*Contopus cooperi*), Red Crossbill (*Loxia curvirostra*), Turkey Vulture (*Cathartes aura*), and Winter wren (*Troglodytes troglodytes*).

A total of 11 species comprising 24 individual birds were recorded in the Study Area during spring migration diurnal watch surveys (Table 7.61; Tables 11/12, Appendix M). American Kestrel (*Falco sparverius*), Red-tailed Hawk (*Buteo jamaicensis*), and Sharp-shinned Hawk (*Accipiter striatus*) were the most frequently and abundantly observed species. Several soaring species were observed, including six diurnal raptor species.

Table 7.61: Total Observations by Bird Group – 2022 Spring Migration Diurnal Watch Surveys

Bird Group	Group #	# Individuals	# Species
Waterfowl	1	0	0
Shorebirds	2	1	1
Other Waterbirds	3	0	0
Diurnal Raptors	4	16	6
Nocturnal Raptors	5	0	0
Passerines	6	7	4
Other Landbirds	7	0	0
Total		**24**	**11**

The SOCI observed during spring migration diurnal watch surveys included American Kestrel (*Falco sparverius*), Evening Grosbeak (*Coccothraustes vespertinus*), and Turkey Vulture (*Cathartes aura*).

2022 Breeding Bird Surveys

The 2022 BBSs were conducted on June 18, and July 9, 2022. A total of 30 10-minute point count surveys were conducted within the Study Area, with 590 individual birds, representing 59 species, observed (Table 7.62; Tables 13/14, Appendix M). The most abundant and frequently observed species were the Common Yellowthroat (*Geothlypis trichas*), Hermit Thrush (*Catharus guttatus*), Ovenbird (*Seiurus aurocapilla*), and Palm Warbler (*Dendroica palmarum*). Migrant passerines accounted for 79.7% of the species and 91.7% of the individual birds observed.

Table 7.62: Total Observations by Bird Group – 2022 Breeding Bird Surveys

Bird Group	Group #	# Individuals	# Species
Waterfowl	1	5	1
Shorebirds	2	4	1
Other Waterbirds	3	2	2
Diurnal Raptors	4	2	2
Nocturnal Raptors	5	0	0
Passerines	6	541	47
Other Landbirds	7	36	6
Total		**590**	**59**

Nightjar and owl surveys were conducted on July 7 and 17, 2022. A total of 20 10-minute point count surveys were conducted throughout the Study Area, across varying habitats and a wide spatial distribution (Drawing 7.26). A total of 68 individual birds representing five species were observed (Table 7.63; Tables 15/16, Appendix M). Common Nighthawk (*Chordeiles minor*) was the most common species observed, accounting for 87% of all birds. SOCI observed included the Common Nighthawk, Common Tern (*Sterna hirundo*), and Red Crossbill (*Loxia curvirostra*).

Table 7.63: Total Observations by Bird Group – 2022 Nightjar and Owl Surveys

Bird Group	Group #	# Individuals	# Species
Waterfowl	1	0	0
Shorebirds	2	8	1
Other Waterbirds	3	0	0
Diurnal Raptors	4	0	0
Nocturnal Raptors	5	1	1
Passerines	6	59	3
Other Landbirds	7	0	0
Total		**68**	**5**

SOCI observed during the 2021 breeding surveys include American Kestrel (*Falco sparverius*), American Robin (*Turdus migratorius*), Chimney Swift (*Chaetura pelagica*), Common Nighthawk (*Chordeiles minor*), Common Tern (*Sterna hirundo*), Eastern Wood-Pewee (*Contopus virens*), Evening Grosbeak (*Coccothraustes vespertinus*), Gray Jay (*Perisoreus canadensis*), Hairy Woodpecker (*Picoides villosus*), Nashville Warbler (*Vermivora ruficapilla*), Northern Parula

(*Parula americana*), Olive-sided Flycatcher (*Contopus cooperi*), Rose-breasted Grosbeak (*Pheucticus ludovicianus*), Red Crossbill (*Loxia curvirostra*), and Winter Wren (*Troglodytes troglodytes*).

Throughout all field surveys, the occurrence of any species listed under *SARA*, COSEWIC, and/or the NS *ESA* was recorded (Drawing 7.27 and 7.28; Table 17, Appendix M).

7.4.5.8 Habitat Modelling Results

Following a review of desktop resources and the completion of field assessments, a habitat model was completed for the following SOCI, which were observed during BBSs and are listed as “Endangered”, “Threatened”, “Special Concern”, or “Vulnerable” under COSEWIC, *SARA*, or NS *ESA* based on their respective breeding habitat requirements:

- Chimney Swift (*Chaetura pelagica*)
- Common Nighthawk *(Chordeiles minor)*
- Eastern Wood-Pewee *(Contopus virens)*
- Evening Grosbeak *(Coccothraustes vespertinus)*
- Olive-sided Flycatcher *(Contopus cooperi)*

The results of the modelling are shown in Drawings 7.29 – 7.33.

7.4.5.9 Remote Sensing Results

Avian Radar Assessment

Through both the fall 2021 (August 16 to October 18, 2021) and spring 2022 (April 11 to June 16, 2022) migration periods, the ARS was deployed to monitor for BTs within a sampling of the airspace above and near the Study Area. The fall 2021 radar deployment was split between a large clearcut to the south of Little Bon Mature Lake and the edge of the road near the southern end of Big Bon Mature Lake. The spring 2022 radar deployment was only at the large clearcut to the south of Little Bon Mature Lake (Drawing 7.34).

Observed BTs during the fall 2021 monitoring campaign using the vertical radar mode were limited to only three days: August 31, September 2, and September 25. Most of the 22,928 BTs were observed on August 31 (nBTs = 9,954) and September 2 (nBTs = 12,839). Targets observed were across multiple nominal height bins on each of the three days (Table 18, Appendix M).

Figure 7.5 (Table 19, Appendix M) shows that the horizontal radar mode identified 40,793 BTs during the fall 2021 monitoring campaign. Most of these BTs were clustered around late August and mid-October, while the largest migration event (nBTs = 9,175) occurred on August 24.

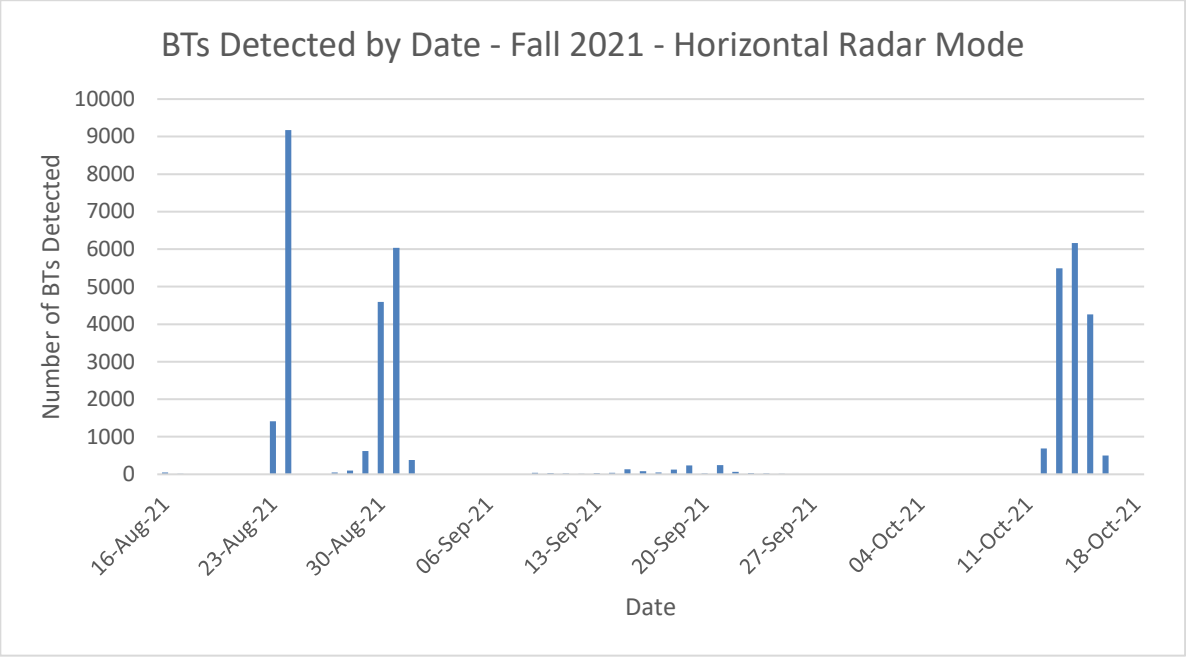

Figure 7.5: BT Detection Results for the Horizontal Radar Mode during the Fall 2021 Monitoring Campaign

Fall 2021 BT detection for the vertical radar mode peaked on August 31 and September 2, 2021. The horizontal mode detection had numerous BT detections on August 31 (nBTs = 6,036). Detections remained low throughout much of September but rose again for several days from October 12-16, 2021.

Figure 7.6 (Table 20, Appendix M) shows that the horizontal radar mode identified 36,491 BTs during the spring 2022 monitoring campaign, over numerous days. A peak of BT was observed on April 14, 2022 (nBTs = 32,074), the largest detection within a single day of the monitoring campaigns. No observations were made after May 19, 2022. While BT observations peaked in early-to-mid April, migratory bird movement appears to have persisted into at least mid-May.

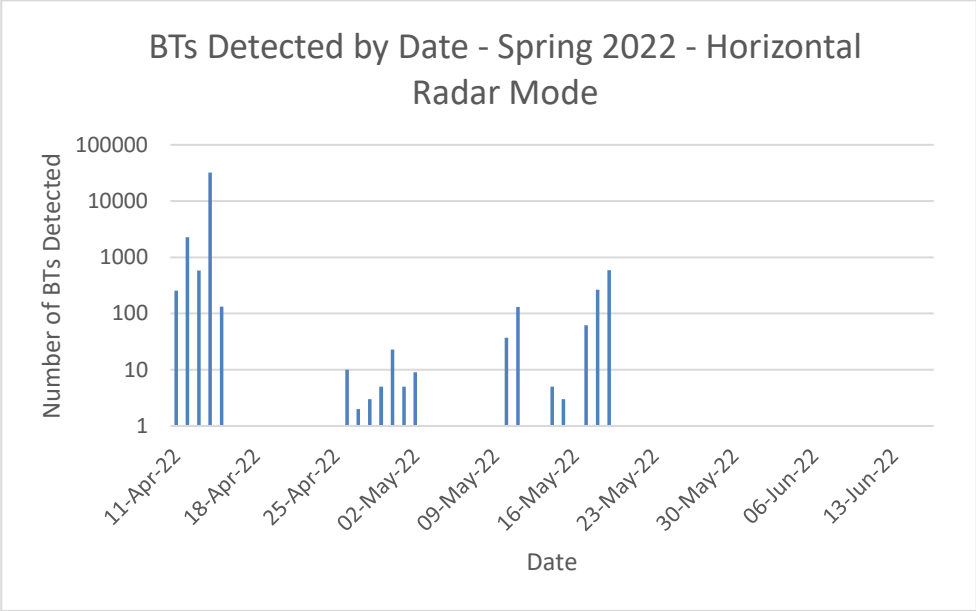

Figure 7.6: BT Detection Results for the Horizontal Radar Mode during the Spring 2022 Monitoring Campaign

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 during migration (Liechti & 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.

Weather data was collected from the nearby Western Head Weather station (ECCC, 2022e; Tables 21/22, Appendix M). While peak BT detection in spring 2022 occurred on April 14, 2022, the weather for that day indicated 7 mm precipitation (rain, fog, mist, etc.), with wind coming primarily from the north and northwest, suggesting some of those BTs could be weather related noise. Though with migratory movements being stochastic, it is possible that bird movements occurred during poor weather. It is also worth noting that on April 13 (nBTs = 585), May 11 (nBTs = 130), May 18 (nBTs = 267), and May 19th (nBTs = 593), there was very little precipitation and prevailing winds from the south and southwest, suggesting potential migratory movements. Both results are consistent with the findings of other studies that examined the

effects of weather and atmospheric conditions on bird migration (Richardson, 1990; Liechti & Bruderer, 1998).

Tidal and moon phase data was also collected as a potential indicator for migratory movements (DFO, 2023, Somacon, 2023); however, the dataset did not show an obvious correlation between BT detections and tide cycles, possibly owing to the Study Area's position inland well away from the Atlantic Coast.

Determining Migratory Bird Density

The vertical radar mode provided high resolution on the height at which BTs were detected during the fall 2021 monitoring campaign. To correct for the distortions in BT detection counts at different ranges (both distance and height), it is necessary to correct for the airspace volume scanned by the radar at each range bin (or height bin in the case of the horizontal radar mode). Based on the geometry of the radar's beam angle (described above), the volume of airspace scanned in each of the range and height bins for the radar modes was determined using CAD software. These volumes are shown for each height bin in Table 7.64 along with the number of targets detected in each of the height bins, and the target density (i.e., the number of targets detected per cubic kilometer of airspace) for the vertical radar mode deployed during the fall 2021 monitoring period.

Table 7.64: BT Density and Related Parameters Observed During Fall 2021 Monitoring Campaign

Height Bin (m)	Airspace Scanned (km3)	Number of BTs Detected	Target Density (BT/km3)
0-25	0.1015	34	335.0
25-50	0.1016	109	1072.8
50-100	0.2036	331	1625.7
100-150	0.2043	613	3000.5
150-200	0.2052	997	4858.7
200-250	0.2063	1163	5637.4
250-500	1.052	6012	5714.8
500-1000	2.226	9206	4135.7
1000-1500	2.337	4437	1898.6
1500-2000	2.426	26	10.7
2000-3000	3.774	0	0.0
Total	**12.8375**	**22928**	**1786.0**

Figure 7.6 shows the number of BTs detected and Target Density calculated for the fall 2021 monitoring period for each height bin (as measured by the vertical radar mode).

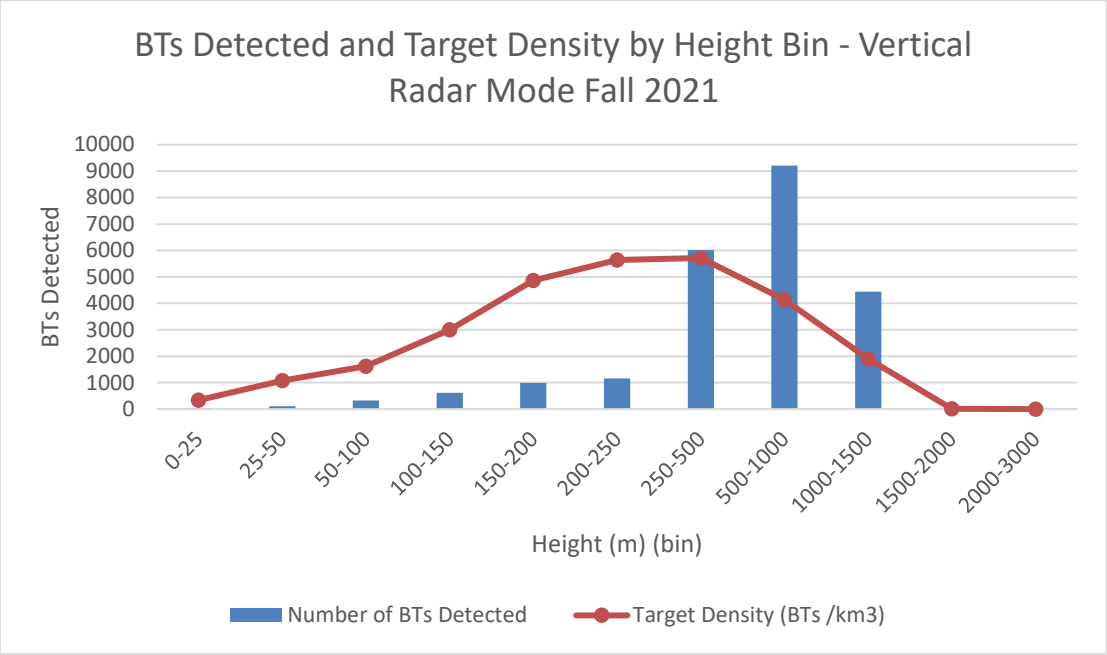

Figure 7.6: BTs Detected and Target Density by Height bin – Vertical Radar Mode Spring 2022

Figure 7.6 and Table 7.64 show that most BTs were detected in the 250-500 m, 500-1000 m and 1000-1500 m height bins; however, target density was relatively equal in the 150-200 m, 200-250 m, 250-500 m, and 500-1000 m height bins. This may indicate that migratory bird activity in the airspace above the Study Area is somewhat even in the height ranges of 150 to 1000 m. Birds are known to migrate at heights over 3,000 m, but most may fly much lower, with smaller bodied species generally traveling at lower heights (Farnsworth, 2013). This may indicate a diversity in the body size composition of birds migrating in the area.

The ARS deployed for the spring 2022 monitoring campaign was not equipped with a vertical radar mode, but the horizontal mode was angled at 15° above the horizon. This allowed an estimate of the height of the BTs detected to be calculated using a trigonometric regression based on the target's range and the radar's angle (known hereafter as nominal target height). Table 7.65 shows the number of BTs detected and target density by nominal height bin during the spring 2022 monitoring campaign.

