ELLERSHOUSE 3 WIND PROJECT

Environmental Assessment Registration Document

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EXECUTIVE SUMMARY

Ellershouse 3 Wind Limited Partnership proposes to construct and operate the Ellershouse 3 Wind Project, a 66 megawatt (MW) wind development located near the community of Ellershouse in Hants County, Nova Scotia. The Project will consist of up to 12 (5.9 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. The Environmental Assessment Registration document has been completed according to methodologies and requirements outlined in A Proponent's Guide to Environmental Assessment and has incorporated guidance from the Guide to Preparing an EA Registration Document for Wind Power Projects in Nova Scotia.

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

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

The results of the assessment indicated that the Project, with the implementation of mitigation and monitoring measures, will not result in significant adverse residual effects. The Project will also have a positive residual effect associated with the reduction of greenhouse gas emissions (i.e., production of renewable energy) and economic prosperity within Nova Scotia. Potential impacts on bats, birds, visual aesthetics, shadow flicker, and sound were evaluated cumulatively with the nearby existing turbines associated with the Ellershouse Wind Farm. Cumulative effects were determined not significant.

Ellershouse 3 Wind Limited Partnership has, and will continue, to engage and collaborate with local communities, the Mi'kmaq of Nova Scotia, and government representatives to ensure that any potential concerns identified in association with the Project are addressed and mitigated.

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ACCDC	Atlantic Canada Conservation Data Centre
AM	Amplitude modulation
AQHI	Air Quality Health Index
AREA	Alternative Energy Resource Authority
ARIA	Archaeological Resource Impact Assessment
ARS	Avian Radar System
ATV	All-terrain Vehicle
ARD	Acid Rock Drainage
AVFN	Annapolis Valley First Nation
BMPs	Best Management Practices
BTs	Biological Targets
CAAQS	Canadian Ambient Air Quality Standards
CanWEA	Canadian Renewable Energy Association
CCG	Canadian Coast Guard
CCME	Canadian Council of Ministers of the Environment
CCOHS	Canadian Centre for Occupational Health and Safety
CEPA	Canadian Environmental Protection Act

CH_4	Methane
CLC	Community Liaison Committee
CMM	Confederation of Mainland Mi'kmaq
CO	Carbon Monoxide
CO2	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
DO	Dissolved Oxygen
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
KMKNO	Kwilmu'kw Maw-klusuaqn Negotiation Office
IBA	Important Bird Areas
IBoF	Inner Bay of Fundy (Atlantic salmon population)
IPCC	United Nations Intergovernmental Panel on Climate Change
ISED	Innovation, Science and Economic Development Canada
kWh/year	kiloWatts per hour per year
kV	kiloVolt
LAA	Local Assessment Area
LABO	Eastern red bat
LACI	Hoary bat
LANO	Silver-haired bat
LOI	Letter of Intent
Lpm	Litres per minute
m^3	Cubic metres
m/s	Metres per second
MARI	Maritime Archaeological Resource Inventory
masl	Metres above sea level
MBCA	Migratory Bird Convention Act

MBBA	Maritimes Breeding Bird Atlas
MCG	Mi’kmaq Conservation Group
MEKS	Mi’kmaq Ecological Knowledge Study
mg/L	Milligrams per litre
MBII	Migratory Bird Interaction Index
MOU	Memorandum of Understanding
mS/cm	MilliSiemens per centimetre
MW	Megawatt
MYOT	Myotis Species
NCNS	Native Council of Nova Scotia
NFCs	Night Flight Calls
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
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)
O_3	Ozone
OBL	Obligate
OLA	Nova Scotia Office of L’nu Affairs
PESU	Tri-colored Bat
PID	Property Identification
PM	Particulate Matter
PPE	Personal Protective Equipment
PRI	Potentia Renewables Inc.
RAA	Regional Assessment Area
RABC	Radio Advisory Board of Canada
RBP	Rate-based Procurement
RCMP	Royal Canadian Mounted Police
RFP	Request for Proposal
SAR	Species at Risk
SARA	Species at Risk Act
SCADA	Supervisory Control and Data Acquisition
SGEM	Silvicultural Guide for the Ecological Matrix

SO_2	Sulfur Dioxide
SO_x	Sulfur Oxides
SOCI	Species of Conservation Interest
tCO2e	Tonnes of Carbon Dioxide Equivalent
tCO2e/kg	Tonnes of Carbon Dioxide Equivalent per kilogram
tCO2e/km	Tonnes of Carbon Dioxide Equivalent per kilometre
tCO2e/tonne·km	Tonnes of Carbon Dioxide Equivalent per tonne-kilometre
tCO2e/y	Tonnes of Carbon Dioxide Equivalent per year
TRS	Total Reduced Sulfur
TSP	Total Suspended Particulate
µm	Microns or micrometres
$\mu g/m^3$	micrograms per cubic metre
UNKW	Unknown
UPL	Upland
UTM	Universal Transverse Mercator
VC	Valued Component
VHF	Very high frequency
WAM	Wet Areas Mapping
WESP-AC	Wetland Ecosystem Services Protocol – Atlantic Canada
WSP	WSP Canada Inc.
WSS	Wetlands of Special Significance

LIST OF DRAWINGS

LIST OF APPENDICES

1.0 PROPONENT DESCRIPTION

Ellershouse 3 Wind Limited Partnership (Ellershouse 3 Wind LP or Proponent), is proposing to plan, develop, finance, construct, own, and operate the Ellershouse 3 Wind Project (the Project). The Project is owned by Ellershouse 3 Wind LP. Ellershouse 3 Wind LP is owned by the Ellershouse 3 Wind GP Inc. (general partner), the Annapolis Valley First Nation (AVFN, majority owner), and Potentia Renewables Canada Holdings, a subsidiary of Potentia Renewables Inc. (PRI). AVFN are members of the Confederacy of Mainland Mi'kmaq and hold land reserves in Cambridge, NS, where many members reside, and land adjacent to the Project. PRI is a Canadian developer, owner, and operator of renewable energy assets owned by Power Sustainable, a subsidiary of Power Corporation Canada.