Table 7.65: BT Density and Related Parameters Observed During Spring 2022 Migration Season

Nominal Target Height Bin (m)	Airspace Scanned (km^3)	Number of 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

Nominal Target Height Bin (m)	Airspace Scanned (km^3)	Number of BTs Detected	Target Density (BT/km^3)
200-250	0.2063	14	67.86
250-500	1.052	8496	8076.05
500-1000	2.226	28003	12580
1000-1500	2.337	0	0
1500-2000	2.426	0	0
2000-3000	3.774	0	0
Total	**12.8375**	**36491**	**2842.53**

Figure 7.7 shows the number of BTs detected and target density calculated for the spring 2022 monitoring campaign for each height bin (as measured by the radar mode anlged at 15°).

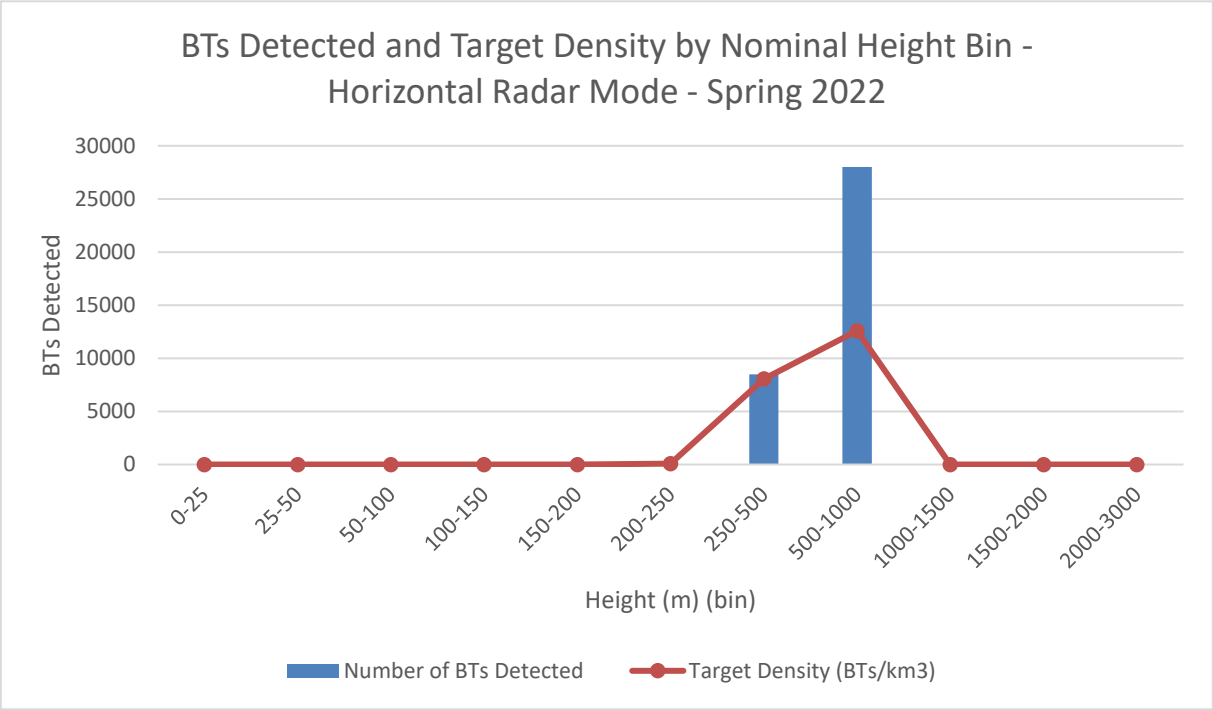

Figure 7.7: BTs Detected and Target Density by Nominal Height Bin – Horizontal Radar Mode Spring 2022

Table 7.65 and Figure 7.7 show that most migratory bird activity detected by the ARS during the spring 2022 monitoring campaign occurred in the 250-500 m and 500-1000 m nominal height bins, which is consistent with the results of the fall 2021 monitoring campaign, but for a notable lack of any targets detected below 200 m. While BT counts and density are both observed to be highest in the 500-1000 m bin, density in the 250-500 m bin is more similar than the BT counts. It should be noted that this radar configuration is limited in the resolution of target height that it can detect due to the shallow 15° angle.

Avian Acoustic Assessment

Figure 7.8 summarizes the results of the avian acoustic assessment for the spring 2022 monitoring period.

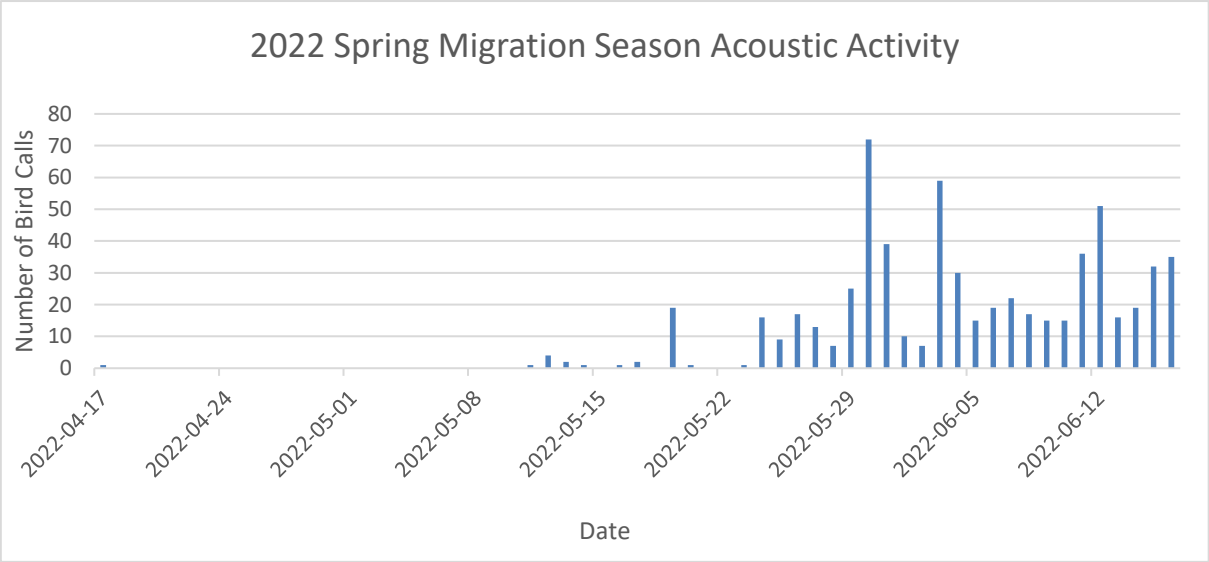

Figure 7.8: Avian Acoustic Activity by Date during the 2022Sspring Migration Season

Figure 7.8 shows that avian acoustic activity increased later in May and remained high until the end of the monitoring period. 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. In addition, most avian acoustics identified were calls or songs, rather than NFCs, which may explain the large number of calls identified in the middle of May through to June. As described above, fewer BTs were detected during the latter half of May, when acoustic activity increased. This indicates that these results are not useful in assessing migratory bird activity due to the errors introduced by noise.

The most abundant species identified through the acoustic monitoring program was the Common Nighthawk (*Chordeiles minor)* (Figure 7.9). The Owl and Nightjar surveys conducted throughout the study area showed Common Nighthawk presence in several areas as well.

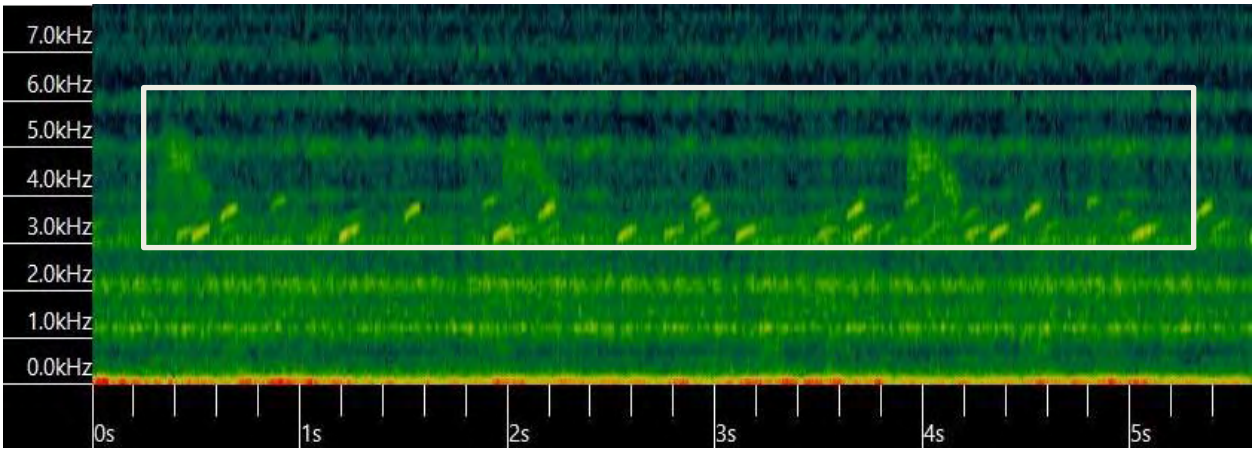

Figure 7.9: Spectrogram Showing a Common Nighthawk as Identified using Kaleidoscope (2022). Common Nighthawk Sounds are Highlighted in the Boxed Area

The fall data did not yield any meaningful amount of clustered avian acoustics and are therefore not included in the analysis.

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 7.66). These activities could result in habitat removal, reductions in food availability, and direct bird-turbine interactions which often involve strikes. Other Project related activities, including during construction and operation, may impact avifauna behaviors, such as increased traffic and noise.

Table 7.66: 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

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. The RAA for avifauna includes surrounding regions that may fall within the habitat range of each species, bounded by pre-existing infrastructure and roads, as well as the Mersey River, as it is a possible migratory corridor for waterbirds headed inland (Drawing 7.21).

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

Species at Risk
One of the primary threats to SAR is habitat loss. 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; ECCC, 2016c; NSNRR, 2022d).

Chimney Swift, Common Nighthawk, Eastern Wood-Pewee, Evening Grosbeak, and Olive-sided Flycatcher were observed during spring migration and BBSs, with evidence of breeding activity noted within the Study Area and confirmed near a variety of habitats (Table 17, Appendix M; Drawing 7.27). Impacts to wetlands and other habitats of significance to SAR for foraging or breeding has been avoided to the greatest extent possible through Project design, through avoidance of specific features, as well as the use of existing roads wherever possible.

The Olive-sided Flycatcher, Evening Grosbeak, and Common Nighthawk have all been assessed federally under *SARA*, to establish conservation measures and to inventory critical points of action to minimize species decline and stabilize populations for future recovery. Deforestation, reduced availability of prey, land conversion, infrastructure development, and climate change contribute to disruption (ECCC, 2016b; ECCC, 2016c; NSNRR, 2022d). The Eastern Wood-Pewee has been assessed in Nova Scotia under the NS *ESA*, and while it is at risk from many of the same threats as other SAR, as an aerial flycatcher, prey abundance and timing are suspected to be some of the most significant threats to its survival as a species (NSNRR 2022d).

Common Nighthawks were observed in abundance during field surveys, especially during the targeted nightjar surveys in July 2022, primarily foraging for food and passing. While these observations are consistent with potential breeding behaviours, no confirmed breeding evidence was observed. Modelled habitat suggests there is adequate breeding habitat available, including along roads (both active and unused) throughout the Study Area.

Olive-sided Flycatchers occupy wetlands and other habitats of several varieties, as evidenced by the observations encountered throughout 2021 and 2022 BBSs. While there were numerous observations of Olive-sided Flycatchers within the Assessment Area, no confirmed breeding evidence was observed.

Evening Grosbeaks occupy breeding habitat in mature and old growth softwood stands. The only specimens observed during the 2022 BBSs were calling and did not display any breeding behaviours. Preferred breeding habitats for Evening Grosbeaks (i.e., mature/old growth forests) have been avoided through the Project design (Section 7.4.1).

Chimney Swifts, like other SAR mentioned above are vulnerable to changing habitat availability, though they are known as a more common urban species than a woodland species, given the lack of large hollow trees due to logging (ECCC, 2007). It is unlikely that the Project will have any interaction with Chimney Swift breeding habitat.

Habitat modelling (Drawings 7.29, 7.30, 7.31, 7.32, 7.33) suggests that there is abundant usable habitat available for each of those species within the Study Area. While Chimney Swift nesting/breeding habitat was not modelled given a lack of available relevant data, habitats used for foraging, as well as potential habitats of interest were modelled and noted for avoidance.

General Effects to Avifauna

Road Traffic
Many species of avifauna are known to use the roadways within the Study Area, as evidenced by field survey results (Appendix M). An increase in road traffic will increase chances of mortality to those avifauna using the roadways, especially Roughed 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.

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. Only 8.4 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. Habitat alteration may result in the removal of refugia which may increase predation risks and disrupt the ecological balance within a localized community. Direct habitat loss and fragmentation within the LAA will therefore be small and has been minimized by Project design to reduce the effects of habitat loss.

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 (30 m to 180 m). Direct impacts to individual species are difficult to quantify, as the passage of any given species at any given moment in time is unpredictable; however, the likelihood of impacts to avifauna can be better understood with further monitoring of radar-detectable activity, in conjunction with mortality surveys. Mortality monitoring has been carried out by Strum at numerous other facilities in Nova Scotia, with low mortality rates observed.

The avian radar assessment program identified several instances of suspected migratory bird activity (as indicated by high daily BT counts) during the fall 2021 and spring 2022 monitoring campaigns.

The 2021 fall and 2022 spring migration diurnal count surveys observed very few large-bodied birds in the vicinity of the Study Area, both over land and over water. Sea birds and other birds flocking together were not observed in large numbers within the Study Area, but many of the larger raptor species observed within the Study Area, including Bald Eagles, are expected to be nesting at nearby water bodies, including the Mersey River. As few large flocks were observed, most interactions between the turbines and avifauna are expected to be with migratory birds passing through the rotor sweep area of the turbines while using directly adjacent habitats, not with seabirds and waterfowl migrating along the Mersey River, or up and down the Atlantic coast of Nova Scotia.

In both the fall 2021 and spring 2022 monitoring campaigns, the daily total of BTs detected was highly variable, 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). Interactions with the turbine infrastructure would vary over time, along with variations in migratory bird density as migratory bird movements pass over the RAA. Bird strikes and avian mortalities are likely to be proportional to migratory bird activity, which can occur stochastically throughout the spring and fall migration seasons.

The results of the fall 2021 and spring 2022 radar monitoring program indicates that migratory bird activity was highest in the 200-250 m, 250-500 m and 500-1000 m height bins, which suggests that most of the migratory bird activity would occur above the height of the wind turbines. Based on these findings, the number of bird strikes and level of avian mortalities from

the Project is expected to be low, which is consistent with other studies that examined interactions between wind turbines and avifauna (Zimmerling et al., 2013)

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.

Mitigations to be employed during the construction phase 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.

Mitigations to be employed during the operational phase to reduce the Project's effects on avifauna may include:

- Establish speed limits for operational vehicles to mitigate the effect of collisions with avifauna.

Mitigations to be employed during the decommissioning phase to reduce the Project's effects on avifauna may include:

- 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 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 BBS post-construction to establish potential impacts to the breeding bird community, while also addressing changes in population dynamics, with special attention paid 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, medium duration, intermittent, reversible, and not significant.

8.0 SOCIO-ECONOMIC ENVIRONMENT

8.1 Economy

8.1.1 Existing Environment

The Mersey River has been an active thoroughfare for the inhabitants of the area for thousands of years. Part of Kespukwitk, Mi'kma'ki, the area around the Mersey River, is still used by the Mi'kmaq. The Project is closest to the Ponhook Reserve, 12.5 km northwest of the Project, which is part of Acadia First Nation.

The Project is in the Region of Queens Municipality (the Municipality, RoQM) (population 10,351), near the communities of Milton (population 999, approximately 4.4 km east of the Project), Brooklyn (population 849, approximately 9.3 km east of the Project), and Liverpool (population 2,549, approximately 7.4 km southeast of the Project). Liverpool is the most populated community in the Municipality and is located on the south shore of Nova Scotia.

The Municipality is made up of 49 communities and encompasses the former Town of Liverpool. As of 1996, the Queens Municipal District and the Town of Liverpool amalgamated to become the Region of Queens Municipality. All communities within Queens County are members of the Municipality, except for First Nation's Communities. Queens County is bordered by Annapolis County to the north, Lunenburg County to the east, Shelburne County to the southwest, and Digby/Yarmouth Counties to the west (Region of Queens Municipality, n.d.).

The County covers a land area of approximately 2,393 km^2 (Statistics Canada, 2022) and is bordered to the south/southeast by the Atlantic Ocean.

Population statistics for the RoQM, County and province of Nova Scotia derived from the 2016 and 2021 census of population are summarized in Table 8.1.

Table 8.1: Regional Population

Population Statistics	Region of Queens Municipality	Queens County	Nova Scotia
Population in 2021	10,422	10,501	969,383
Population in 2016	10,302-10,307*	10,351	923,598
Population change from 2016-2021 (%)	1.2	1.4	5.0
Total private dwellings 2021	6,676	6,705	476,007
Private dwellings occupied by usual residents 2021	4,977	5,005	428,228
Population density (per km^2)	4.4	4.4	18.4
Land area (km^2)	2,387.52	2393.44	5,2824.71

*2016 population is listed as 10,307 in the 2016 census and 10,302 in the 2021 census

(Data Sources: Statistics Canada, 2022)

The RoQM has seen some population growth in recent years (+1.2% 2016-2021). This contrasts with a 20-year trend of population decline that began in 1996 (Government of NS Department of Municipal Affairs and Housing, 2020). Although this marginal growth rate is below the provincial population growth rate of 5% (2016-2021), the Municipality's growth may be indicative of a 'rural boom' being seen in several regions across the country. A Brookfield Institute report on Canada's labour market indicates Ontario, British Columbia (BC) and Atlantic Canada have all seen a record number of residents relocating from larger cities to greener areas since the COVID-19 pandemic began (Russek et al., 2021).

The average age in Queens County is 50.4 years, while the average in the Municipality is 50.5; both have a median age of 55.6. Both averages are higher than that of the provincial average which sits 44.2, with a median of 45.6. Age distributions are shown in Table 8.2.

Table 8.2: Age Distribution in Queens County and the Municipality, 2021

Age Statistics	Queens County	Region of Queens Municipality
0 - 14 years	1,135 (10.8%)	1120 (10.7%)
15 - 64 years	6,075 (57.9%)	6,020 (57.7%)
65+ years	3,285 (31.3%)	3,280 (31.5%)
Total Population	**10,500 (100%)**	**10,425 (100%)**

Source: Statistics Canada 2022; note that due to rounding, total percentage may be ± 100%.

The majority of residents in the Region of Queens Municipality have knowledge of the English language (Table 8.3). Outreach and engagement for this Project has been and will continue to take place in English.

Table 8.3: Knowledge of Official Languages

Language(s)	Total
English only	9,815 (95%)
French only	0 (0%)
English and French	480 (5%)
Neither English nor French	10 (<1%)
Total respondents (excludes institutional residents)	10,315 (100%)

Source: Statistics Canada 2022; note that due to rounding, total percentage may be ± 100%. Statistics Canada also notes that census enumeration of reserves and First Nations Communities are incomplete and thus show poor resolution of Indigenous Language knowledge, thus their omission in this section.

The education level of the RoQM has increased since 2011 (Government of Nova Scotia Department of Municipal Affairs and Housing, 2020). Census data concerning the value of dwellings and average total individual income is provided in Table 8.4.

Table 8.4: Housing Costs and Average Individual Income

Jurisdictions	Average Dwelling Value in 2020	Average Total Income in 2020
Region of Queens Municipality	$213,200	$38,680
Queens County	$213,200	$38,640
Province of Nova Scotia	$295,600	$47,480
Canada	$618,500	$54,450

Source: Statistics Canada 2022

The Liverpool Fire Department is located approximately 9 km southeast of the Study Area on Main Street in Liverpool. Health and emergency services exist in the area and are accessible to Project workers if the need should arise at the Queens General Hospital on School Street in Liverpool, approximately 10 km southeast of the Study Area. More specialist care can be accessed in Bridgewater, approximately 30 minutes northeast on Highway 103.

There is a high percentage (10.8%) of manufacturing workers in this region when compared to the rest of the province (6.4%) (Table 8.5). Prior to 2012, the Bowater Mersey Paper Mill was a major employer in the area. Its closure in 2012 directly impacted about 320 mill employees and had effects on woodland and sawmill workers throughout the region (CBC News, 2012).

The RoQM also has a diverse seafood industry that operates year-round. Groundfish, lobster, scallops, and other shellfish are harvested and processed within the Municipality. Some finfish marine aquaculture is also being practiced (Region of Queens Municipality, n.d.).

A 2021 Agricultural Sector Review of the Municipality indicates the agriculture industry is valued at just under $2 million (Region of Queens Municipality, 2021). Agricultural land is affordable and available in this region. Last year there were 155 registered parcels of land assessed as

agricultural (8,394 acres), amounting for approximately 4% of arable land (Region of Queens Municipality, 2021); however, field sizes and topography are not suitable for mechanized row cropping. Aging infrastructure and population also pose challenges to the agricultural industry (Region of Queens Municipality, 2021).

Statistics for Queens County and the Province of Nova Scotia indicate the unemployment rate in 2021 was 14.4%, compared to the Nova Scotia Provincial Rate of 12.7%. Employment rate in the County is 38.9%, well below the provincial average of 51.9%. Queen's County also has a relatively high percentage of the population that is not in the labour force (54.6%), leading to the relatively low percentage of employed persons.

A breakdown of the labour force for Queens County and Nova Scotia is provided in Table 8.5. The highest proportions of workers in Queens County fall into the "health care and social assistance", "retail trade", "agriculture, forestry, fishing and hunting", and "manufacturing" categories, with strong numbers in "construction" and "accommodation and food services" as well.

Table 8.5: Top Industries for the Employed Labour Force Over 15 Years of Age (2016)

Industry	Queens County	Nova Scotia
Health Care and Social Assistance	550 (13.1%)	70,595 (14.5%)
Retail Trade	490 (11.7%)	58,985 (12.1%)
Manufacturing	450 (10.8%)	31,210 (6.4%)
Agriculture, forestry, hunting and fishing	445 (10.6%)	17,880 (3.7%)
Construction	320 (7.6%)	35,720 (7.3%)
Accommodation and Food Services	305 (7.3%)	30,010 (6.2%)

(Data Source: Statistics Canada, 2022)

Forestry activities exist in the immediate vicinity of the Project. Within 5 km of the Study Area, economic activities include those businesses listed in Table 8.6. It is also possible that outdoor recreation related economic activities take place within a close proximity, including backcountry guiding.

Table 8.6: Local Businesses and Proximity to Study Area

Business	Distance and direction from Study Area*
Mersey Lodge	2.8 km N
Three Mile Rifle Range	2.7 km NE
Tri County Heating & Cooling	3.2 km E
Mini's Soaps	3.8 km E
Dave Hatt's Auto Sales Ltd.	4 km E
Grant's Taxi	4 km E
Redfox Computer Services	4.1 km E
Nova Veterinary Clinic Milton	4.2 km E

*All distances measured from edge of the Study Area, using the most direct route.

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 8.7).

Table 8.7: 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 the RoQM and Queens County. The RAA includes the entire province.

Assessment Criteria
Assessment criteria provided in Section 4.6 apply for 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 $300 million in investments into the province of Nova Scotia. The Partnership 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 will create a CLC, which will help to relay information and 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 maintenance, 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 will deliver services in a variety of areas, including: civil and electrical engineering, legal, 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, 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 provide approximately at least 100 of varying duration throughout the development and construction periods.
- Operations and Maintenance - Operational wind projects require long-term operations and maintenance professionals to be located either on-site or within short driving distance of the Project. During operation, this Project will require 6-12 full time equivalent technicians. The jobs associated with operations and maintenance are long-term, steady, stable, and high-paying jobs.

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, restaurants, and grocery stores (USDE, 2008).

As outlined in the *Wind Turbine Facilities Municipal Taxation Act* (2006), the RoQM 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 $1,170,000 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.

The Proponent is committed to being a good neighbour, as outlined in their presentations during open house public consultation sessions, as well as through the Project Website. Roswall is committed to creating an annual community dividend, to provide an endowment fund to support community initiatives. This endowment fund would be administered by the CLC. Expression of interest in providing a not-for-profit clean energy rate for community initiatives has also been expressed by the Project Team to support a positive community relationship.

With the Project providing a RTR economic model, savings on energy costs are expected over time for all customers who opt to purchase their power directly from the Project (Figure 8.1). Short term costs are expected to be similar, but over time there is expected to be significant savings given low production costs of renewables within the current model.

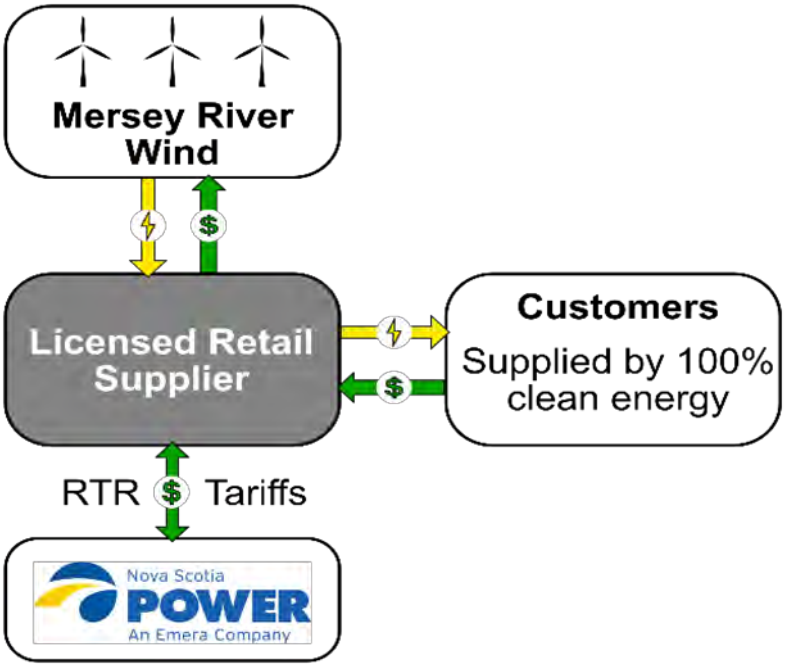

Figure 8.1: Renewable to Retail Economic Model

The option for consumers to purchase clean energy directly from the Project has the potential to attract businesses to the area who are in search of clean energy to support their needs. The opportunity to purchase energy from a provider also creates competition in the Nova Scotian market, which should help to reduce emissions in the long run, while remaining cost effective for consumers.

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 to the economy is expected to be positive, extend to the RAA for a medium duration, and be continuous.

8.2 Land Use and Value

8.2.1 Existing Environment

The properties on which the Project will reside are in an inland rural setting approximately 4.4 km from the closest town (Milton, 3 km east of Study Area). Land use around the Study Area is varied and includes forestry, hydroelectric generation (through NS Power's Mersey River Hydro System), as well as recreation.

Based on available mapping and aerial photography, there is no residential development in the immediate vicinity of the Study Area. Structures identified in the vicinity of the Study Area, unrelated to the Project, include several hunting and/or fishing camps.

Known past land uses in proximity to and within the Study Area include forestry activities under the direction of the Bowater Mersey Paper Company Limited (commonly known as Bowater Mersey). Bowater Mersey operated within the Study Area up until the closure of their paper facility. NS Power also occasionally uses the road network within the Study Area to access their hydro system when River Road (on the east bank of the Mersey River) is not accessible.

The closest identified reserve lands are located at Ponhook Lake First Nation, approximately 3.5 km northwest of the centre of the Study Area on the shore of Lake Rossignol. Further consideration of First Nations resources and the results of the MEKS are included under Section 5.0.

The closest protected land area to the Project is the Tidney River Wilderness Area, 10 km west of the Study Area (Drawing 7.6). Several pending or proposed Nature reserves are in close proximity to the Study Area, including portions of the properties where the Project is proposed. The Lower Mersey Nature Reserve, Long Lake Bog Nature Reserve, and Mersey River Provincial Park are all proposed for lands bordering or within the Study Area. A summary of the active managed and protected areas, including proximity to the Project, are listed in Table 8.8.

Table 8.8: Managed and Protected Areas near the Project

Name/Designation	Distance and direction from Assessment Area*
Ten Mile Lake Provincial Park	13 km N
Tidney River Protected Area	19 km SW
Port l'Hebert Provincial Park	20.3 km SW
Tidney River Wilderness Area	10 km W
Port Joli Bird Sanctuary	19 km SW
Kejimkujik National Park (Seaside Unit)	21.4 km S
Long Lake Bog Conservation Lands	1.2 km SW

*All distances measured from the approximate Assessment Area, using the most direct route

The Project is in moderate proximity to several protected areas as well as Provincial and National Parks. Impacts to these areas are not expected, as all are at least 10 km from the Study Area, and none of them make direct use of the Study Area. It is possible that the turbines may

be visible from some areas within the provincial and national parks.
No active mineral rights have been granted within the Study Area. No signs of historical mining have been encountered during field surveys.

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 8.9).

Table 8.9: 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 is the RoQM and Queens County. The RAA is not applicable.

Assessment Criteria
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 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 that are ongoing in the area will not have their functionality disrupted by the Project. As

the 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 context, 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, there is reason to believe that 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*. 2010).

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 very 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 recent 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: an ordinary least squares model, which is standard for this type of study, and 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).

Another 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 (i.e., maximizing the use of existing roads and cut blocks) and consultation 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 to 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

Nova Scotia Highway 103 and Nova Scotia Trunk 8 will be the primary roads used to deliver turbine parts to the Project. The turbines will come from Port Mersey, via the Brooklyn exit off Highway 103. Other industrial supplies such as concrete and road materials will be sourced as locally as possible.

There is a network of access roads present within the Study Area that will be used as the primary points of access to each turbine. Each turbine pad may have shorter access roads spurring off the existing main roads to facilitate access directly. The entirety of the Study Area is accessible via a bridge off River Road in Milton. Secondary access can also be achieved via crossing the Mersey River at the Lower Lake Falls dam at the north end of the Study Area. This route is significantly longer as users pass the more direct route at the southeast end of the Study Area to access it. River Road, which serves as the primary point of access for NS Power's hydroelectric systems is well maintained and plowed through the winter, while many of the roads within the Study Area are not regularly maintained.

Existing traffic within the Study Area is limited to forestry related activities commercially, as well as NS Power. Recreational traffic is commonly ATVs and other OHVs, though there are also some light trucks. Traffic increases during hunting season and on the weekends for recreational purposes, while industrial activities are more common from Monday to Friday.

Air Navigation, communications and navigation aids are addressed in Section 10.2 (EMI letters, NAV CAN consultation – include letters submitted to all interested parties).

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. In some cases, due to the size and weight of the components, some may only be transported on Sundays.
- 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
Project activities primarily have the potential to interact with transportation during construction (Table 8.10).

Table 8.10: 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	X	X	X						X	

Assessment Boundaries
The LAA for transportation is Queens County. The RAA extends from Queens County to Port Mersey.

Assessment Criteria
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. Most days during construction will have 20-40 trucks per day, with a few days requiring 100 trucks. 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.
- Replace removed signage and guardrails immediately with appropriate temporary signage to ensure 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. However, the Project will develop a complaint response protocol, which will consider complaints related to traffic.

Conclusion
The impact to traffic 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 RoQM is popular for outdoor adventure enthusiasts and is home to Kejimkujik National Park and National Historic Site, the Kejimkujik National Park Seaside, Nova Scotia's only Dark Sky Preserve, and the UNESCO Southwest Nova Biosphere. It is also known for its white sand beaches, surfable shorelines, and numerous museums.

Birding, fishing, geocaching, golf, hiking, biking, canoeing, kayaking, surfing, cross-country skiing, snowshoeing, and other outdoor activities are popular in the RoQM (Region of Queens Municipality, n.d.). In addition, a recently submitted EA for the Liverpool Wind Farm Project indicates that the Queens County ATV Association has been establishing a multi-use trail through the former Bowater Mersey logging roads (Unify Energy Inc & Wattswind, 2015).

Kejimkujik Seaside and Kejimkujik National Park and Historic Site are both located within the RoQM and see upwards of 11,000 and 65,000 visitors/year, respectively (McBain, 2020, Region of Queens Municipality, n.d.). The Dark Sky Preserve, so named in 2010 by the Royal Astronomical Society of Canada, can also be found within Kejimkujik National Park. The Park limits artificial lights, providing for a clear view of the stars with limited ambient light pollution. The Park also contains one of the largest collections of petroglyphs in North America. These depictions have been instrumental in providing information on regional history and insight into local Mi'kmaw culture. Due to the distance of the parks from the Project, they are not likely to be impacted by the Project's development or operational lighting on each turbine.

The Southwest Nova Biosphere Reserve was designated as a UNESCO site in 2001 and spans across the counties of Annapolis, Digby, Yarmouth, Shelburne, and Queens. The Southwest Nova Biosphere Reserve Association promotes the natural and cultural history found within this Biosphere and encourages conservation, sustainable development, and capacity for building research and forming partnerships with local communities.

In addition to Kejimkujik Seaside, multiple white sand beaches can be enjoyed in the Region of Queens, including Beach Meadows Municipal Beach, Summerville Beach Provincial Park, Eagle Head Beach, and Hunts Point Beach, all of which are located along the coastline, east and southeast of the proposed Project location; surfing is best from late August through mid-November.

Museums are also abundant within the RoQM, with the majority located in Liverpool which is also home to multiple heritage buildings.

In addition to the recreational and historical sites present in the RoQM, places to stay are numerous and include the following (Region of Queens Municipality, n.d.):

Campgrounds and RV:

- Ponhook Lodge Campground, Greenfield
- Fisherman's Cove RV & Campground, Hunts Point
- Thomas Raddall Provincial Park, Port Joli

Hotels, Motels, and B&Bs:

- The Senator Guest Suites Downtown, Liverpool
- Quarterdeck Beachside Villas & Grill, Port Mouton
- Loghome Vacation Eastern Shore, Mill Village
- Blueberry Bay Seaside Inn, West Berlin
- White Point Beach Resort, White Point
- Summerville Beach Retreats Chalets, Summerville
- Port Mouton Bay Cottages & Guest House
- Hunt's Point Beach Cottages, Hunts Point
- Gallery Guest House B&B, Liverpool
- Captains Quarters Cottages, Hunts Point

- Best Western Plus Liverpool Hotel & Conference Centre, Liverpool
- Tupper Lake Farm and Resort, North Brookfield
- Port Mouton Hostel, Port Mouton
- Motel Transcotia, Brooklyn
- Geranium House Bed and Breakfast, Liverpool
- Caledonia Country Hostel, Caledonia
- Lane's Privateer Inn, Liverpool
- Mersey River Chalets, Caledonia
- Mersey Lodge, Milton

The closest accommodation(s) to the Project are the Mersey Lodge on the River Road (northwest), and the Best Western Hotel in Liverpool (east). Both locations are approximately 9 km from the centre of the Study Area. Increased consumer use is not expected outside of the timeframe of Project development and construction.