The Project is being developed with the support of the Alternative Energy Resource Authority (AREA), a 100% municipally-owned company comprised of three Nova Scotian municipalities – Mahone Bay, Antigonish, and Berwick. Collectively, the towns own AREA, which owns and operates the Ellershouse I and II Wind Farms (existing Ellershouse Wind Farm) [23.5 megawatt (MW)] adjacent to the Project.

Ellershouse 3 Wind LP retained Strum Consulting to support the development and submission of the Environmental Assessment (EA). Strum Consulting is an independent multi-disciplinary team of consultants with extensive experience in undertaking EAs throughout Atlantic Canada.
Contact information for Ellershouse 3 Wind LP and their consultant is included in Table 1.1.

Table 1.1: Proponent and Consultant Contact Information

Proponent Information	
Project Name	Ellershouse 3 Wind Project
Proponent Name	Ellershouse 3 Wind Limited Partnership
Chief Executive Officer(s) / Principal(s)	Ben Greenhouse, CEO, Potentia Renewables Inc. and Ellershouse 3 GP Inc.
Mailing and Street Address	Suite 1102, 200 Wellington Street West Toronto, Ontario M5V 3C7
Proponent Contact Information for the EA Registration	Ryan Hearn, Manager, Environment and Community Consultation E3GP c/o Potentia Renewables Inc. Phone: 416-703-1911 ext. 249 Email: rhearn@potentiarenewables.com Project Website: ellershouseiiiwind.com
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

Ellershouse 3 Wind LP proposes to develop, construct, and operate the 66 MW Project located on private land in the Municipality of West Hants, near the communities of Ellershouse and Hartville, Nova Scotia (Drawing 2.1). The approximate center of the Project is located at 44.895753° N, 64.054422° W.

The Project will include up to 12 turbines generating up to 5.9 MW each (Drawing 2.2), access roads, interconnecting transmission system, substation, connection to the Nova Scotia Power Inc. (NS Power) grid, and the associated infrastructure for the aforementioned facilities.

The Project location was carefully selected due to excellent land and community partners, and distance to existing electrical and civil infrastructure. The Project will interconnect to NS Power's transmission system through a direct line tap to the 138kV L-6051 transmission line, located approximately 350 m from the proposed substation. The existing Ellershouse Wind Farm, which consists of 10 operating wind turbines that are owned and operated by AREA, is located immediately north of the proposed Project.

The Study Area[1] consists entirely of private lands, which are currently utilized for forestry and silviculture. Ellershouse 3 Wind LP has secured the land required for the Project through lease and easement agreements on private properties owned and developed for forestry purposes.

Upon approval of the EA, construction activities are proposed to begin in 2024 and, once constructed, the Project is expected to be operational in 2025 for a minimum of 25 years.

2.2 Purpose and Need for the Undertaking

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. The Project has been proposed in support of this renewable energy target. 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 challenges associated with fossil fuel consumption around the world.

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,

[1] Study area is defined in Section 3.1.

the increase in ground, water, and atmospheric temperatures has resulted in direct mortality and redistribution of 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.
- 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 target of 80% renewable by 2030 as outlined in the *Environmental Goals and Climate Change Reduction Act* (2021; Government of Nova Scotia, 2022a) by producing enough energy to power approximately 20,650 Nova Scotian homes.

Ellershouse 3 Wind LP 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 ongoing energy literacy/education. As the Project is adjacent to the existing Ellershouse Wind Farm, there is an active Community Liaison Committee (CLC) in place, which helps 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	Royal Canadian Mounted Police (RCMP)	RCMP response received May 10, 2022 confirming no objection to the Project. Updates may be required pending final turbine selection.
Aeronautical obstruction clearance Lighting design for navigational purposes	Transport Canada	Transport Canada aeronautical assessment, including lighting plan approval received June 9, 2022. Updates may be required pending final turbine selection.
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, Ellershouse 3 Wind LP will submit a Request for Project Review to DFO.
Species at Risk Act (*SARA*)	Environment and Climate Change Canada (ECCC), DFO	A *SARA* permit was acquired for fish and fish habitat assessments throughout the Study Area, as Inner Bay of Fundy (IBoF) Atlantic Salmon (*Salmo salar*) are present.
Migratory Bird Convention Act (*MBCA*)	ECCC	Compliance legislation – there is no expectation that a *MBCA* permit will be required.

2.3.2 Provincial

The Project is subject to a Class I EA as defined by the Environmental Assessment Regulations, NS Reg. 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).

Other potential 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*)	NS Natural Resources and Renewables (NSNRR)	Compliance legislation – there is no expectation that an *ESA* permit will be required.
Notification of blasting (if required)	NSECC	Future approval.

Requirement	Regulatory Body	Status/Comments
Overweight/Special move permit Access permit Work within highway right-of-way Use of right-of-way for pole lines	Nova Scotia Public Works (NSPW)	Future approval.
Elevator lift license	NS Labour Skills and Immigration	Future approval.
Archaeology Field Research Permit	NS Communities, Culture, Tourism and Heritage (NSCCTH)	Permit obtained to complete the archeology assessment.
Nova Scotia Temporary Workplace Traffic Control Manual	NSPW	Compliance for the use of provincial roads during the construction, operation, and decommissioning phases of the Project.

2.3.3 Municipal

A Municipal Planning Strategy and Land use By-law exists in the Municipality of the District of West Hants and requires approval for wind power projects. Approval for 'Large Wind Turbines' (>100 kW production capacity) is only considered by development agreement (Municipality of the District of West Hants 2008a and b).

2.4 Funding

The Project will be financed through a combination of equity, debt and federal funding made available through the Nova Scotia rate-based procurement (RBP) request for proposals (RFP). For the avoidance of doubt, this refers to both the Canada Infrastructure Bank Royalty and Contribution Agreement and Natural Resources Canada's (NRCan) Smart Renewables Electrification Pathways Program.