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. During field surveys, several deer hunters were encountered on the site, along with blinds and tree stands that appear to have been used for hunting. Coyote trapping was also encountered within the Study Area. Other avian or mammalian hunting or trapping may occur within the Study Area, though no signs were observed during field surveys.

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 8.11).

Table 8.11: 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 Queens County. The RAA is not applicable.

Assessment Criteria
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. The Project is in a rural setting in an inland area with one public access point and no published attractions nearby. No spatial data is available regarding the places visited within 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, indicating that the Project is not likely to have a significant impact on tourism in the area.

It is difficult to determine with certainty how tourists will react to a wind power development. Wind farms are objects of fascination for many and thus could generate tourism for the local community, while others consider them to be an "eyesore". 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).

The South Shore of Nova Scotia is a scenic area with beautiful beaches and a fantastic view of the Atlantic Ocean. Tourism in the area is focused on the coastline and associated draws, as well as Kejimkujik National Park. While the Project is in this general vicinity, it will not be part of the viewscape that most tourists or other residents of nearby communities would see, given its setback towards the interior of the province and distance from residential areas and the national park. For further information on the viewplanes and landscape impacts, see Section 10.4.

The turbines will consist of a small footprint on privately leased Crown 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, especially for uses related to the existing environment such as hunting and trapping.

Mitigation Measures

- Continue to work with local recreation groups to ensure continued access within the Study Area for recreation and hunting/trapping.
- Continue to work with nearby landowners to ensure there is a positive relationship within the community.

Monitoring

A specific tourism and recreation monitoring program is not recommended.

Conclusion

The impact to recreation and tourism is expected to be negligible, and is therefore considered not significant.

8.5 Other Undertakings in the Area

Mersey River Hydro System

NS Power operates the Mersey River Hydro System, which consists of a series of generating stations along the Mersey River. The total capacity of the system is 43 MW. Given its proximity to the Study Area, energy transmission infrastructure is conveniently close by.

The Liverpool Wind Energy Storage Project

There is a 3.6 MW two turbine wind energy project 12.5 km east of the Study Area, just north of Brooklyn, NS. This provincial Community Feed-In Tariff project began operations in 2017. The hub height of these units is 95 m (Watts Wind Energy Inc., 2012).

9.0 ARCHAEOLOGICAL RESOURCES

9.1 Archaeological Resource Impact Assessment

9.1.1 Overview

The purpose of the ARIA is to highlight areas of potential archaeological sensitivity associated with the Project. Boreas Heritage Consulting Inc. 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 A2022NS034, issued by NSCCTH – Special Places Program.

As archaeological work can often result in findings or information of a confidential or sensitive nature, a summary is provided in the EA, with the detailed findings 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 and delineate 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 ends, 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. As the layout went through several iterations before the final Assessment Area was confirmed, the area surveyed during the ARIA is larger than the Project's Assessment Area (as defined in Section 3.1) and is referenced in the EA as "survey 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 survey area. Parallel pedestrian transects were completed, at intervals of 20 to 30 m (maximum of 50 m), across the survey 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 survey 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 field component also included a preliminary shovel testing program. The objective of the subsurface survey was to determine whether buried archaeological resources were present within areas ascribed high potential for encountering archaeological resources. During the testing program, strategies were identified for the appropriate methodology and scope of more detailed assessment for areas of known archaeological resources.

A baseline was established across each testing area to standardize and document the location of shovel tests and to facilitate detailed recording of any resources encountered. A total of 90 shovel tests were manually excavated at 5 m intervals across the high potential areas (HPAs). All soil removed from the test pits was screened through 6 mm wire mesh to facilitate the recovery of artifacts within the excavated soil. If archaeological resources were identified and appeared to extend beyond the previously defined high potential area, additional testing would be conducted to delineate archaeological site margins.

Details of the testing program and archaeological recording of identified features were documented in field notes, site plans, stratigraphic drawings, and photographs. A hand-held GPS unit was used to record UTM coordinates. All coordinates are UTM projection with NAD 83 as datum. Any archaeological resources encountered during the shovel testing program would be evaluated and sufficiently documented for registration within the MARI data base. All artifacts recovered would be processed and catalogued in accordance with standards set by the Special Places Program of NSCCTH.

Upon completion of field activities, analysis, and interpretation, the results of the assessment were summarized in a report, including recommendations for appropriate resource management strategies. Photos, detailed plans, and GIS-based mapping of the testing area and specific find locations (if applicable) were incorporated into the report.

9.1.4 Assessment Results

The field component of the ARIA was carried out between August and December 2022 and resulted in the identification of 14 areas (HPA-01 to 14) considered to exhibit high potential for encountering archaeological resources. Two of these areas (HPA-06 and HPA-08) were subsequently subjected to preliminary shovel testing during which no cultural material was encountered. Additional shovel testing is recommended for HPA-06, while HPA-08 is recommended to be cleared of further requirements.

Following the results of the ARIA, the Project Area was modified to ensure avoidance of HPA-01 to HPA-05, HPA-07, and HPA-10 to 13. Two additional HPAs (HPA-09 and HPA-14), which are associated with watercourse crossings, will be subject to shovel testing if they cannot be avoided during the detail design phase.

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. Areas exhibiting high potential for archaeology resources have either been avoided or were subject to a shovel testing program, with no tests showing as positive for cultural material. Additional shovel testing will be completed for HPA-06 and shovel testing will be completed for HPA-09 and HPA-14 if they cannot be avoided during the detail design phase.

Mitigation
The following mitigation measures are recommended:

- Conduct additional shovel testing at HPA-06 prior to ground disturbance.
- Conduct shovel testing at HPA-09 and HPA-14 prior to ground disturbance.
- Develop procedures in the EPP related to the potential unexpected discovery of

archaeological items or sites 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.
- Maintain avoidance of identified areas of high potential.
- 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 notified in advance and will be provided with the acceptance letter from NSCCTH prior to completion of any disturbance in those 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, be 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 CONSIDERATIONS

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 - Effects 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 through the use of 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 (150 m rotor diameter and 105 m hub height), the maximum throwing distance associated with the Project's turbines is 382.5 m. Turbines for the proposed Project have been located over 850 m from the nearest residential receptor. The public road within closest proximity to a turbine is River Road, which is approximately 1.5 km northeast from the nearest turbine. Therefore, there is little to no risk associated with ice throw to the public using these roads. 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) 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 105 m. Fires may be ignited by lightning, an electrical malfunction, and 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 turbines at least 2.7 km from the nearest non-participating habitable building, and is 1.5 km from the nearest public road. 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 to 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 Canada Renewable Energy Association (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.

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 is provided 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**

Systems	Consultation Zone
Cellular Type Networks, Land Mobile Radio Networks, and Point-to-Point Systems below 890 MHz	**1 km**
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 varies 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. Responses are provided in Appendix N.

Table 10.2: EMI Consultation Results

Signal Source	Operator	Consultation Results
Air defense and air control radar systems DND Radio Communications	Department of National Defense	Correspondence sent September 2022. Response requesting NAV Canada Land Use number September 2022. Letter of non-objection received November 2022.
Maritime vessel traffic system radars	Canadian Coast Guard	Correspondence sent September 2022. Letter of non-objection received October 2022.
VHF omnidirectional range Primary air traffic control surveillance radar	NAV Canada	January 2021 Correspondence regarding installation of multiple Meteorological (Met) Towers. October 2021 Request for Long Term (2+ years) installation of Met Towers approved. EMI Notification Letter sent September 2022. Response received in October 2022 providing Land Use file number and requesting Met Tower location information. Met Tower location information confirmed January 2023.
Weather radar	ECCC	Correspondence sent September 2022. Letter of non-objection received September 2022.
Radiocommunication Systems	RCMP Bridgewater Police Liverpool Police	Correspondence sent September 2022. Response from the RCMP received in September 2022 requesting coordination with Bell, who are acting on behalf of the RCMP in the province with leased towers. Still awaiting response from Bridgewater Police and Liverpool Police.

Signal Source	Operator	Consultation Results
Regulator	Innovation, Science, and Economic Development Canada (formerly Industry Canada)	Correspondence sent September 2022. Acknowledgement email received September 2022.
Telecom	Bell Eastlink NCS Managed Services Inc. Rogers Communications Seaside Communications	Correspondence sent September 2022. Response received from NCS Managed Services in September 2022 asking what stage the Project was at and if it had been awarded provincial funding. Project Team answered questions in September 2022. Letter of non-objection received from Bell September 2022. Still awaiting response from Rogers Communications and Seaside Communications.
Emergency Services	Liverpool Fire Fighters Association	Correspondence sent September 2022. Still awaiting response.

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, responses from seven of 14 operators have been received, with four indicating no objection, and one requesting additional information.

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.

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 has to 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 minutes of shadow flicker on the worst day of the year 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 worst-case scenarios.
- To determine if applicable guidelines are met/exceeded.
- To mitigate and minimize shadow flicker experienced by nearby residents, if necessary.
- To consult with potentially affected residents, if necessary.

Receptors located within 2 km of the Study Area were identified using GIS data from the Nova Scotia Geomatics Centre and aerial imagery. As a conservative measure, no distinction was made between habitable dwellings and barns, sheds, or outbuildings. Any structures located on properties with signed agreements as "Project Participants" were not included in the assessment.

The analysis was conducted using the WindPRO version 3.4.424 Service Pack 3 under worst-case scenario conditions (i.e., maximum amount of shadow) which assumes that all the criteria listed in Section 10.3.1 are always met.

Modelling results were mapped and presented as a heat-map, demonstrating the amount of shadow hours each receptor will receive within a calendar year.

10.3.4 Assessment Results

A total of 369 receptors were identified within 2 km of the Study Area (Drawings 10.1A-B). All receptors comply with the guidelines. Under worst-case scenario conditions (meeting criteria described in Section 10.3.1 above), the greatest shadow flicker experienced at a receptor is 5 hours and 36 min per year and 13 minutes on the worst day. Detailed results showing all receptors within 2 km of the Study Area are provided in Appendix O.

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-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
All identified receptors comply with the threshold of 30 minutes per day and 30 hours per year of shadow flicker.

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 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.)

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 areas where turbines were expected to be visible within the area surrounding the Project. The following locations were selected (Drawing 10.2A-D):

- On the bridge at the center of Bridge Street (coordinates provided in Drawing 10.2A)
- From the dam on River Road (coordinates provided in Drawing 10.2A)

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 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 turbines in place.

10.4.4 Assessment Results

Visual simulations are provided in Drawings 10.2A-D.

Turbines will be equipped with pilot warning and obstruction avoidance lighting to ensure compliance with NAV Canada and Transport Canada safety requirements.

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-D). 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 a prominent feature in the view from the observer location.

It is noted that the magnitude criteria for visual effects is considered a neutral criteria 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, turbines are visible from both observer locations; however, the tree line and landscape features limit visibility of most turbines that are within the line of sight.

Operational lighting could be visible from the turbines during the night. However, potential impacts to residents are expected to be limited due to the distance between the Project and nearest permanent residence, 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.
Mitigation
No mitigation is recommended related to viewscapes.

The following mitigation is recommended regarding turbine lighting:

- Limit lighting on turbine hubs and blades to minimum levels while still meeting requirements of NAV Canada and Transport Canada.
- Prohibit general lighting within the Project Area. Lighting will only be used when technicians are working on-site.

Construction activities will be limited to daytime hours when possible. It is noted that the turbine 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. On-site lighting will be pointed downward to minimize light throw.

Monitoring
No monitoring programs are recommended.

Conclusion
Results are characterized as low 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 line corridor 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 modeling 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
Queens County	By-Law NO. 7 A By-Law Prohibiting Certain Noises (Queens Municipality, 2022)	*"Noise or sound that unreasonably disturbs the peace and tranquility of a neighborhood"*	2300 to 0600
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, 2022e) which are currently in the consultation phase. Any changes to the guidelines as a result of this update will be referenced/incorporated as part of the Project's EPP.

There are no municipal, provincial, or federal regulations related to operational sound, but many jurisdictions (including NSECC) have adopted the industry standard that wind turbine (Project) generated sound must not exceed 40 dBA at the exterior of any residential receptors.

10.5.3 Assessment Methodology

Ambient Sound
Desktop resources and field observations were used to identify nearby sources of sound and characterize types of 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 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.

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.
Note, sound levels and impacts from blasting activities have not been included in this assessment as these activities are not anticipated. If blasting is determined to be required during construction, 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 the vicinity of the Project.
- 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.
- Ensure Project generated sound levels at nearby receptors remain below guidelines.

The sound assessment identified receptors within a 2 km radius of the Assessment Area. The assessment was completed using the WindPRO version 3.5.552 software package. For the purposes of this model, 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. No attempt to distinguish sheds and outbuildings from dwellings or cottages was made. Any structures located on properties with signed agreements as "Project Participants" 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.
- UTM coordinates for receptors (all non-Project participant structures within a 2 km radius of the Assessment Area were evaluated).
- A wind speed of 10 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., water).

Modelling results were mapped and presented as a heat-map, demonstrating the sound levels each 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.

The Study Area is approximately 4 km northwest of Highway 103, a northeast-southwest highway travelling between Halifax and Yarmouth. This major highway is travelled daily by vehicular traffic emitting different levels of sound, including transport trucks and motorcycles. In addition, the Mersey River contains a series of hydroelectric dams owned and operated by NS Power. The operation, maintenance, and expansion of these hydroelectric facilities and associated infrastructure also contribute to ambient sound levels within the Study Area. Forestry is also active throughout the Study Area; sounds associated with forestry activities include operation of forestry machinery and logging trucks. Recreation and local traffic (e.g., car, ATV, dirt bike traffic) also exists within the Study Area. In addition to anthropogenic ambient sound, there is also natural 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]
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 (undated)
[2]Transport Scotland (undated)
[3]WorkSafe BC (2016)
[4]Government of Oregon (undated)
[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). Construction activities are anticipated to occur across the spring and summer months of 2023.

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 10.7 above. Combined sound levels produced by multiple pieces of equipment operating simultaneously have not been included in the assessment.

Operational Sound

A total of 369 receptors were identified within 2 km of the Study Area. Results of the sound modelling (presented as a heat map) are shown on Drawing 10.3 and detailed results are provided in Appendix P. No operational turbines exist within 3 km of the Project; therefore, only the Project turbines were modelled. No receptors exceed the recommended guideline of 40 dBA. The highest predicted sound level at a receptor is 33.3 dBA.

Information from the turbine manufacturer confirmed that tonality would be limited to 3 dB at 1.5 m above the ground, 500 m downwind from the turbine. As the nearest non-participating receptor is located 1.89 km from a turbine, tonality is not expected to be a concern. Therefore, low frequency sound is not expected to be a concern and additional modelling for low frequency sound was not completed. A literature review related to infrasound/low frequency sound is provided in Appendix P.

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 for 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 (continuously).

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. Sounds produced during construction have the potential to exceed these thresholds at some residential receptors located within close proximity to activities at some locations within the Project Area.

However, there are no seasonal or permanent non-participating residences within 1 km of the turbine and road layout. Given that the construction footprint is widespread, Project-related construction noise potentially exceeding NSECC guidance at individual receptors would occur over a very short time frame and may not overlap with the use of these properties. 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. Therefore, most Project-related construction sound will be consistent with existing sound levels. 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.

Residences near the proposed transmission corridor may experience very short-term construction noise potentially exceeding regulatory/guidance values. A total of 65 non-participating receptors were identified within 500 m of the Assessment Area, closest at 30 m, all of which are located near the intersection of Highway 8 and River Road (where the existing Milton substation is located). Only construction activities associated with the grid connection (Milton substation) and adjacent 2 km of the transmission corridor are within 500 m of non-participating receptors. These receptors may experience sound levels exceeding regulatory guidelines; however, these construction sounds are considered temporary/short-term and are similar to sounds generated by traffic (residential, recreational, forestry, etc.) along Highway 8 and River Road.

Operational sound at receptor locations is predicted to comply with the guidelines adopted within 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.
- Limit vehicle idling.
- Conduct construction activities within the recommended daytime hours of 7:00 am to 10:00 pm.
- Include mitigation and monitoring for blasting in the Project's EPP, if geotechnical investigations determine it is required.

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 high magnitude, within the LAA, short duration, intermittent, reversible, and not significant.

Operational phase results are characterized as low magnitude, within the LAA, medium duration, intermittent, 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 Project Area	Seasonal aspects not applicable; short-term duration	Intermittent	Reversible	Not significant	Mitigation required; no monitoring required
Climate Change	Positive – A positive effect on GHG emissions is expected	Within the Study Area	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 Assessment Area	Seasonal aspects not applicable; short-term duration	Intermittent	Reversible	Not significant	Mitigation required; monitoring may be required
Waterbodies and Watercourses	Low – No loss of aquatic habitat, with minimal potential for altered hydrology	Within the Assessment Area	Seasonal aspects applicable; short-term duration	Single event	Reversible	Not significant	Mitigation and 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?
Fish and Fish Habitat	Low – small loss of fish habitat or impact to fish behaviours	Within the Assessment Area	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 Assessment Area	Seasonal aspects applicable; short-term duration	Single event	Reversible	Not significant	Mitigation and monitoring required
Terrestrial Habitat	Low – Some loss of terrestrial habitat, but overall habitat functions remain intact	Within the Assessment Area	Seasonal aspects not applicable; long-term duration	Single event	Reversible	Not significant	Mitigation required; no monitoring required
Terrestrial Flora	Low – Small loss of habitat supporting terrestrial flora SOCI, but no terrestrial flora SOCI individuals lost	Within the Assessment Area	Seasonal aspects not applicable; long-term duration (for habitat, N/A for individual SOCI)	Single event (for habitat, N/A for individual SOCI)	Reversible	Not significant	Mitigation required; no monitoring required
Terrestrial Fauna	Low – Small loss of habitat supporting fauna, but no impacts to fauna behaviours expected	Regions surrounding the AA that may fall within the habitat range of each species, bounded by pre-existing infrastructure and roads or other large crossing areas	Seasonal aspects applicable; long-term duration (for habitat, N/A for SOCI)	Continuous	Reversible	Not significant	Mitigation and 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?
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 Assessment Area	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 Assessment Area and the airspace directly surround the turbines	Seasonal aspects not applicable; medium-term duration	Intermittent	Reversible	Not significant	Mitigation and monitoring required
Economy	Positive – A positive effect on the economy is expected	Within Nova Scotia	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 measurable change in traffic levels and/or moderate disruptions to traffic flow and routing	Within the area of Queens County extending to Port Mersey	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					Not significant	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 Assessment Area	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	No mitigation or monitoring required
Electromagnetic Interference	Low – Letter of no objection received	Within consultation zones as defined by 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 location(s), but results are below guidance	Within 2 km buffer around Study Area	Seasonal aspects applicable; medium-term duration	Intermittent	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?
Visual Impacts	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)	Within observer locations	Seasonal aspects not applicable; medium-term duration	Continuous	Reversible	Not significant	Mitigation required; no monitoring required
Sound: Construction Phase	High – Sound levels from Project activities are expected to exceed 65 dBA at residential and sensitive receptor locations during multiple activities (continuously)	Within 2 km buffer around Study Area	Seasonal aspects not applicable; short-term duration	Intermittent	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 2 km buffer around Study Area	Seasonal aspects not applicable; medium-term duration	Intermittent	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., wind storms, dust storms).
- Enforce site speed limits to minimize dust generation.
- Ensure equipment meets all applicable provincial and air quality regulations and emissions standards.
- Ensure equipment is fueled using low-sulphur 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.
- 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.
- 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) undergo 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, limit the use of fossil fuels, and reduce excessive sound.
- 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 sulphide 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 sulphide potential will conform to the Sulphide Bearing Material Disposal Regulations, NS Reg. 57/95 and any requirements from relevant regulatory departments.
- Store all soils 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 onsite 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 habitats, including wetlands and watercourses.
- Ensure wetlands and watercourses are clearly marked and avoid impacts to the watercourse/wetland 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.
    - Plan any activities to align with low-flow periods.
- Revegetate along the watercourse edge and above the ordinary high-water mark to facilitate the stabilization of the area.
- 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 (including alteration, compaction, or otherwise).
    - Where unavoidable, complete wetland alterations in accordance with the NS Wetland Conservation Policy (NSECC, 2019) 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.
    - If travel through wetlands is required, use geotextile matting, time work to occur during frozen ground conditions, or travel through the drier portions of the wetland, as appropriate.
- 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, 2015b; NSECC, 2015c).
- 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.
- Ensure surface run-off containing suspended materials or other harmful substances is minimized.
- Direct run-off from construction activities away from wetlands.
- Maintain existing vegetation cover and riparian vegetation, where possible.
- Integrate water management systems including diversion and collection ditches, roadside drainage channels, and stormwater retention ponds.
- Design any necessary alterations in a way that maintains the natural grade of a 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.
- Integrate outlet protection features to dissipate flow velocities and decrease erosion at the outflow.
- If concrete is to be utilized, ensure it is pre-cast and cured for at least one week prior to use at a crossing site (NSECC, 2015b; NSECC, 2015c).
- 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, 2015b; NSECC, 2015c).
- Utilize vegetated swales for the phytoremediation of contaminated runoff.
- Utilize rock material that is clean, coarse granular, non-ore-bearing, non-watercourse-derived, and non-toxic to aquatic life (NSECC, 2015b; NSECC, 2015c).
- Use of quarried, crushed materials for road construction to reduce the introduction of invasive vascular plant species.

Terrestrial Environment

General mitigation measures for impacts to terrestrial habitat, flora, fauna, bats, and avifauna include the following:

- Minimize overall area to be cleared, road density, habitat fragmentation, and habitat isolation by utilizing pre-existing roads and previously altered areas (i.e., clearcuts).
    - Desktop and field assessments identified important habitat features to be avoided during the design phase, such as old-growth forest, wetlands, and waterbodies. Where small areas of overlap exist between protected stands under the Old-Growth Forest Policy and the Assessment Area, these stands will be avoided.
- Avoidance of topographic funnels, such as within lake or river valleys, for turbine placement to reduce the likelihood of interactions with concentrated bird movements.
- Restore cleared areas as much as possible to reduce impacts from habitat loss and promote continued growth of terrestrial flora, primarily through revegetation of road rights-of-way, and limit effects of fragmentation.
    - Revegetate cleared areas using native seed mixes, and particularly use seed mixes that do not contain clover to avoid attracting deer to the area.
    - Augment connectivity by creating semi-artificial pathways such as wildlife corridors, greenbelts, and vegetated buffers around wetlands and watercourses, where possible.
- Complete clearing during winter months when bats are overwintering in caves (end of September to late April).
- Continue to review habitat modelling results, field survey results, and guidance from NSNRR through the detail design phase.
- Minimize road salting to avoid attracting ungulates to roadsides.
- Minimize loss 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.
    - As required, buffers will be enforced around known locations of terrestrial flora SOCI within close proximity to the Assessment Area.
    - Where flora SOCI or their buffers overlap with the Assessment Area, the Project Area will utilize only the pre-existing road and the area opposite the road from the flora/buffer.
    - Consultation with the IRM team will be undertaken to uphold the regulations in the ‘At-Risk Lichens – Special Management Practices’ and other plant-specific management practices and maintain ecological integrity for flora SOCI.
- 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 SAR/SOCI is encountered.
    - Transplantation or seed collection will be suggested as a contingency plan during consultation if flora SOCI are unexpectedly encountered and cannot be avoided.
    - A separate plan for transplantation will be developed along with a monitoring protocol to determine the success of this mitigation measure if it is determined to be required.

- Ensure equipment is as clean as possible to prevent the introduction of non-native species into previously untouched areas.
    - Because exotic 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, such as by inspecting vehicles prior to moving between area.
- 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 to 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
    - American marten – June to August
    - Snapping Turtle – October to April (hibernation) and late May to early June (nesting)
    - Bats – late April to late September
    - Birds – April 1 to September 30 (nesting period)
- Minimize loss of important habitat required by priority species (i.e., for reproduction events), including:
    - Mainland moose – wetlands and isolated islands/peninsulas
    - Fisher and American marten – large snags, large woody debris, or live, hollow standing trees in intact forests
    - Snapping turtle – muddy substrate of permanent water bodies for hibernation, sunny, well-drained areas for nesting
    - Bats – Abandoned mines, large diameter (≥25 cm) snags and hollow trees (over-day roosting habitat)
- Prevent injury/mortality of bats by avoiding important habitat (i.e., hibernacula, migration routes, and migratory stopovers) along with placement of turbines away from freshwater habitats demonstrated to bat activity, which has been incorporated into the Project's design/development.
- Maintain all equipment and machinery on site so that a level of good working condition is kept to reduce noise and vibration emissions. Where practical, install vehicles and machinery with noise muffling equipment to limit disturbance.
- Prohibit harassment and feeding of wildlife by Project personnel
- 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.
- 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.
- 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.
- 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.
- Continue to work with nearby landowners to ensure there is a positive relationship within the community.

Archaeological Resources
General mitigation measures archaeological resources include:

- Conduct additional shovel testing at HPA-06 prior to ground disturbance.
- Conduct shovel testing at HPA-09 and HPA-14 prior to ground disturbance.
- Develop procedures in the EPP related to the potential unexpected discovery of archaeological items or sites 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.
- Maintain avoidance of identified areas of high potential.
- 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 notified in advance and will be provided with the acceptance letter from NSCCTH prior to completion of any disturbance in those areas.

Other Considerations
General mitigation measures for impacts to human health, shadow flicker, EMI, visual impacts, and sound include the following:

- Continue engagement and education with local recreational users 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 personal protective equipment (PPE) and associated safety protocols and procedures to mitigate risk of injury and/or fatality, especially during potential icing conditions.
- Implement a prevention and evacuation plan for Project personnel as part of the EPP, in addition to general safety protocol and training.
- Ensure signal operators are consulted on any future layout updates.
- Continue consultation with operators who have not yet responded to the notification letters.
- Develop a complaint response protocol, which will consider complaints related to shadow flicker 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 and may include the provision of screening, the development of a turbine-specific curtailment plan, or a negotiated form of compensation.
- Limit lighting on turbine hubs and blades to minimum levels while still meeting requirements of NAV Canada and Transport Canada.
- Prohibit general lighting within the Project Area. Lighting will only be used when technicians are working on-site.
- Conduct construction activities within the recommended daytime hours of 7:00 am to 10:00 pm.
- Include mitigation and monitoring for blasting in the Project's EPP, if geotechnical investigations determine it is required.

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 on the design and operation of the turbine, including applicable operating procedures, safety protocols, and evacuation plans. To further mitigate damages 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). With an estimated lifecycle of 25-30 years, this Project can be considered on the same temporal context as climate change. 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 and sea level rise may impact turbines, powerlines, and/or roadways, causing washouts and/or damage to infrastructure.

12.1.1 Temperature

The projected rising temperatures 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 deaths 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 lifetime to protect Project personnel. If it is unsafe to work due to severe conditions, a stop-work-authority may be issued.

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 runs parallel to the Mersey River which feeds into the Atlantic Ocean. The southeastern edge of the Study Area is approximately 46 masl, while the edge next to the Mersey River is approximately 30.5 masl. The majority of the Assessment Area, however, is between 76 and 107 masl. The proposed turbine locations are between 84 and 117 masl and should therefore experience minimal to no impacts from rising sea levels. The integrity of the roads leading to the Project site are of greatest concern as they have the lowest elevation, however these roads are at least 9 km from the ocean and are therefore unlikely to be impacted by rising water levels within the lifespan of the Project.

12.1.3 Flooding

Flooding may increase due to rising sea levels (Section 12.1.2) and 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, 2022c). The Project was designed to mitigate the risks of flooding by concentrating the road and turbine layout in high elevation areas, designing roadside ditches next to all roads to encourage drainage of rainwater off the roads, and by maintaining vegetated roadsides to absorb excess water.

12.2 Natural Hazards

12.2.1 Severe Weather Events

Nova Scotia is subject to severe weather events including flooding, blizzards, hurricanes, and wildfires, 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 has the potential to flood the Project Area, making the roads impassable. Project design features noted in Section 12.1.3 will also mitigate the effects of heavy rainfall.

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 10.1.2. 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 Nova Scotia government employs a Fire Weather Index (FWI) during the forest fire season to determine fire danger across the forested areas in Nova Scotia (NSNRR, 2021h). The FWI during the summer months across the Study Area ranges from low (0-5) to moderate (5-10) (NRCan, 2022). 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. Federal and provincial FWI data is updated daily, with the closest provincial weather stations to the Study Area being 'Milton' (NSNRR, 2021; NRCan, 2022b). Although most days in the wildfire season 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.

12.3 Potential Residual Effects

Environmental effects associated with climate change and natural hazards may result in a potentially significant effect on the Project. However, implementing mitigative and adaptive strategies would reduce and limit the likelihood of impacts on all phases of the Project. Therefore, the residual effects associated with climate change are considered insignificant.

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 Nova Scotia *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 for all phases of the Project.
- Ensure erosion and sediment controls are installed per the manufacturer's specifications.
- Heed Environment Canada'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), vegetation, and wildlife 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 it is available during construction.

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:

- Develop a Spill Prevention and Response Plan as part of the Project's EPP, which will set out spill prevention and response procedures.

- Ensure all fuels, lubricants, and chemicals are stored in designated containers and areas.
- Provide secondary containment in storage areas (where possible).
- Ensure the equipment used is inspected and free of fluid leaks.
- Ensure fuel storage areas, refueling, and/or equipment lubrication are located a minimum of 30 m from any surface and groundwater feature (i.e., watercourse, well).
- Ensure refueling of machinery and equipment is conducted on an impervious surface.
- Ensure any equipment servicing is completed off-site. If this is not possible, ensure the work is completed on an impervious surface.
- Ensure the storage of all dangerous goods comply with the Workplace Hazardous Material Information System (WHMIS).
- Ensure all mobile equipment has spill kits stocked with 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.
- Ensure site workers are trained in the use of on-site spill kits.

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 ASSESSMENT

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, u.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. The nearest wind development, known as the Liverpool Wind Energy Storage Project, consists of two 3.6 MW turbines located approximately 12.5 km east of the Study Area near Brooklyn, NS. These two 95 m wind turbines were developed through the provincial Community Feed-In Tariff program and began operations in 2017 (Watts Wind Energy Inc., 2012). Table 14.1 summarizes other industrial activities/developments near the Assessment Area (within approximately 5 km).

Table 14.1: Nearby Industrial Activities

Development	Development Activity	Status of Activity	Activity Location	Distance to AA*
Forestry	Harvests, thinning, plantations, & other treatments.	Active	Throughout Study Area	Within AA
Mersey River Hydro System	Operation and maintenance for a series of hydroelectric dams, power lines, and substation.	Active	Along the Mersey River	0.11 km NW

*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 regards 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	There are no new watercourse crossings associated with this Project.
Fish & Fish Habitat	No	There are no new watercourse crossings associated with this Project.
Wetlands	No	The Project is maximizing the use of existing disturbed areas to minimize impacts to wetlands. In accordance with provincial permitting requirements, all impacted wetlands will be compensated for, such that there is no residual effect.
Terrestrial Habitat	No	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.

VC	Cumulative Effects Assessed	Reasoning
Terrestrial Flora	No	Avoidance of SOCI.
Terrestrial Fauna	No	Avoidance of SOCI.
Bats	No	Nearest wind developments located over 12 km from the Study Area.
Avifauna	No	Nearest wind developments located over 12 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.
EMI	No	Residual impacts considered not significant.
Shadow Flicker	No	Shadow flicker produced by the Project is within guidelines. Nearest wind development is 12.5 km away and will not act cumulatively with the Project.
Visual Aesthetics	No	Residual impacts considered not significant.
Sound	No	Sound levels from the operation of wind turbines are below guidance thresholds. Nearest wind development is 12.5 km away and will not act cumulatively with the Project.

None of the identified VCs have been considered or assessed at a cumulative level based on: the nearest wind development being over 12 km from the Study Area and the nature of nearby industrial activities. Industrial activities identified (i.e., forestry & hydroelectric) 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. In addition, adjacent hydroelectric activities are primarily contained within the Mersey River and do not overlap with the Assessment Area, with the exception of the Project utilizing the existing NS Power Milton Substation.

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 Q. A list of the Project team and their associated roles is provided below.

Senior review and oversight

- Shawn Duncan, BSc, President
- Melanie Smith, MES, Vice President, Environmental Assessment and Approvals

Project management and technical oversight

- Scott Dickey, MREM, Manager, Environmental Sciences

Environmental Assessment Authors

- Heather Mother, MSc., Senior Environmental Scientist
- Angus Doane, MREM, Environmental Scientist
- Lyndsay Eichinger, MREM, Environmental Scientist
- Darcy Kavanagh, MSC, MREM, Environmental Scientist
- Dafna Schultz, MREM, EPt, Environmental Scientist
- Frank Gascon, EIT, Environmental Engineer

Geomatics

- Mathew Savelle, BSc., Adv Dipl, Manager, Geomatics
- Peter Opra, MSc., GIS Specialist
- Eric Johnson, BSc., Adv Dipl., GIS Technician

Community Engagement

- Courtney Morrison, MREM, Community Engagement Coordinator

Sub-consultants

- Chris Pepper, Avifauna Expert
- Sara J. Beanlands, MSc., Principal Boreas Heritage - Archaeologist

17.0 REFERENCES

Activities Designation Regulations, NS Reg 47/95

Adamus, P.R. (2021). *Wetland Ecosystem Services Protocol – Atlantic Canada (WESP-AC).* Retrieved from MCFT Training Course.

Air Quality Regulations, NS Reg. 8/2020

Allen, A.W. (1983). *Habitat Suitability Index Models: Fisher*. Retrieved from https://pubs.er.usgs.gov/publication/fwsobs82_10_45

Atlantic Canada Conservation Data Centre (ACCDC). (2022). *Species ranks*. Retrieved from http://accdc.com/en/ranks.html

Atlantic Canada Conservation Data Centre (ACCDC). (2023). *Data Report 7534: Milton, NS.* Retrieved from ACCDC.

Bastashe, M., Van Dam, J., Sondergaard, B., & Rogers, A. (2006). Wind Turbine Noise – An Overview. *Canadian Acoustics, 34*(2), 7-15.

Bill NO. 4, *Biodiversity Act*, 3rd Session, 63rd General Assembly, 2021

Bird Studies Canada. (2016). *Maritimes Breeding Bird Atlas*. Retrieved from https://www.mba-aom.ca/

Bird Studies Canada & Nature Canada. (2022). *Canada important bird areas interactive map*. Retrieved from https://www.ibacanada.com/mapviewer.jsp?lang=EN

Blakeslee, C. J., Galbraith, H. S., & Deems, R. M. (2018). The effects of rearing temperature on American glass eels. *Agricultural Sciences, 9*(8).

Botanische Staatssammlung München. (2022*). Fuscopannaria ahlneri (P. M. Jørg.) P. M. Jørg.* Retrieved from https://lichenportal.org/cnalh/taxa/index.php?taxon=54250&clid=1147

Brinkley, C & Leach, A. (2019). Energy next door: a meta-analysis of energy infrastructure impact on housing value. *Energy Research & Social Science, 50*, 51-65.