2.5 Structure of the EA 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 – Summary
Section 12	Effects of the Environment on the Undertaking
Section 13	Accidents and Malfunctions

Section	Content
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 the St. Croix River watershed, near the community of Ellershouse in Hants County, Nova Scotia (Drawing 2.1). The approximate centre of the Project is 44.895753° N, 64.054422° 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). The Study Area was used for desktop assessments to inform field surveys and enable preliminary Project design. An Assessment Area was subsequently established for detailed field investigations, which includes the physical footprint of the Project where the direct physical disturbance is expected to occur (i.e., the Project Area), plus a buffer to allow design flexibility and assess for indirect effects beyond the direct effects within the Project Area. For this Project, the buffer included a 100 m x 100 m area around each turbine, a 25 m buffer on either side of the centreline for the road layout, a 5 m buffer on either side of the centreline for the collector lines, and a 50 m buffer on either side of the main interconnection route. The areas of the Study Area, Assessment Area, and Project Area are provided in Table 3.2.

Table 3.1: Land Parcels within the Study Area

PID	Landowner	Land Use
45407285	Atlantic Star Forestry LTD	Commercial Forest
45407277	Atlantic Star Forestry LTD	Commercial Forest
45407269	Atlantic Star Forestry LTD	Commercial Forest
45407244	Atlantic Star Forestry LTD	Commercial Forest
45407251	Atlantic Star Forestry LTD	Commercial Forest
45407228	Atlantic Star Forestry LTD	Commercial Forest
45407210	Atlantic Star Forestry LTD	Commercial Forest
45407236	Atlantic Star Forestry LTD	Commercial Forest
45407202	Atlantic Star Forestry LTD	Commercial Forest
45407194	Atlantic Star Forestry LTD	Commercial Forest
45407137	Atlantic Star Forestry LTD	Commercial Forest
45407152	Atlantic Star Forestry LTD	Commercial Forest
45407160	Atlantic Star Forestry LTD	Commercial Forest
45407178	Atlantic Star Forestry LTD	Commercial Forest
45407186	Atlantic Star Forestry LTD	Commercial Forest
45407145	Atlantic Star Forestry LTD	Commercial Forest
45007903	Atlantic Star Forestry LTD	Commercial Forest
45407129	Atlantic Star Forestry LTD	Commercial Forest
45407095	Atlantic Star Forestry LTD	Commercial Forest
45407111	Atlantic Star Forestry LTD	Commercial Forest

Table 3.2: Areas of Study

Area of Study	Area (ha)
Study Area	7,950
Assessment Area	235
Project Area*	69

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

3.1.1 Siting Considerations

As part of the Project planning process, a detailed constraints analysis was conducted to minimize the potential effects to the environment, nearby residents, and sociocultural resources. This analysis was continually updated and refined based on the results of Project-specific desktop studies, modelling, and field assessments, as well as engagement with stakeholders and the Mi'kmaq of Nova Scotia. As a result, several layout iterations were reviewed to reflect a growing knowledge of the Study Area and surrounding community and environmental considerations before developing the current layout. A drawing illustrating the Project development constraints is provided in (Drawing 3.1).

Project and Project component siting included the following considerations:

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

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

Table 3.3: Summary of Minimum Setbacks and Separation Distances

Setback Category	Distance	Relevant Regulators / Stakeholders
Watercourses	30 m from turbines (from tip of blade – where possible or otherwise where authorized by NSECC)	NSECC
Wetlands	30 m from turbines (from tip of blade – where possible or otherwise where authorized by NSECC)	NSECC, NSNRR
Wetlands of Special Significance	At least 30 m, to be determined in consultation with NSECC	NSECC, NSNRR
Protected Areas and Public Resources	To be determined in consultation with NSECC and NSNRR, as appropriate.	NSECC / NSNRR
Rare Plants and Lichens	Species-specific (Section 7.4.2)	NSNRR
Adjacent Land Use	206.5 m (height + blade length)	West Hants Municipality
Public Roads	309.75 m *(1.5 x Turbine Height)*	Health Canada

Setback Category	Distance	Relevant Regulators / Stakeholders
Powerlines	309.75 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
Sound / Noise	As necessary to meet sound / noise constraints based off sound modelling	NSECC

The Project Area also offers considerable development opportunities that were incorporated into the Project design to minimize potential effects to surrounding land uses, local residents, and environmental features. Project development opportunities include the following:

- 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 Study Area).
- Expanding upon an existing wind project site, which incorporates existing roads into the Project design, minimizing overall new road disturbance impacts and clearing requirements.
- Engagement with the existing CLC for the Ellershouse Wind Farm, which provides a forum for ongoing dialogue.
- Working with a community familiar with and in support of wind project developments.

3.2 Physical Components

3.2.1 Turbine Specifications

The Project will be powered by up to 12 wind turbines, rated at up to 5.9 MW. The nominal capacity of the Project is capped at 66 MW. Specifications are provided in Table 3.4.

Table 3.4: Turbine Technical Specifications

Turbine Component	Specifications
Rated Capacity	Up to 5.9 MW
Rotor Diameter	163 m
Hub Height	Up to 125 m
Cut-in Wind Speed	3 metres per second (m/s)
Cut-out Wind Speed	up to 26 (m/s)
Swept Area	20,867 square metres (m^2)
Rotor Speed (variable)	Variable
Generator	Double fed asynchronous
Brake System	Aerodynamic brake plus disc brake
Remote Monitoring	Supervisory Control and Data Acquisition (SCADA)
Lighting Requirements	Per Transport Canada Requirements
Materials	Tubular steel tower with glass/carbon fibre composite rotors
Colour	Based on manufacturer specifications and regulatory requirements

3.2.2 Road Layout

A comprehensive road network currently exists in the Study Area and is associated with ongoing forestry activities. These roads will be upgraded, as required, to safely transport the turbines, provide appropriate turning radius, and support construction activities in compliance with local and provincial guidelines/requirements. In some cases, the construction of new roads will be required to access proposed turbine locations; however, Ellershouse 3 Wind LP is planning to leverage the network of existing roads to the greatest extent possible.