British Columbia Ministry of Environment and Climate Change (BCECC). (2018). *Inventory and Survey Methods for Rare Plants and Lichens. Standards for Components of British Columbia's Biodiversity No. 43.* Retrieved from https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/inventory_and_survey_methods_for_rare_plants_and_lichens.pdf

Broders, H., Quinn, G. M., & Forbes, G.J. (2003). Special Status, and the Spatial and Temporal Patterns of Activity of Bats in Southwest Nova Scotia, Canada. *Northeastern Naturalist, 10*(4), 383-398.

Broders, H., & Forbes, G. (2004). Interspecific and intersexual variation in roost-site selection of northern long-eared and little brown bats in the Greater Fundy National Park Ecosystem. *Journal of Wildlife Management, 68,* 602-610.

Caceres, C. & Barclay, R. (2000). Myotis septentrionalis. *Mammalian Specie, 634,* 1-3.

Canada Wildlife Act, RSC. 1985, c. W-9

Canada Wildlife Service (CWS). (2007). *Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds.* Retrieved https://publications.gc.ca/site/eng/458449/publication.html

Canadian Centre for Occupational Health & Safety (CCOHS). (2022). *Noise – Occupational Exposure Limits in Canada*. Retrieved from https://www.ccohs.ca/oshanswers/hsprograms/occ_hygiene/occ_exposure_limits.html

Canadian Council of Ministers of the Environment (CCME). (undated). *CAAQS*. Retrieved from https://ccme.ca/en/air-quality-report#slide-7

Canadian Environmental Protection Act, SC 1999, c. 33

Canadian Navigable Waters Act, RSC 1985, c. N-22

Canadian Renewable Energy Association (CanWEA). (2006a). *Community Benefits, Why Wind is Right – Right Now.* Retrieved from http://www.CanWEA.ca/images/uploads/File/12_community.pdf

Canadian Renewable Energy Association (CanWEA). (2006b). *North Cape Wind Farm*. Retrieved from http://www.canwea.ca/images/uploads/File/Case_studies/North_Cape_e.pdf

Carter, J. (2011). *The Effect of Wind Farms on Residential Property Values in Lee County, Illinois*. [Master's Thesis, Illinois State University].

CBC News. (2012). *Bowater Mersey Mill shutting down*. Retrieved from https://www.cbc.ca/news/canada/nova-scotia/bowater-mersey-mill-shutting-down-1.1153284

CBC News. (2022, November 21). *Nova Scotia designates blue felt as its provincial lichen.* Retrieved from https://www.cbc.ca/news/canada/nova-scotia/nova-scotia-blue-felt-provincial-lichen-1.6658795#:~:text=Designation%20is%20said%20to%20be%201st%20of%20its%20kind%20in%20Canada&text=Nova%20Scotia%20has%20declared%20blue,dense%20forest%20of%20the%20province

Centre for Plant Conservation (CPC). (2020). *What Makes a Plant Rare?* Retrieved from https://saveplants.org/rarity-mini-article/

Chief Medical Officer of Health (CMOH). (2010). *The Potential Health Impact of Wind Turbines*. Retrieved from https://health.gov.on.ca/en/common/ministry/publications/reports/wind_turbine/wind_turbine.pdf

Chief Medical Officer of Health (CMOH) of Ontario. (2010). *Potential Health Impacts of Wind Turbines.* Retrieved from http://www.health.gov.on.ca/en/common/ministry/publications/reports/wind_turbine/wind_turbine.pdf

Colby, D. (2008). *The Health Impact of Wind Turbines: A Review of Current White, Grey, and Published Literature*. Retrieved from https://www.wind-works.org/cms/fileadmin/user_upload/Files/Health_and_Wind_by_C-K_Health_Unit.pdf

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). (2008). *COSEWIC assessment and status report on the Snapping Turtle Chelydra serpentina.* Retrieved from https://registrelep-sararegistry.gc.ca/virtual_sara/files/cosewic/sr_snapping_turtle_0809_e.pdf

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). (2010). *COSEWIC assessment and status report on the Atlantic salmon Salmo salar.* Retrieved from https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/cosewic-assessments-status-reports/atlantic-salmon.html

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). (2011). *COSEWIC Assessment and Status Report on the Atlantic Salmon Salmo salar in Canada*. Retrieved from https://species-registry.canada.ca/index-en.html#/species/672-264#documents

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). (2012a). C*OSEWIC assessment and status report on the Striped Bass Morone saxatilis in Canada.* Retrieved from https://wildlife-species.canada.ca/species-risk-registry/virtual_sara/files/cosewic/sr_bar_raye_striped_bass_1213a_e.pdf

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). (2012b). *COSEWIC Assessment and Status Report on the American Eel Anguilla rostrata*. Retrieved from https://wildlife-species.canada.ca/species-risk-registry/virtual_sara/files/cosewic/sr_anguille_amer_eel_1012_e.pdf

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). (2013a). *COSEWIC status appraisal summary on the Frosted Glass-whiskers Sclerophora peronella in Canada*. Retrieved from https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/cosewic-assessments-status-reports/frosted-glass-whiskers-appraisal-summary-2014.html

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). (2013b). *COSEWIC assessment and status report on the Little Brown Myotis Myotis lucifugus, Northern Myotis Myotis septentrionalis and Tri-colored Bat Perimyotis subflavus in Canada*. Retrieved from https://www.registrelep-sararegistry.gc.ca/virtual_sara/files/cosewic/sr_Little%20Brown%20Myotis%26Northern%20Myotis%26Tri-colored%20Bat_2013_e.pdf

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). (2016). *COSEWIC assessment and status report on the Wrinkled Shingle Lichen Pannaria lurida in Canada.* Retrieved from https://www.sararegistry.gc.ca/virtual_sara/files/cosewic/sr_Wrinkled%20Shingle%20Lichen_2016_e.pdf

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). (2019). *COSEWIC assessment and status report on the White-rimmed Shingle Lichen* Fuscopannaria leucosticta *in Canada*. Retrieved from https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/cosewic-assessments-status-reports/white-rimmed-shingle-lichen-2019.html

Committee on the Endangered Status of Wildlife in Canada (COSEWIC). (2022). *COSEWIC status report in preparation with anticipated assessment dates.* Retrieved from https://www.cosewic.ca/index.php/en-ca/reports/status-reports-preparation.html

Canadian Renewable Energy Association (CREA). (2020). *Best Practices for Wind Farm Icing and Cold Climate Health & Safety*. Retrieved from https://renewablesassociation.ca/wp-content/uploads/2021/01/Best-Practices-for-Wind-Farm-Icing-and-Cold-Climate_June2020.pdf

DataStream Initiative. (2021). *Dissolved Oxygen A Water Monitor's Guide to Water Quality*. Retrieved from https://datastream.cdn.prismic.io/datastream/a7aeae1b-a092-43d2-877a-acfbffa75c92_Dissolved_Oxygen.pdf

Davis, D., & Browne, S. (1996). *The Natural History of Nova Scotia*. Nova Scotia Museum, Halifax, NS. p. 304.

Department of Fisheries and Oceans Canada (DFO). (2013). *Recovery Potential Assessment for Southern Upland Atlantic Salmon. Canadian Science Advisory Secretariat Maritimes Region Science Advisory Report 2013/009.* Retrieved from https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/348496.pdf

Department of Fisheries and Oceans Canada (DFO). (2014). *Recovery Potential Assessment for Eastern Cape Breton Atlantic Salmon. Canadian Science Advisory Secretariat Maritimes Region Science Advisory Report 2013/072.* Retrieved from https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/361033.pdf

Department of Fisheries and Oceans Canada (DFO). (2022). *Aquatic species at risk map*. Retrieved from https://www.dfo-mpo.gc.ca/species-especes/sara-lep/map-carte/index-eng.html

Department of Fisheries and Oceans Canada (DFO). (2023). *Marine Environmental Data Section Station Inventory Data.* Retrieved from https://www.isdm-gdsi.gc.ca/isdm-gdsi/twl-mne/inventory-inventaire/sd-ds-eng.asp?no=491&user=isdm-gdsi&region=PAC

Duiker, S. W. (2005). *Effects of Soil Compaction*. Retrieved from https://extension.psu.edu/effects-of-soil-compaction

Ellenbogen, J., Grace, S., Heiger-Bernays, W., Manwell, J., Mills, D., Sullivan, K., & Weisskopf, M.G. (2012). *Wind Turbine Health Impact Study: Report of Independent Expert Panel.* Prepared for Massachusetts Department of Environmental Protection and Massachusetts Department of Public Health.

Ellis, E. (1999). *Martes americana*. Retrieved from https://animaldiversity.org/accounts/Martes_americana/

Evans, T., Cooper, J., & Lenchine, V. (2013). *Infrasound Levels Near Windfarms and in Other Environments.* Prepared for the South Australia Environmental Protection Agency.

Electrical Academia. (undated). *Wind turbine parts and functions*. Retrieved from https://electricalacademia.com/renewable-energy/wind-turbine-parts-functions/#:~:text=A%20wind%20turbine%20consists%20of,a%20wind%20turbine%20cannot%20function.&text=The%20foundation%20is%20under%20the,it%20is%20covered%20by%20soil

Endangered Species Act, SNS 1998, c. 11

Environment Act, SNS 1994-95, c. 1

Environmental Assessment Regulations, NS Reg. 221/2018

Environmental Protection Act, RSO 1990, c. E.19

Environment Canada and Climate Change (ECCC). (2007). *COSEWIC assessment and status report on the Chimney Swift Chaetura pelagica.* Retrieved from https://novascotia.ca/natr/wildlife/biodiversity/pdf/statusreports/sr_ChimneySwift.pdf

Environment Canada and Climate Change (ECCC). (2015). *Recovery Strategy for Little Brown Myotis (Myotis lucifugus), Northern Myotis (Myotis septentrionalis), and Tri-colored Bat (Perimyotis subflavus) in Canada.* Retrieved from https://www.registrelep-sararegistry.gc.ca/virtual_sara/files/plans/rs_LittleBrownMyotisNorthernMyotisTricoloredBat_e_proposed.pdf

Environment and Climate Change Canada (ECCC). (2016a). *Management Plan for the Snapping Turtle (Chelydra serpentina) in Canada [Proposed].* Retrieved from https://www.registrelep-sararegistry.gc.ca/virtual_sara/files/plans/mp_snapping%20turtle_e_proposed.pdf

Environment Canada and Climate Change (ECCC). (2016b). *Recovery Strategy for the Olive-sided Flycatcher (Contopus cooperi) in Canada.* Retrieved from https://novascotia.ca/natr/wildlife/species-at-risk/docs/RECOVERY_PLAN_Adopted_Olive_sided_flycatcher_10Feb21.pdf

Environment Canada and Climate Change (ECCC). (2016c). *Recovery Strategy for the Common Nighthawk (Chordeiles minor) in Canada.* Retrieved from https://www.registrelep-sararegistry.gc.ca/virtual_sara/files/plans/rs_common%20nighthawk_e_final.pdf

Environment and Climate Change Canada (ECCC). (2020). *Criteria for public weather events*. Retrieved from https://www.canada.ca/en/environment-climate-change/services/types-weather-forecasts-use/public/criteria-alerts.html#rainfall

Environment and Climate Change Canada (ECCC). (2022a). *Canadian climate normals 1981-2010 station data: Liverpool Big Falls, NS.* Retrieved from https://climate.weather.gc.ca/climate_normals/results_1981_2010_e.html?stnID=6383&autofwd=1

Environment and Climate Change Canada (ECCC). (2022b). *Daily data report for 2012-2022: Western Head, NS.* Retrieved from https://climate.weather.gc.ca/climate_data/daily_data_e.html?hlyRange=1959-08-17%7C2023-01-03&dlyRange=1959-08-01%7C2023-01-03&mlyRange=1959-01-01%7C2007-07-01&StationID=6501&Prov=NS&urlExtension=_e.html&searchType=stnProx&optLimit=yearRange&StartYear=1840&EndYear=2023&selRowPerPage=25&Line=4&txtRadius=100&optProxType=decimal&selCity=&selPark=&txtCentralLatDeg=&txtCentralLatMin=0&txtCentralLatSec=0&txtCentralLongDeg=&txtCentralLongMin=0&txtCentralLongSec=0&txtLatDecDeg=44.0741&txtLongDecDeg=-64.8651&timeframe=2&Day=3&Year=2022&Month=1#

Environment and Climate Change Canada (ECCC). (2022c). *Nova Scotia – Air quality health index – Provincial summary*. Retrieved from https://weather.gc.ca/airquality/pages/provincial_summary/ns_e.html

Environment and Climate Change Canada (ECCC). (2022d). *Management Plan for the Blue Felt Lichen (Degelia plumbea) in Canada. Species at Risk Act Management Plan Series. Environment and Climate Change Canada, Ottawa. iv + 23 pp*. Retrieved from https://sararegistry.gc.ca/virtual_sara/files/plans/mp_blue_felt_lichen_e_final.pdf

Environment and Climate Change Canada (ECCC). (2022e). *Western Head, Nova Scotia*. Retrieved from https://weather.gc.ca/past_conditions/index_e.html?station=wwe

Environmental Goals and Sustainable Prosperity Act, SNS 2007, c 7

Environmental Laboratory. (1987). *Corps of Engineers Wetlands Delineation Manual, US Army Corp of Engineers, 1987.* Retrieved from https://www.lrh.usace.army.mil/Portals/38/docs/USACE%2087%20Wetland%20Delineation%20Manual.pdf

Farmer, A. M. (2003). *The effects of Dust on Vegetation - A Review. Environmental Pollution*. Retrieved from https://www.sciencedirect.com/science/article/abs/pii/026974919390179R

Farnsworth, A. (2013). *Understanding Radar and Birds*. Retrieved from https://birdcast.info/news/understanding-birds-and-radar/

Fenton, M. B. & Barclay, R. (1980). Myotis lucifugus. *Mammalian Species, 42*, 1-8.

Fern, R.R., Davis, H.T., Baumgardt, J.A., Morrision, M.L., & Campbell, T.A. (2018). Summer activity patterns of four resident south Texas bat species. Global *Ecology and Conservation, 16*.

Fisheries Act, RSC 1985, c. F-14

Flanagan, M., Roy-McDougall, V., Forbes, G., & Forbes, G. (2013). Survey Methodology for the Detection of Wood Turtles (Glyptemys insculpta*). Canadian Field Naturalist* ,*127*(3), 216-223.

Garroway, C. & Broders, H. (2008). Day roost characteristics of northern long-eared bats (Myotis septentrionalis) in relation to female reproductive status. *Ecoscience 15,* 89-93.

GeoNova. (2022). *Nova Scotia topographic database - Water features (line layer).* Retrieved from https://data.novascotia.ca/Lands-Forests-and-Wildlife/Nova-Scotia-Topographic-DataBase-Water-Features-Li/fpca-jrmt

Global Fungal Red List Initiative. (undated). *Fuscopannaria ahlneri*. Retrieved from http://iucn.ekoo.se/iucn/species_view/414875/

Government of British Columbia. (undated). *Cumulative effects framework.* Retrieved from https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/cumulative-effects-framework

Government of Canada (GOC). (2013). *Fact sheet on halocarbon regulations on federal and Aboriginal lands*. Retrieved from https://www.canada.ca/en/environment-climate-change/services/air-pollution/issues/ozone-layer/measures-protect/federal-halocarbon-regulations-information/fact-sheet-aboriginal-lands.html

Government of Canada (GOC). (2015). *Proposed Recovery Strategy for Little Brown Myotis (Myotis lucifugus), Northern Myotis (Myotis septentrionalis), and Tri-colored Bat (Perimyotis subflavus) in Canada.* Retrieved from https://www.registrelep-sararegistry.gc.ca/virtual_sara/files/plans/rs_LittleBrownMyotisNorthernMyotisTricoloredBat_e_proposed.pdf

Government of Canada (GOC). (2018). *Regional Hazards: Nova Scotia*. Retrieved from https://www.getprepared.gc.ca/cnt/hzd/rgnl/ns-en.aspx

Government of Canada (GOC). (2019a). *Causes of climate change*. Retrieved from https://www.canada.ca/en/environment-climate-change/services/climate-change/causes.html

Government of Canada (GOC). (2019b). *Canada's changing climate report*. Retrieved from https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/energy/Climate-change/pdf/CCCR_FULLREPORT-EN-FINAL.pdf

Government of Canada (GOC). (2019c). *Changes in temperature*. Retrieved from https://www.canada.ca/en/environment-climate-change/services/climate-change/canadian-centre-climate-services/basics/trends-projections/changes-temperature.html

Government of Canada (GOC). (2020). *Blue Felt Lichen (Degelia plumbea): management plan 2020 proposed.* Retrieved from https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/management-plans/blue-felt-lichen-2020.html

Government of Canada. (2022). *Species at Risk Public Registry*. Retrieved from https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html

Government of Ontario. (2021). *A guide to the Noise Regulation under the Occupational Health and Safety Act Appendix D: Noise in construction, mining, farming and firefighting operations.* Retrieved from https://www.ontario.ca/document/guide-noise-regulation-under-occupational-health-and-safety-act/appendix-d-noise-construction-mining-farming-and-firefighting-operations

Government of Oregon. (undated). *ATV sound.* Retrieved from https://www.oregon.gov/oprd/ATV/Pages/ATV-Sound.aspx

Government of the Northwest Territories. (2013). *Conductivity Environment and Natural Resources.* Retrieved from https://www.enr.gov.nt.ca/en

Government of Nova Scotia. (2022). *Species At Risk – Recovery Update.* Retrieved from https://novascotia.ca/natr/wildlife/species-at-risk/

Government of Nova Scotia (NS) Department of Municipal Affairs and Housing. (2020). *Municipal Report: Region of Queens Municipality.* Retrieved from: https://beta.novascotia.ca/sites/default/files/documents/1-2754/region-queens-municipality-municipal-profile-and-financial-condition-indicators-results-2020-en.pdf

Gulden, W. E. (2011). A Review of the Current Evidence Regarding Industrial Wind Turbines and Property Values from a Homeowner's Perspective. *Bulletin of Science, Technology & Society*, *31*(5), 363-368.

Hatch. (2008). *Nova Scotia wind integration study*. Retrieved from https://energy.novascotia.ca/sites/default/files/NS-Wind-Integration-Study-FINAL.pdf

Health Canada. (2014). *Wind Turbine Noise and Health Study: Summary of Results.* Retrieved from https://www.canada.ca/en/health-canada/services/health-risks-safety/radiation/everyday-things-emit-radiation/wind-turbine-noise/wind-turbine-noise-health-study-summary-results.html

Health Canada. (2020). *Radiofrequency electromagnetic fields (EMF).* Retrieved from https://www.canada.ca/en/health-canada/services/health-risks-safety/radiation/types-sources/radiofrequency-fields.html

Heavy-duty Vehicle and Engine Greenhouse Gas Emission Regulations, SOR/2013-24

Hegmann, G., Cocklin, C., Creasey, R., Dupuis, S., Kennedy, A., Kingsley, L., Ross, W., Spaling, H., & D. Stalker. (1999). *Cumulative effects assessment practitioners' guide.* Retrieved from https://www.canada.ca/content/dam/iaac-acei/documents/policy-guidance/cumulative-effects-assessment-practitioners-guide/cumulative_effects_assessment_practitioners_guide.pdf

Henry, M., Thomas, D., Vaudry, R., & Carrier, M. (2002). Foraging Distances and the Home Range of Pregnant and Lactating Little Brown Bats (Myotis Lucifugus). *Journal of Mammalogy, 83*(3), 767-774.

Hinman, J. L. (2010). *Wind Farm Proximity and Property Values: A Pooled Hedonic Regression Analysis of Property Values in Central Illinois*. [Thesis, Illinois State University]. Retrieved from https://puc.sd.gov/commission/dockets/electric/2017/el17-055/exhibit4.pdf

Hoen, B., Wiser, R., Cappers, P., & Thayer, M. (2009). The Impact of Wind Power Projects on Residential Property Values in the United States: A Multi-Site Hedonic Analysis. *Journal of Real Estate Research, 33*.

Horn, J., Arnett, E., & Kunz, T. (2008). Behavioral Responses of Bats to Operating Wind Turbines. *Journal of Wildlife Management, 72*(1), 123-132.

Horton, K.G., Van Doren, B.M., Albers, H.J., Farnsworth, A. & Sheldon, D. (2021). Near-term ecological forecasting for dynamic aeroconservation of migratory birds. *Conservation Biology, 35*(6), pp.1777-1786.

Howe, Gastmeier, Chapnick Ltd (HGC). (2010). *Low Frequency Noise and Infrasound Associated With Wind Turbine Generator Systems: A Literature Review*. Prepared for the Ontario Ministry of the Environment.

Impact Assessment Act, SOR/2019-285

Intergovernmental Panel on Climate Change (IPCC). (2018). Annex I: Glossary. In *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 541-562. https://doi.org/10.1017/9781009157940.008

Intergovernmental Panel on Climate Change (IPCC). (2022). *Climate Change 2022 - Impacts, Adaptation and Vulnerability.* Retrieved from https://www.ipcc.ch/report/ar6/wg2/

Iowa State University. (2022). *Station data and met data: Western Head*. Retrieved from https://mesonet.agron.iastate.edu/sites/dyn_windrose.phtml?station=CWWE&network=CA_NS_ASOS&bin0=2&bin1=5&bin2=7&bin3=10&bin4=15&bin5=20&conv=from&units=mps&nsector=36&fmt=png&dpi=100&year1=2012&month1=1&day1=1&hour1=0&minute1=0&year2=2022&month2=12&day2=31&hour2=0&minute2=0

Jansson, S., Malmqvist, E., Brydegaard, M., Akesson, S., & Rydell, J. (2020). A Scheimpflug Lidar used to observe insect swarming at a wind turbine. *Ecological Indicators*, 117, 106578.

Keith, S. E. (2018). Wind turbine low frequency and infrasound propogation and sound pressure level calculations at dwellings. *The Journal of Acoustical Society of America, 144*(981).

Kenter, P. (2017). *Nova Scotia contractor completes massive single-day wind turbine pour.* Retrieved from https://canada.constructconnect.com/dcn/news/projects/2017/02/nova-scotia-contractor-completes-massive-single-day-wind-turbine-pour-1021503w

Knight, E., Hannah, K., Brigham, M, & McCracken, J. (2019). *Canadian Nightjar Survey Protocol*. Retrieved from http://wildresearch.ca/wp-content/uploads/2019/05/National-Nightjar-Survey-Protocol-WildResearch-2019.pdf

Knopper, L.D., Ollson, C.A, McCallum, L. C., Aslund, M. L., Berger, R. G., Souweine, K., & McDaniel, M. (2014). Wind turbines and human health. *Public Health*, 19.

LeBlanc, M.P. (2007). *Recommendations for risk assessments of ice throw and blade failure in Ontario*. Retrieved from https://d3n8a8pro7vhmx.cloudfront.net/uplandprairiewind/pages/64/attachments/original/1492703881/ice_throw_document_%28002%29.pdf?1492703881

Leventhall, G. (2006). Infrasound from Wind Turbines – Fact, Fiction or Deception. *Canadian Acoustics*, *34*(2), 29-36.

Liechti, F., & Bruderer, B. (1998). The Relevance of Wind for Optimal Migration Theory. *Journal of Avian Biology, 29*(4), 561–568.

Laposa, S & Mueller, A. (2010). Wind Farm Announcements and Rural Home Prices: Maxwell Ranch and Rural Northern Colorado. *Journal of Sustainable Real Estate, 2*(1), 383-402.

Long, C.V., Flint, J.A., Lepper, & P.A. (2011). Insect attraction to wind turbines: does colour play a role? *European Journal of Wildlife Research,* 57, 323-331.

Lovich, J.E. & Ennen, J.R. (2013). Assessing the state of knowledge of utility-scale wind energy development and operation on non-volant terrestrial and marine wildlife. *Applied Energy,* 103, 52–60.

Maijala, P. P., Kurki, I., Vainio, L., Pakarinen, S., Kuuramo, C., Lukander, K., Virkkala, J., Tiippana, K., Stickler, E. A., & Sainio, M. (2021). Annoyance, perception, and physiological effects of wind turbine infrasound. *The Journal of the Acoustical Society of America, 149*, 2238.

Maine Department of Environmental Protection. (2022). *Reducing Acidification in Endangered Atlantic Salmon Habitat.* Retrieved from https://www.maine.gov/dep/water/monitoring/rivers_and_streams/salmon/Third%20year%20of%20clam%20shells%20(003).pdf

Market and Opinion Research International. (2002). *Tourist Attitudes Toward Windfarms*. Retrieved from http://www.bwea.com/pdf/MORI.pdf

Meyer, R. (2007). *Martes pennanti*. In: *Fire Effects Information System* (online). Retrieved from https://www.fs.usda.gov/database/feis/animals/mammal/pepe/all.html

McBain, K. (2020). *Despite setbacks, Kejimkujik Park saw good visitation numbers.* Retrieved from https://www.thestar.com/news/canada/2020/12/08/despite-setbacks-kejimkujik-park-saw-good-visitation-numbers.html

McCallum, L. C., Aslund, M. L., Knopper, L.D., Ferguson, G. M., & Ollson, C.A. (2014). Measuring electromagnetic fields (EMF) around wind turbines in Canada: is there a human health concern? *Environmental Health*, 13(9).

McGuire, L.P., Guglielmo, C. G., Mackenzie, S.A., & Taylor, P. D. (2011). Migratory stopover in the long-distance migrant silver-haired bat, *Lasionycteris noctivagans*. *Journal of Animal Ecology*, 81(2), 377-385.

McGrath, T., Pulsifer, M., Seymour, R., Doucette, L., Forbes, G., McIntyre, R., Milton, R., Cogan, L., Retallack, M., & Crewe, T. (2021). *Nova Scotia Silvicultural Guide for the Ecological Matrix.* Retrieved from https://novascotia.ca/ecological-forestry/docs/silvicultural-guide.pdf

McLean, K. (2018, March*). Wood Turtle Monitoring and Stewardship in the Annapolis River Watershed*. Retrieved from https://novascotia.ca/natr/wildlife/habfund/final17/NSHCF17_05_CARP_McLean.pdf

Mersey Tobeatic Research Institute (MTRI). (2022). *Invasive Species in Nova Scotia – Second Edition.* Retrieved from https://nsinvasives.ca/wp-content/uploads/2022/05/NBISC_Invasive-Species_Giude-2022.pdf

Migratory Birds Convention Act, SC 1994, c. 22

Ministry of Transportation of Ontario (MTO). (2009). *Environmental Guide for Fish and Fish Habitat, Section 5: Impact Assessment and Mitigation.* Retrieved from: https://longpointbiosphere.com/download/fish__water/MTO-Fish-Guide-June-2009-Final.pdf

Minnesota Department of Natural Resources (DNR). (2022). *Coccocarpia palmicola: Salted shell lichen*. Retrieved from https://www.dnr.state.mn.us/rsg/profile.html?action=elementDetail&selectedElement=NLTES10080

Mitsch, W. J., & Gosselink, J. G. (2001). Wetlands (third edition). *Regulated Rivers Research and Management, 17*(3), 295–295.

Moseley, M. (2007). *Records of bats (Chiroptera) at caves and mines in Nova Scotia.* Retrieved from the Nova Scotia Museum.

Nash, T.H., Ryan, B.D., Gries, C., Bungartz, F., (eds.). (2004). *Lichen Flora of the Greater Sonoran Desert Region Vol 2.* Retrieved from https://lichenportal.org/cnalh/taxa/index.php?taxon=55973

National Geographic. (2022). *Invasive Species.* Retrieved from https://education.nationalgeographic.org/resource/invasive-species

National Renewable Energy Laboratory (NREL). (2017). *2015 cost of wind energy review*. Retrieved from https://www.nrel.gov/docs/fy17osti/66861.pdf

National Wildlife Federation (NWF). (undated). *Moose.* Retrieved from https://www.nwf.org/Educational-Resources/Wildlife-Guide/Mammals/Moose

National Wind Watch Inc. (undated). *How big is a wind turbine?*. Retrieved from https://www.wind-watch.org/faq-size.php#:~:text=How%20much%20do%20wind%20turbines,total%20weight%20of%20164%20tons

Natural Resources Canada (NRCan). (2017). *About Renewable Energy*. Retrieved from https://www.nrcan.gc.ca/our-natural-resources/energy-sources-distribution/renewable-energy/about-renewable-energy/7295

Natural Resources Canada (NRCan). (2022a). *CanVec Database – Hydrographic Features*. Retrieved from https://open.canada.ca/data/en/dataset/8ba2aa2a-7bb9-4448-b4d7-f164409fe056

Natural Resources Canada (NRCan). (2022b). *CWFIS: Interactive Map.* Retrieved from https://cwfis.cfs.nrcan.gc.ca/interactive-map?zoom=8&center=2292290.966344817%2C10933.87960105588&month=7&day=9&year=2022#iMap

Neily, P., Basquil, S., Quigley, E., & Keys, K. (2017). *Ecological Land Classification for Nova Scotia.* Retrieved from https://novascotia.ca/natr/forestry/ecological/pdf/Ecological-Land-Classification-guide.pdf

Nova Scotia Environment and Climate Change (NSECC). (1990). *Guidelines for Environmental Noise Measurement and Assessment*. Retrieved from https://novascotia.ca/environmental-noise-measurement-assessment-engagement/

Nova Scotia Environment and Climate Change (NSECC). (1977). *Town of Liverpool Water Survey Summer Works Program.* Retrieved from https://novascotia.ca/nse/groundwater/docs/GroundwaterResourceReport_Queens1.pdf

Nova Scotia Environment and Climate Change (NSECC). (1993). *Procedure for conducting a pre-blast survey*. Retrieved from NSECC.

Nova Scotia Environment and Climate Change (NSECC). (2009). *Guide to Addressing Wildlife Species and Habitat in an EA Registration Document*. Retrieved from https://novascotia.ca/nse/ea/docs/EA.Guide-AddressingWildSpecies.pdf

Nova Scotia Environment and Climate Change (NSECC). (2011). *Nova Scotia 1:10,000 Primary Watersheds*. Retrieved from https://www.novascotia.ca/nse/watercourse-alteration/docs/Watercourse-Alterations-Standard.pdf

Nova Scotia Environment and Climate Change (NSECC). (2012). *Wetland Indicator Plant List*. Retrieved from https://novascotia.ca/nse/wetland/indicator.plant.list.asp

Nova Scotia Environment and Climate Change (NSECC). (2015a). *Nova Scotia Groundwater Observation Well Network*. Retrieved from https://novascotia.ca/nse/groundwater/groundwaternetwork.asp

Nova Scotia Environment and Climate Change (NSECC). (2015b). *Guide to Altering Watercourses*. Retrieved from https://novascotia.ca/nse/watercourse-alteration/docs/NSE-Watercourse-Alteration-Program-May29.pdf

Nova Scotia Environment and Climate Change (NSECC). (2015c). *Nova Scotia Watercourse Alterations Standard*. Retrieved from https://www.novascotia.ca/nse/watercourse-alteration/docs/Watercourse-Alterations-Standard.pdf

Nova Scotia Environment and Climate Change (NSECC). (2017). *A Proponent's Guide to Environmental Assessment.* Retrieved from https://novascotia.ca/nse/ea/docs/EA.Guide-Proponents.pdf

Nova Scotia Environment and Climate Change (NSECC). (2019). *Nova Scotia wetland conservation policy*. Retrieved from https://novascotia.ca/nse/wetland/docs/Nova.Scotia.Wetland.Conservation.Policy.pdf

Nova Scotia Environment and Climate Change (NSECC). (2020). *Standards for Quantification, Reporting, and Verification of Greenhouse Gas Emissions*. Retrieved from https://climatechange.novascotia.ca/sites/default/files/uploads/QRV_Standards.pdf

Nova Scotia Environment and Climate Change (NSECC). (2021). *Guide to preparing an EA registration document for wind power projects in Nova Scotia*. Retrieved from https://novascotia.ca/nse/ea/docs/EA.Guide-Proponents-WindPowerProjects.pdf

Nova Scotia Environment and Climate Change (NSECC). (2022a). *Nova Scotia environment ambient air quality data*. Retrieved from https://novascotia.ca/nse/airdata/

Nova Scotia Environment and Climate Change (NSECC). (2022b). *Ambient air quality standards: Public engagement*. Retrieved from https://novascotia.ca/ambient-air-quality-standards-public-engagement/

Nova Scotia Environment and Climate Change (NSECC). (2022c). *Nova Scotia Well Logs Database*. Retrieved from https://novascotia.ca/nse/groundwater/welldatabase.asp

Nova Scotia Environment and Climate Change (NSECC). (2022d). *Parks and protected areas interactive map*. Retrieved from https://novascotia.ca/parksandprotectedareas/plan/interactive-map/

Nova Scotia Environment and Climate Change (NSECC). (2022e). *Guidelines for environmental noise measurement and assessment*. Retrieved from https://novascotia.ca/environmental-noise-measurement-assessment-engagement/

Nova Scotia Environment and Climate Change (NSECC) & Nova Scotia Natural Resources and Renewables (NSNRR). (2009). *Online interactive groundwater map*. Retrieved from https://nsefp.ca/wp-content/uploads/2014/07/droponwaterFAQ_InteractiveGroundwaterMap.pdf

Nova Scotia Environment and Labour (NSEL). (2002). *Focus on the Tobeatic: Tobeatic Management Planning Exercise Background Information & Worksheet*. Retrieved from https://novascotia.ca/nse/protectedareas/docs/tobeaticplanning.pdf

Nova Scotia Natural Resources (NSNR). (2018). *At-Risk Lichens–Special Management Practices.* Retrieved from https://novascotia.ca/natr/wildlife/habitats/terrestrial/pdf/SMP_BFL_At-Risk-Lichens.pdf

Nova Scotia Natural Resources and Renewables (NSNRR). (undated). *Wind Energy in Nova Scotia*. Retrieved from https://energy.novascotia.ca/renewables/wind-energy

Nova Scotia Natural Resources and Renewables (NSNRR). (2002*). Mineral Resource land use atlas*. Retrieved from https://novascotia.ca/natr/meb/geoscience-online/interactive-nts-map.asp

Nova Scotia Natural Resources and Renewables (NSNRR). (2007). *Woodlot Management Home Study Module 4: Woodlots and Wildlife*. Retrieved from https://novascotia.ca/natr/Education/woodlot/modules/module4/pdf/module4.pdf

Nova Scotia Natural Resources and Renewables (NSNRR). (2009). *Potential for Radon in Indoor Air.* Retrieved from https://fletcher.novascotia.ca/DNRViewer/?viewer=Radon

Nova Scotia Natural Resources and Renewables (NSNRR). (2012a). *Wet Areas Mapping (WAM).* Retrieved from NSNRR.

Nova Scotia Natural Resources and Renewables (NSNRR). (2012b). *Potential Boreal Felt Lichen habitat layer.* Retrieved from NSNRR.