3.2.3 Substation and Power Collection Systems

The Project requires a new substation that will be installed within a fenced yard and will include a step-up transformer, circuit breakers, relays, SCADA system, revenue meter, telecommunication equipment, control building, and support structures. The system connection at the substation will consist of a single span line tap to NS Power 138 kV transmission line L-6501, anticipated to be approximately 350 m from the substation's 138 kV dead-end structure. The line tap dead-end structure will be installed approximately 2 kms from 17V-St Croix Substation and 25 kms from 120H-Brushy Hill substations.

The Project's electrical collection system will bring power from the wind turbines to the substation. The collection system will be comprised of a series of 34.5 kV aboveground and underground collector lines. Aboveground components will include a standard pole structure with the associated guy wire, foundation, and groundings. Underground collector lines will be installed in trenches that will generally be co-located with the access roads.

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. Transportation of turbine components is addressed in Section 8.3.

3.3.1 Site Preparation and Construction

Site preparation activities include:

- Land surveys for placement of roads, turbines, and associated works.
- Geotechnical investigations.
- Placement of erosion and sedimentation control measures.
- Clearing of trees, grubbing, and grading for construction.

General construction activities include:

- Access road infrastructure upgrading and construction.
- Laydown area and turbine pad construction.
- Transportation of turbine components, equipment, and materials.
- Foundation excavation and construction, including blasting, if required.
- Materials preparation and storage (e.g., crusher and storage areas).
- Turbine and infrastructure assembly.
- Site waste and dust management.
- Construction of collection system and substation.
- Grid connection.
- Removal of temporary works and site restoration.
- Commissioning.

Access Road Construction

Approximately 16 km of the existing road network will be used as part of the Project, with approximately 4 km of new road construction required. Roads are expected to be constructed to a standard carriageway width of 6 m plus ditches sloped at a ratio of 2:1 to accommodate proper drainage and culverts where required. There will be areas where the roadway width could increase to approximately 11 m plus the width for ditches to accommodate cut and fill areas, wide turning radiuses, or areas where the assembly crane will transit between turbines during construction.

During the construction phase, Project roads will be maintained with additional gravel or periodic grading. Aggregate material for road construction will be transported from on site or off-site quarries and stored temporarily until used. Any material removed for road construction will be stored or disposed of in accordance with regulations for road construction. Any material stored on the 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
- Feller buncher
- 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:

- Delineation of work areas and installation of erosion and sedimentation control measures.
- Removal of vegetation and site grading.

- Removal of overburden and soils.
- Blasting/chipping of bedrock (to be determined, based on geotechnical conditions and foundation design).
- Pouring and curing of concrete foundations (complete with reinforcing steel).
- Placement of competent soils to bring area to grade.
- Compaction of fill or soils.
- Trenching and installation of above ground and below ground electrical collector systems and the grounding system, and fibre optic communication systems.

Depending on the turbine foundation requirements, foundations could be approximately 18 m in diameter and extend to a depth of 3 to 5 m below grade. Each turbine pad and laydown area is expected to be approximately 100 m by 100 m. Each turbine foundation, turbine pad, and crane pad will be designed to suit the specific requirements of the turbine and the geology and surrounding topography during the detailed design process.

The construction of a typical turbine pad (from clearing to final preparation for erecting of the turbine) can take between 1 to 4 months, depending on weather, soil, and construction vehicle access. The following equipment may be used for the laydown area and turbine pad construction:

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

Turbine Assembly

The wind turbine assembly includes tower sections, the nacelle, the hub, and three-blade rotors. All sections will be delivered by specialized transportation equipment and the pieces will require a crane for removal from the vehicle at each of the prepared turbine pads or staging areas as required.

The tower sections will be erected in sequence on the turbine foundation, followed by the nacelle, hub, and rotor blades. Turbine assembly will require the use of cranes and tag lines. Erection will depend on weather, specifically wind and daylight conditions. Typical assembly duration per turbine is expected to be between 2 to 5 days. The following equipment is expected to be used for turbine assembly:

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

Collection System and Substation Construction
The Project will connect to a substation constructed strategically to be near the closest available grid connection. The construction of a substation can take between 4 to 6 months, depending on weather, soil, and construction vehicle access. The electrical collector system construction can take between 2 to 4 months to complete. Substation and collector system construction will be scheduled following detailed design, engineering, and procurement.

The following equipment is expected to be used during the collector system and substation construction process:

- Excavator
- Backhoe
- Bucket trucks
- Light cranes
- Light trucks
- Hydrovac
- Overhead Tension Stringing Equipment
- Directional Driller
- Telehandler
- Rollers

Removal of Temporary Works and Site Restoration
Once construction has been completed at each of the components listed in Section 3.2, temporary works will be removed, and the site will be appropriately graded. The following equipment is expected to be used in this process:

- Excavator and/or backhoe
- Grader
- Dump trucks
- 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 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 Operations and Maintenance

Maintenance activities will conform to manufacturer's equipment specifications and standard operating procedures.

The life span of the Project is estimated to be a minimum of 25 years. During this time, roads will be used to access the turbines by staff and maintenance personnel. The roads will be maintained with additional gravel and grading, as required. During the winter months, all roads will be plowed, sanded, and/or salted, as required for driving safety and to ensure access to all site locations 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 wind farm, signage will be affixed and maintained on 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. These signs will be maintained during 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

As noted above, the operational life of the Project is estimated to be a minimum of 25 years. NSECC will be provided with decommissioning plans for review prior to Project decommissioning.

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

- Dismantling and removal of the turbines.
- Decommissioning the turbine foundations as per the conditions of the land lease agreement.
- Removal, recycling (where possible), and disposal of collection system, conductor, and poles.
- Removal of other equipment, as required, and reinstatement and stabilization of land, where necessary.