Nova Scotia Natural Resources and Renewables (NSNRR). (2012c). *Protocol for Mainland Moose Snow Tracking Survey.* Retrieved from NSNRR.

Nova Scotia Natural Resources and Renewables (NSNRR). (2014). *Wetlands of special significance database.* Retrieved from NSNRR.

Nova Scotia Natural Resources and Renewables. (NSNRR). (2017). *Provincial landscape viewer.* Retrieved from https://nsgi.novascotia.ca/plv/

Nova Scotia Natural Resources and Renewables (NSNRR). (2018). *Significant species and habitats database*. Retrieved from NSNRR.

Nova Scotia Natural Resources and Renewables (NSNRR). (2019). *Karst risk map.* Retrieved from https://fletcher.novascotia.ca/DNRViewer/?viewer=Karst

Nova Scotia Natural Resources and Renewables (NSNRR). (2020). *Recovery Plan for Tri-colored bat (Perimyotis subflavus) in Nova Scotia [Final].* Retrieved from https://novascotia.ca/natr/wildlife/species-at-risk/docs/RECOVERY_PLAN_Tri_colored_Bat_27Sept20.pdf

Nova Scotia Natural Resources and Renewables (NSNRR). (2021a). *Nova Scotia Geoscience Atlas*. Retrieved from https://novascotia.ca/natr/meb/geoscience-online/geoscience_about.asp

Nova Scotia Natural Resources and Renewables (NSNRR). (2021b). *Nova Scotia Groundwater Atlas*. Retrieved from https://fletcher.novascotia.ca/DNRViewer/?viewer=Groundwater

Nova Scotia Natural Resources and Renewables (NSNRR). (2021c). *Acid Rock Drainage*. Retrieved from https://novascotia.ca/natr/meb/hazard-assessment/acid-rock-drainage.asp

Nova Scotia Natural Resources and Renewables (NSNRR). (2021d). *Wetlands inventory*. Retrieved from NSNRR.

Nova Scotia Natural Resources and Renewables (NSNRR). (2021e). *Recovery Plan for the Moose (Alces alces Americana) in Mainland Nova Scotia*. Retrieved from https://novascotia.ca/natr/wildlife/biodiversity/pdf/recoveryplans/mainlandmooserecoveryplan.pdf

Nova Scotia Natural Resources and Renewables (NSNRR). (2021f). *Hunter and Trapper Harvest Statistics Index*. Retrieved from http://novascotia.ca/natr/hunt/furbearer-harvests.asp#bycounty

Nova Scotia Natural Resources and Renewables (NSNRR). (2021h). *Fire Weather Forecast Maps and Indices.* Retrieved from https://novascotia.ca/natr/forestprotection/wildfire/forecasts.asp

Nova Scotia Natural Resources and Renewables (NSNRR). (2022a). *Nova Scotia Pumping Test Database*. Retrieved from https://novascotia.ca/natr/meb/download/dp498.asp

Nova Scotia Natural Resources and Renewables (NSNRR). (2022b). *An Old-Growth Forest Policy for Nova Scotia.* Retrieved from https://novascotia.ca/ecological-forestry/docs/old-growth-forest-policy.pdf

Nova Scotia Natural Resources and Renewables (NSNRR). (2022c). *Pellet Group Inventory Data Collection Protocol March 2022.* Retrieved from NSNRR.

Nova Scotia Natural Resources and Renewables (NSNRR). (2022d). *Management Plan for the Eastern Wood-pewee (Contopus virens) in Nova Scotia*. Retrieved from https://novascotia.ca/natr/wildlife/species-at-risk/docs/EAPW_Management_Plan_Final_7March2022.pdf

Nova Scotia (NS) Power. (2018). *Nova Scotia Power Incorporated Hydro Asset Study*. Retrieved from https://irp.nspower.ca/files/key-documents/background-materials/20181221-NS-Power-Hydro-Asset-Study-REDACTED.pdf

Nova Scotia (NS) Power. (2022). *Clean energy*. Retrieved from https://www.nspower.ca/cleanandgreen/clean-energy#how

O'Farrell, M.J & Gannon, W.L. (1999). A Comparison of Acoustic Versus Capture Techniques for the Inventory of Bats. *Journal of Mammalogy, 80*(1), 24-30.

Occupational Health and Safety Act, SNS. 1996, c. 7

Ontario Ministry of Natural Resources (OMNR). (2000). *Conserving the forest interior: a threatened wildlife habitat*. 12 pp

Ontario Ministry of Natural Resources (OMNR). (2022). *Bats and bat habitats: guidelines for wind power projects*. Retrieved from https://www.ontario.ca/page/bats-and-bat-habitats-guidelines-wind-power-projects#section-4

Open Data Nova Scotia. (2022). *Nova Scotia Hydrographic Network*. Retrieved from https://data.novascotia.ca/Environment-and-Energy/Nova-Scotia-Hydrographic-Network/dk27-q8k2/data

Ozone-depleting Substances and Halocarbon Alternatives Regulations, SOR/2016-137

Padey, P., Blanc, I., Le Boulch, D., & Xiusheng, Z. (2012). A simplified life cycle approach for assessing greenhouse gas emissions of wind electricity. *Journal Of Industrial Ecology*, 16, S28-S38. Doi: 10.1111/j.1530-9290.2012.00466.x

Parisé, J., & Walker, T. (2017). Industrial wind turbine post-construction bird and bat monitoring: A policy framework for Canada. *Journal of Environmental Management, 201*, 252-259.

Physical Activities Regulations, SOR/2019-285

Province of Nova Scotia (NS). (2009). *Protected Water Areas of Nova Scotia*. Retrieved from https://www.novascotia.ca/nse/water/docs/protected.water.areas.map.pdf

Province of Nova Scotia (NS). (2015). *Electricity Review Report*. Retrieved from https://energy.novascotia.ca/sites/default/files/Electricity%20System%20Review_Report.pdf

Province of Nova Scotia (NS). (2018). *Nova Scotia Wet Places*. Retrieved from https://novascotia.ca/natr/wildlife/habitats/nswetlands/

Province of Nova Scotia (NS). (2021). *Geographic Data Directory: Forest Inventory*. Retrieved from https://nsgi.novascotia.ca/gdd/

Province of Nova Scotia (NS). (2022). *Geographic Data Directory: Old Growth Forest Policy*. Retrieved from https://nsgi.novascotia.ca/gdd/

Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations, SOR 2010-201

Queens Municipality. (2022). *Bylaw No. 7 A Bylaw Prohibiting Certain Noises*. Retrieved from https://www.regionofqueens.com/document-library/bylaws/municipal-bylaws/510-bylaw-no-7-prohibiting-certain-noises/file

Radio Advisory Board of Canada (RABC) & Canadian Renewable Energy Association (CanWEA). (2020). *Technical Information and Coordination Process Between Wind Turbines and Radiocommunication and Radar Systems.* Retrieved from https://www.rabc-cccr.ca/about/publications/wind-turbines-radio-radar/

Rabin, L., Coss, R., & Owings, D. (2006). The effects of wind turbines on antipredator behavior in California ground squirrels (*Spermophilus beecheyi*). *Biological Conservation*, 131(3), 410–420.

Reed, P.B. (1988). *National List of Plant Species that Occur in Wetlands: NE Region (Region 1) U.S. Fish and Wildlife Service, Washington, DC.* Retrieved from https://digitalmedia.fws.gov/digital/api/collection/document/id/1348/download

Region of Queens Municipality. (2021). *Agricultural Sector Review 2021 – Queens County*. Retrieved from https://www.regionofqueens.com/document-library/business/2368-agricultural-sector-review-2021-pdf/file

Regulations Respecting Greenhouse Gas Emissions, NS Reg 260/2009

Richardson, W.J. (1990). Timing of Bird Migration in Relation to Weather: Updated Review. *Bird Migration*, 78-101. https://doi.org/10.1007/978-3-642-74542-3_6

Rod, J. & Heiger-Bernays, W. (2012). Municipality of the County of Kings Health and Safety Impacts from Large-Scale Wind Turbines (P12-01). Final Report. May 2012.

Russek, Elias, & Thorton. (2021). *Yesterday's Gone: Exploring possible futures of Canada's labour market in a post-COVID world.* Retrieved from https://brookfieldinstitute.ca/wp-content/uploads/Yesterdays-Gone_Final.pdf

Rydell, J., Bach, L., Dubourg-Savage, M.-J., Green, M., Rodrigues, L., & Hedenstrom, A. (2010). Mortality of bats at wind turbines links to nocturnal insect migration? *European Journal of Wildlife Research,* 56, 823-827.

Schmidt, J. H. & Klokker, M. (2014). Health Effects Related to Wind Turbine Noise Exposure: A Systematic Review. *PLoS One*, *9*(12).

Segers, J., & Broders, H. (2014). Interspecific effects of forest fragmentation on bats. Canadian *Journal of Zoology, 92*(8), 665-673.

Seifert, H., Westerhellweg, A., & Kroning, J. (2003). *Risk Analysis of Ice Throw from Wind Turbines.* Retrieved from http://www.mi-group.ca/files/boreas_vi_seifert_02.pdf

Shepherd, K.P., Hubbard, H.H. 1991. Physical characteristics and perception of low frequency noise from wind turbines, *Noise Control Engineering Journal, 36*(1), pp 5-15.

Somacon. (2023). *Moon Phases*. Retrieved from https://www.somacon.com

Sonus. (2010). *Infrasound Measurements from Wind Farms and Other Sources*. Prepared for Pacific Hydro Pty Ltd.

Southern California Edison (SCE). (2016). *Final environmental impact report*. Retrieved from https://ia.cpuc.ca.gov/environment/info/ene/mesa/attachment/A1503003%20ED-SCE-01%20Q.PD-01%20Attachment%20(Revised%20Noise%20Levels%20Construction%20Equipment).pdf

Special Places Protection Act, RSNS 1989, c 438

Species at Risk Act, SC 2002, c. 29

Squared Consultants Inc. (2022). *GHGenius*. Retrieved from https://ghgenius.ca/

Statistics Canada. (2022). *Census Profile, 2021 Census of Population*. Retrieved from https://www12.statcan.gc.ca/census-recensement/2021/dp-pd/prof/index.cfm?Lang=E

Sulphide Bearing Material Disposal Regulations, NS Reg. 57/95

Survey and Mapping Infrastructure Act, 2003

Taylor, P.D., Brzustowski, J.M., Matkovich, C. et al. radR: an open-source platform for acquiring and analysing data on biological targets observed by surveillance radar. *BMC Ecol 10*, 22 (2010).

The Driller. (2005). *Hearing protection and air-rotary drilling – Part 1.* Retrieved from https://www.thedriller.com/articles/86218-hearing-protection-and-air-rotary-drilling-part-1#:~:text=The%20sound%20level%20measurements%20around,to%20107%20dB(A)

Tilman, D., Siemann, E., Wedin, D., Knops, J., Reich, P., & Ritchie, M. (1997). Influence of Functional Diversity and Composition on Ecosystem Processes. *Science, 277* (5330): 1300-02.

Tourism Nova Scotia (n.d.) *Target Geographic Regions*. Retrieved from https://tourismns.ca/target-geographic-regions

Tourism Nova Scotia (2022). *April 2022 Tourism Performance*. Retrieved from https://tourismns.ca/news/intouch-blog/april-2022-tourism-performance

Town Lake - Designation, NS Reg. 248/2007

Transport Scotland. (undated). *Appendix A17.1 Typical construction plant and noise levels*. Retrieved from https://www.transport.gov.scot/media/42094/appendix-a171-typical-construction-plant-and-noise-levels.pdf

Trombulak, S. C., & Frissell, C. A. (2000). Review of Ecological Effects of Roads on Terrestrial and Aquatic Communities. *Conservation Biology, 14*(1), 18–30.

Uadiale, S., Urban, E., Carvel, R., Lange, D., & Rein, G. (2014). Overview of Problems and Solutions in Fire Protection Engineering of Wind Turbines. *Fire Safety Science,* 11, 983-995.

Unify Energy Inc, Wattswind (2015). *Environmental Assessment: Liverpool Wind Farm.* Retrieved from https://novascotia.ca/nse/ea/liverpool-wind-farm/Liverpool_Wind_Farm_EA_Report_2015-08-31_S1-2.pdf

United States Department of Agriculture - Natural Resources Conservation Service (USDA-NRCS). (2010). *Field Indicators of Hydric Soils in the United States: A Guide for Identifying and Delineating Hydric Soils.* Retrieved from http://fwf.ag.utk.edu/mgray/wfs340/PDF/NRCSHydricSoils_FieldIndicators.pdf

United States Environmental Protection Agency (US EPA). (2013). *Streams, Types of Streams.* Retrieved from https://archive.epa.gov/water/archive/web/html/streams.html

United States Environmental Protection Agency (US EPA). (2021). *Overview of greenhouse gases*. Retrieved from https://www.epa.gov/ghgemissions/overview-greenhouse-gases#f-gases

United States Environmental Protection Agency (US EPA). (2022a). *Health and environmental Effects of particulate matter (PM).* Retrieved from https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm

United States Environmental Protection Agency (US EPA). (2022b). *pH*. Retrieved from https://www.epa.gov/caddis-vol2/ph

United States Environmental Protection Agency (US EPA). (2022c). *Climate Adaptation and Storms & Flooding*. Retrieved from https://www.epa.gov/arc-x/climate-adaptation-and-storms-flooding

United States (US) Fish and Wildlife Service. (2021). *Atlantic Salmon*. Retrieved from https://www.fws.gov/species/atlantic-salmon-salmo-salar

United States Energy Information Administration (US EIA). (2022). *How much carbon dioxide is produced per kilowatthour of U.S. electricity generation?*. Retrieved from https://www.eia.gov/tools/faqs/faq.php?id=74&t=11

United States Department of Agriculture- Natural Resources Conservation Service (USDA-NRCS). (2010). *Field Indicators of Hydric Soils in the United States: A Guide for Identifying and Delineating Hydric Soils*. Retrieved from https://nrcspad.sc.egov.usda.gov/DistributionCenter/pdf.aspx?productID=663

United States Department of Energy (USDE). (2008). *20% Wind Energy by 2030: Increasing Wind Energy's Contribution to U.S. Electricity Supply*. Retrieved from: http://www.nrel.gov/docs/fy08osti/41869.pdf

University of Bath. (2011). Inventory of Carbon & Energy *(ICE) v.2.0*. Retrieved from https://perigordvacance.typepad.com/files/inventoryofcarbonandenergy.pdf

Vestas. (2023). *Vestas North America*. Retrieved from https://www.vestas.ca/en-ca

Voigt, C. (2021). Insect fatalities at wind turbines as biodiversity sinks. *Conservation Science and Practice,* 3, e366.

Volkoff, H., & Rønnestad, I. (2020). Effects of temperature on feeding and digestive processes in fish. *Temperature, 7*(4), 307–320. https://doi.org/10.1080/23328940.2020.1765950

Watts Wind Energy Inc. (2012). *The Liverpool Wind Energy Storage Project*. Retrieved from https://wattswind.com/portfolio/liverpool/

Wellig, S., Nusslé, S., Miltner, D., Kohle, O., Glaizot, O., Braunisch, V., Obrist, M.K., & Arlettaz, R. (2018). Mitigating the negative impacts of tall wind turbines on bats: Vertical activity profiles and relationships to wind speed. *PloS One,* 13(3), 1-16.

Whitlock, R. (2015, November 21). Windmill Aflame: Why Wind Turbine Fires Happen, How Often and What Can be Done About It. *Interesting Engineering.* Retrieved from https://interestingengineering.com/science/windmill-aflame-why-wind-turbine-fires-happen-how-often-and-what-can-be-done-about-it

Wildlife Act, RSNS. 1989, c. 504

Wills, M. (2021). *Road Density Threatens Turtle Populations.* Retrieved from https://daily.jstor.org/road-density-threatens-turtle-populations/

Wind Europe. (2017). *Mainstreaming energy and climate policies into nature conservation*. Retrieved from https://windeurope.org/wp-content/uploads/files/policy/topics/sustainability/WindEurope-Paper-on-the-role-of-wind-energy-in-wildlife-conservation.pdf

Wind Turbine Facilities Municipal Taxation Act, SNS 2006, c 22

Workplace Health and Safety Regulations, NS Reg. 52/2013, Part 2, s. 2.1-2.3

WorkSafe BC. (undated). *How loud is it? – Construction.* Retrieved from https://www.worksafebc.com/resources/health-safety/hazard-alerts/how-loud-is-it-construction?lang=en

WorkSafe BC. (2016). *How loud is it? – Forestry.* Retrieved from https://www2.bcforestsafe.org/files/Safety_Alert_WSBC-How_Loud_Is_It-Forestry.pdf

Zedler, J. B., & Kercher, S. (2004). Causes and Consequences of Invasive Plants in Wetlands: Opportunities, Opportunists, and Outcomes. *Critical Reviews in Plant Sciences, 23*(5), 431–452.

Zimmerling, R.J., Pomeroy, A.C., d'Entremont, M.V., & Francis, C.M. (2013). Canadian Estimate of Bird Mortality Due to Collisions and Direct Habitat Loss Associated with Wind Turbine Developments. *Avian Conservation and Ecology, 8*(2).

Zinck, M. (1998). *Rolands Flora of Nova Scotia*. Nimbus Publishing, Nova Scotia.

APPENDIX A
ENVIRONMENTAL PROTECTION PLAN – TABLE OF CONTENTS

TABLE OF CONTENTS

Page

LIST OF TABLES

To be Determined

LIST OF FIGURES

To be Determined

LIST OF APPENDICES

To be Determined