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, operation, and decommissioning 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 proposed Table of Contents for the EPP is provided in Appendix A. The EPP will be provided to NSECC prior to the start of construction for review.

3.4 Project Schedule

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

Table 3.5: Project Schedule

Project Activity	Timeline
EA Registration	Q2 2023
Post-EA Environmental Monitoring Programs	2023 onward (as required)
Geotechnical Assessment	Q3 2023
Engineering Design	Q3 2023
Municipal Decision on Development Agreement	Q4 2023
Clearing	Q1 2024 - Q2 2024
Construction	Q4 2024 - Q3 2025
Commissioning	Q4 2025
Operation	Q4 2025
Decommissioning	2050 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 on the EA scope and planning:

- Canadian Wildlife Service (CWS)
- NSCCTH
- NSECC
- NSNRR

- Nova Scotia Office of L'nu Affairs (OLA)
- Fisheries and Oceans Canada

4.1 Site Sensitivity

Potential wind farms are assigned a project risk 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 being considered for the proposed Project is greater than 150 m, the Project is automatically considered to have a category 4 risk rating.

4.2 Assessment Scope and Approach

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

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

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

4.3 Identification of Valued Components

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

- 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
    - other undertakings in the area

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). The intent of the Study Area was to first survey a broad area at a high-level to allow flexibility in the design to move infrastructure and minimize effects to VCs. An Assessment Area was subsequently established for detailed field investigations, which includes the physical footprint of the Project where the direct physical disturbance is expected to occur (i.e., the Project Area), plus a buffer to allow design flexibility and assess for indirect effects beyond the direct effects within the Project Area. For this Project, the buffer included a 100 m x 100 m area around each turbine, a 25 m buffer on either side of the centreline for the road layout, a 5 m buffer on either side of the centreline for the collector lines, and a 50 m buffer on either side of the main interconnection route.

Where appropriate, the Study Area and Assessment Area are identified as the LAA and RAA for specific VCs in the individual VC chapters.

4.4.2 Temporal Boundaries

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

Table 4.1: Temporal Boundaries

Project Phase	Temporal Boundary
Site Preparation and Construction	18-24 months
Operation and Maintenance	25 years or more
Decommissioning	25+ years

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 the Project design to eliminate or reduce potential adverse effects.

4.6 Residual 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 a residual effect occurs	**Project Area –** residual effects are restricted to the Project footprint **Local assessment area –** residual effects extend into the local assessment area **Regional assessment area –** residual effects interact with those of projects in the regional assessment area
Timing and Seasonality 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 MI’KMAQ OF NOVA SCOTIA

5.1 Overview

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 are discussed in the following sections.

5.2 MEKS

A MEKS presents a thorough and accurate understanding of the Mi’kmaq use of the land and resources within an area. It is a report of gathered, identified, and documented ecological knowledge which is held by individual Mi’kmaq people. In addition, the MEKS 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 developed by Membertou Geomatics Solutions and was geographically scoped to include an evaluation of the Project Area along with a 5 km buffer surrounding the Project Area (referred to as the “Study Area” in the MEKS report). 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 within the “Study Area”; and what Mi’kmaq ecological knowledge presently exists with respect to the area. This process is done in accordance with the *Mi’kmaq Ecological Knowledge Protocol, 2nd Edition* (Assembly of First Nova Scotia Mi'kmaq Chiefs, 2014), which 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 summary of the MEKS findings is provided below. Detailed results and mapping are supplied in Appendix B.

Traditional Use in the Project Area

- Deer, bear, and rabbit hunting along with trout fishing and wood harvesting were activities reported by the interviewees. The majority of these activities took place in the recent (44%, 11 – 25 years ago) and historic past (41%, +25 years ago), with some current use (15%, within the last 10 years).

Traditional Use in the Study Area

- Deer, bear, and rabbit hunting along with trout, eel, smelt, and salmon fishing and berry harvesting were activities reported by interviewees. The majority of these activities took place in recent (51%) and historic past (43%), with some current use (6%).

Historic Review

- A review of Specific Claims shows Annapolis Valley First Nation sought return of 100 acres of St. Croix IR 34 claimed by and granted to the Lumber Company in 1866 and 37 acres further alienated by survey in 1870. The current status is "Settled", settled through negotiations, 2022.
- The archaeologically rich St. Croix Archaeological Site, located downriver of the Trunk No.1 bridge and the falls/dam was a large seasonal fishing village that supported a large population during a continuous period spanning the Woodland Period to the Historic/Contact Period (2,500-500 years BP). There is isolated evidence that an Archaic narrow stemmed point in private collection, may date the site as early as 6000 years BP.
- The nearest Tradition Hunting Territories to the Project Area and Study Area covered the Lakes south of Windsor.

5.3 Mi'kmaq Engagement

Ellershouse 3 Wind LP has worked with the Mi'kmaq of Nova Scotia to establish an engagement plan that centers around mutual respect and providing opportunities for engagement with the Mi'kmaq communities. The intent is to provide the Mi'kmaq of Nova Scotia with the opportunity to engage on the Project in a manner that is mutually respectful of their cultural and traditional ways, providing as much information about the Project as it evolves, and responding to feedback from the Mi'kmaq of Nova Scotia to address their questions.

Ellershouse 3 Wind LP recognizes that First Nations' input is an integral component to the success of a project. Early engagement with the Mi'kmaq of Nova Scotia began in January 2021 and May 2021 with an open and transparent introduction letter providing a description of the Project, a map of the associated lands, an early layout of the turbines, proposed consultation approach and proposed timelines, as well as feedback regarding how they would like to see the engagement program move forward.

5.3.1 Engagement Approach

As per *The Proponents' Guide: The Role of Proponents in Crown Consultation with the Mi'kmaq of Nova Scotia* (the Proponent's Guide), Ellershouse 3 Wind LP followed the key principles of engagement and completed pre-development consultation with the 13 Mi'kmaq First Nations as well as focused the engagement program with AVFN, who's St. Croix Reserve is adjacent to the Project. The following outlines the opportunities provided to the Mi'kmaq of Nova Scotia to engage with the Project, as per the six steps in the Proponent's Guide. Supporting material are provided in Appendix C.

5.3.1.1 Step 1 – Early Notification

On January 5, 2021, AREA provided OLA with an introduction letter for the Project and the upcoming engagement. The introduction letter included an outline of the Project, mapping of the area, and an early layout. Ellershouse 3 Wind LP provided a presentation to the OLA on January 28, 2021 and sought guidance regarding future engagement with the Mi'kmaq of Nova Scotia. On May 4, 2021, Ellershouse 3 Wind LP followed up with the OLA to seek and received contact information for communities not yet contact, allowing Ellershouse 3 Wind LP to provide letters of introduction to additional Chiefs.

Ellershouse 3 Wind LP began engagement in January 2021 and May 2021 with letters to the Mi'kmaq First Nations Chiefs introducing the Project and team. Letters were sent to communities and stakeholders in the general proximity of the Project including the following:

- Glooscap First Nation
- Sipekne'katik First Nation
- Annapolis Valley First Nation
- Kwilmu'kw Maw-klusuaqn (KMKNO) / Mi'kmaq Rights Initiative
- Acadia First Nation
- Bear River First Nation
- Eskasoni First Nation
- Millbrook First Nation

Responses to early introduction letters were received from AVFN, Glooscap First Nation, OLA, Mi'kmaq Rights Initiative, and KMKNO. Respondents welcomed the opportunity for the Project Team to share information on the Project and established dates for upcoming meetings. Follow-up correspondence with the Mi'kmaq Rights Initiative occurred in March 2022, and as requested they were added to the Project's mailing list.

Ellershouse 3 Wind LP maintained communication with the Mi'kmaq First Nation communities, providing the Chiefs of the 13 Mi'kmaq communities the November 2021 and March 2022 newsletters for circulation within their communities and comment, as well as invitation to the November 2021 and April 29, 2022 open houses. Newsletters were sent to the following Nations:

- Acadia First Nation
- Annapolis Valley First Nation
- Eskasoni First Nation
- Glooscap First Nation
- L'sitkuk (Bear River)
- Membertou First Nation
- Millbrook First Nation
- Paqtnkek Mi'kmaw Nation
- Pictou Landing First Nation
- Potlotek First Nation
- Sipekne'katik First Nation
- Wagmatcook First Nation
- We'koqma'q First Nation
- Assembly Of NS Mi'kmaw Chiefs
- KMKNO

The First Nation communities in closest proximity to the Project are Glooscap First Nation and AVFN. The AVFN St. Croix Reserve is immediately adjacent to the Project.

Annapolis Valley First Nation
An introduction letter was provided to the AVFN in January 2021, which included a description of the Project, a map of the associated lands, an early layout of the turbines, proposed consultation approach and proposed timeline. Regular contact with the AVFN allowed the Project Team to develop an excellent working relationship as well as discussions on partnership on the Project. Face-to-face meetings were held with AVFN on October 20, 2021; November 23, 2021; December 8, 2021; April 22, 2022; April 26, 2022; and April 28 (open house), 2022. The Project Team met with Chief and Council on April 26, 2022, providing an updated Project layout and the setback from the St. Croix Reserve, the proposed storyboards for the upcoming open house, the Capacity Building proposal, the partnership structure, and the timeline for the Project as the RBP RFP process moves forward. Chief and Council approved the storyboards for the April 29, 2022 open house and indicated they were comfortable with the current design setback from the St. Croix Reserve.
The AVFN agreed to be a partner on the Project in April 2022 and a partnership agreement was entered into May 11, 2022.

Glooscap First Nation
An introduction letter was provided to Glooscap First Nation in January 2021, which included a description of the Project, a map of the associated lands, an early layout of the turbines, proposed consultation approach and proposed timeline. Regular contact with the Glooscap First Nation allowed the Project Team to develop an excellent working relationship as well as discussions on a potential partnership on the Project.

Face-to-face meetings were held with Glooscap First Nation on November 23, 2021 (presentation); December 8, 2021; February 14, 2021; March 11, 2022; and March 16, 2022 (presentation).

Glooscap First Nation provided a letter of support for the Project and provided positive feedback on the engagement that had taken place.

Ellershouse 3 Wind LP reached out to the Native Council of Nova Scotia (NCNS) on May 2, 2022 with an introduction email to determine the level of interest the NCNS may have with the Project and future engagement.

5.3.1.2 Step 2 – Provision of Information

Ellershouse 3 Wind LP has endeavored to provide Project information and updates to the First Nation communities throughout the development process. Initial engagement activities provided the communities with Project information and sought feedback on the Project. These activities are outlined briefly below:

- Distributing introduction letters.
- Distributing newsletters and comment forms (November 2021 and March 2022) to the Chiefs with details on the Project and contact information. The newsletters requested feedback via the comment form included in the mailings.
- Setting up a Project website with Project information and with a request for feedback and comment form, as well as contact information.
- Setting up a Project-specific email that is checked regularly by the Project Team and responding where information is sought.
- Posting a notice in the following local newspapers:
  - The Chronicle Herald
  - The Valley Wire
  - Valley Journal
- Hosting virtual and in-person open houses (November 2021, April 2022).
- Meeting with the existing CLC (established for the existing Ellershouse Wind Farm) to introduce the Project and team as well as seek feedback and answer questions.

The Project Team reached out to the First Nations through 2021 and 2022 and presented the Project to Chief and Council for the following communities:

- Millbrook First Nation: October 19, 2021 (presentation).
- Eskasoni First Nation: December 9, 2021.

- AVFN: October 19, 2021; March 23, 2022; April 26, 2022.
- Glooscap First Nation: November 23, 2021 (presentation); December 8, 2021; February 14, 2022; March 16, 2022 (presentation).

The Project Team met face-to-face with representatives of Ulnooweg on October 13, 2021 and, on October 21, 2021, the Project material was presented to the Chiefs Council by the Ulnooweg representatives. Further face-to-face meetings were held on November 10 and 16, 2021; December 16 and 21, 2021; and February 15, 2022.

The following provides more detail on the methods of engagement.

Newsletters and Comment Forms

The November 2021 newsletter and comment form were distributed to the 13 Chiefs of the Mi'kmaq First Nations and the Assembly of Nova Scotia Chiefs KMKNO.

The March 2022 newsletter and comment form were distributed to the same 13 Chiefs and the Assembly of Nova Scotia Chiefs KMKNO and included the following information:

- Fillable comment forms with the newsletters and on the Project website to assist the communities in providing feedback and to submit comments or questions on the Project.
- A Project-specific email address, fax number, and a mailing address in the comment form.
- Various options for contact to encourage feedback from recipients.

No comments were received from the First Nation Chiefs on either the November 2021 or March 2022 newsletters.

Project Website and Email

The Project-specific website (www.ellershouseiiiwind.com) was established on November 1, 2021 as another method for providing Project information and gathering comments from the First Nations communities. The website included the same content as the newsletter so there was consistency and accuracy in the information being communicated through different methods. An electronic, fillable comment form that could be filled in online or printed and submitted through email or letter mail was included to gather input from the Mi'kmaq First Nations communities. All submitted electronic comment forms are auto forwarded to the Project email, which the Project Team checks for incoming comments. The Project email (ellershouseiiiwind@potentiarenewables.com), phone number and physical address were provided on the electronic comment form. Communities were also invited to submit questions and comments via email. The website link was also included in the newsletters and the newspaper notices.

To assist in accessibility, the Project website has accessibility tools that allow those with visual challenges to alter the website to meet their visual needs.

Open Houses

Three open houses were held for the Project: November 10, 2021 and April 29, 2022 in-person and November 23, 2021 virtually. The intent of the open houses was to provide Project information and seek feedback on the Project.

The November 2021 open houses were advertised in three local papers, the newsletter to the public within 4 kilometres of the Project, and notices to the 13 Mi'kmaq Chiefs and Assembly of Nova Scotia Chiefs KMKNO to reach a diverse and broad population. Participants were provided with comment forms that could be returned in the meeting or submitted through mail or email. In addition, the presentation boards were posted to the website with the electronic comment form, to allow those that could not attend the open house to review the Project information and provide comments. The in-person open house was attended by 27 participants, and the virtual open house was attended by six participants. No comments were provided, and no questions were received during this virtual event. In response to the November 2021 open houses, two comment forms were received, both of which were supportive of the Project. In general, the participants of the November open houses were supportive of the Project.

The April 29, 2022 open house was held to review the Project and potential impacts with the AVFN St. Croix Reserve. The open house was advertised on the AVFN Facebook page, at the guidance of AVFN. The open house was attended by five community members. No comment forms were received from the participants. Questions were asked regarding upcoming wildlife and other studies, potential access to the St. Croix Reserve from the Project, and potential jobs. In general, the feedback was positive, and participants were looking forward to ongoing updates from the Project. To date, no comment forms have been received in response to the April 2022 open house.

The presentation boards for the open houses are included in Appendix C.

Community Liaison Committee

The CLC is central to the Ellershouse area wind projects. Members are very supportive of the existing Ellershouse Wind Farm and are in full support of the development of the Project. All CLC meetings are held at the community hall and are open to the public with open invitations to nearby First Nations communities.

The CLC provides a forum for meaningful and open dialogue between the local residents, landowners, and other interested parties and Ellershouse 3 Wind LP on matters related to construction, operation, maintenance, and decommissioning of the Ellershouse Wind Farm. While the CLC was originally established in response to the existing Ellershouse Wind Farm, it was determined that it was appropriate for the Ellershouse 3 Wind Project to be incorporated into the CLC and that new participants would be welcomed into the committee.

At the April 29, 2022 open house, the AVFN community was invited to join the CLC.

5.3.1.3 Step 3 - Meet with Communities

In the early introduction letters to the Mi'kmaq Chiefs, First Nation communities were asked if they had a preference with respect to engagement. Throughout the engagement process, the Project has worked with the community representatives to provide requested information in emails or presentations, depending on the needs of the communities. At this time, none of the communities have requested an Engagement Plan.

Face-to-face meetings occurred via Microsoft Teams, Zoom, and in-person. The Project has held 25 face-to-face meetings with the following Mi'kmaq communities or First Nation stakeholders:

- OLA
- KMKNO
- Ulnooweg (13 First Nations)
- Millbrook First Nation
- AVFN
- Glooscap First Nation
- Eskasoni First Nation
- Confederacy of Mainland Mi'kmaq

The Project has carried out ongoing discussions with First Nation community representatives through email, letters, phone calls, and meetings. More detailed engagement was undertaken with the AVFN and Glooscap First Nation as the nearest neighbours to the Project.

5.3.1.4 Step 4 - MEKS

Ongoing discussions have occurred with the AVFN regarding their preferred approach to the capturing of ecological knowledge. During the April 26, 2022 meeting, the MEKS protocol was discussed to ensure traditional knowledge and AVFN priorities were addressed. AVFN requested the Project include Mi'kmaw Conservation Group (MCG) in the studies to bring in the traditional knowledge. Ellershouse 3 Wind LP was unable to contract with MCG to conduct a MEKS due to a lack of capacity; however, a MEKS was carried out by Membertou Geomatics Solutions. The final MEKS report is attached as Appendix B, and summary information is provided in Section 5.2.

5.3.1.5 Step 5 - Address Potential Project-specific Impacts

Ongoing consultation with the AVFN resulted in the community requesting a setback from the St. Croix Reserve to protect the forest within the boundaries of the Reserve on December 8, 2021. The Project was redesigned to accommodate this request and the updated layout was presented on April 26, 2022 and at the April 29, 2022 open house.

AVFN expressed concern regarding capturing priority ecological species as part of the EA. They recommended that MCG be included in the ecological studies to address traditional knowledge and AVFN priorities. Ellershouse 3 Wind LP reached out to MCG to request input on studies and participation. Ellershouse 3 Wind LP coordinated with Strum Consulting to include a species at risk project assistant spend a field day with Strum staff in 2022 to complete wetland delineation and bat and radar monitor checks, as well as discuss the community and traditional plant uses.

AVFN communicated their difficulty in accessing the St. Croix Reserve, and their desire to improve access to the area given its remote nature. Currently, the main access point to the St-Croix reserve is from Panuke Lake. The Project Team reviewed the layout with the AVFN community and the adjacent landowner to determine the best possible approach. Construction of the Project will establish a key point of access. AVFN were very enthusiastic about the opportunity for improved accessibility to allow more community members to visit the cultural site.

AVFN requested more information on potential surface water interactions with the Project. The detail design phase of the Project will include a surface water management plan to address water flow during construction and operations, which will be shared with AVFN members. Potential interactions and proposed mitigations for surface water are included in Section 7.3.

Partnering with AVFN provides the Project Team with a regular point of review for potential Project-specific impacts on First Nation communities as the Project evolves.

5.3.1.6 Step 6 – Document the Engagement Process

The Project has been in contact with the OLA and KMKNO regularly since January 2021. The discussion in the sections above document the engagement process. A summary is also provided in Table 5.1.

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

First Nation / Organization	Role(s)/Representatives	Contact Details
Glooscap First Nation	Chief Sidney Peters Council Natural Resource Officer Financial Analyst Finance Committee CEO of Glooscap Ventures	January 12, 2021 Introductory letter from the Mayor of the Town of Berwick on behalf of AREA (email and mail). January 13, 2021 Ellershouse 3 Wind LP was notified that the introductory email was forwarded to Natural Resource Officer. March 2021 Follow up call from the Mayor of the Town of Berwick. November 1, 2021 Newsletter provided to the community. November 23, 2021 Virtual meeting with the CEO of Glooscap Ventures to introduce the Project and participation options. December 8, 2021 Meeting with the CEO of Glooscap Ventures and team, as well as representatives from Glooscap First Nation and AVFN.

First Nation / Organization	Role(s)/Representatives	Contact Details
		January to March 2022 Ongoing discussions related to potential Project cooperation. March 25, 2022 Second newsletter provided to the community. April 26, 2022 Glooscap Ventures CEO provided letter of support for the Project.
Sipekne'katik First Nation	(Former) Chief Sack Council	January 13, 2021 Introductory letter from the Mayor of the Town of Berwick on behalf of AREA (email and mail). March 2021 Follow up call from the Mayor of the Town of Berwick. November 1, 2021 Newsletter provided to the community. March 25, 2022 Second newsletter provided to the community.
Annapolis Valley First Nation	Chief Gerald Toney Council Economic Development Officer	January 12, 2021 Introductory letter from the Mayor of the Town of Berwick on behalf of AREA (email and mail). March 2021 Follow up call from the Mayor of the Town of Berwick. March 4, 2021 Call with the Chief to provide an overview of the Project and discuss partnership opportunities and land leasing. The Chief encouraged the Project Team to follow-up with the Economic Development Officer. March 10, 2021 The Project Team emailed the Economic Development Officer to request meeting. April and May 2021 Follow up discussions with the Economic Development Officer.

First Nation / Organization	Role(s)/Representatives	Contact Details
		October 8, 2021 Ellershouse 3 Wind LP re-introduced the Project to the Economic Development Officer via email. October 14, 2021 Follow up call to the Economic Development Officer. October 20, 2021 Introductory presentation with a summary of participation options. Ellershouse 3 Wind LP expressed interest in keeping an open dialogue, as the Project is closest to this First Nation. Oct 21, 2021 Email to the Economic Development Officer requesting a following up meeting. October 28, 2021 Provided a draft of the newsletter prior to sending. November 1, 2021 Newsletter provided to the community. December 1, 2021 Request for in-person meeting. December 8, 2021 In-person meeting including CEO of Glooscap Ventures and team, as well as representatives from AVFN. December 15, 2021 Follow up with the Economic Development Officer inquiring about First Nation contractors who may be interested in the future work. March 21, 2022 Call with the Economic Development Officer to discuss status of the Project. March 24, 2022 Presentation focusing on partnership and benefits. March 25, 2022 Second newsletter provided to the community.

First Nation / Organization	Role(s)/Representatives	Contact Details
		March 28, 2022 Memorandum of Understanding (MOU) provided to Chief and Council. March 31, 2022 Call with the Economic Development Officer to discuss questions and concerns from Chief and Council and set up a meeting. April 14, 2022 Coordination with AVFN on the location and planning for a community open house. April 26, 2022 In-person meeting with Chief and Council providing an overview of the Project, the status of RFP submission, and the upcoming open house. April 28, 2022 In-person meeting with Councillor Monique Holland at the AVFN Community Hall. Discussed her concerns for the protection of wildlife and ensuring the St-Croix Reserve was preserved for future generations. The Project Team discussed plans to honour the reserve's border and the steps to ensure the Project is compliant with the provincial standards. She asked that the Project Team reach out and speak with a specific Project Manager from Confederation of Mainland Mi'kmaq (CMM) to make sure they would be involved in the process. April 29, 2022 Open House at the AVFN Community Hall. This provided the community an opportunity from 2-6 pm to visit with the Project Team and address any questions and concerns about the Project. The open house was advertised through posted flyers in the AVFN community. May 11, 2022 A partnership agreement was entered into on May 11, 2022 May 30 – July 14, 2022 Regular progress updates to AVFN via email.

First Nation / Organization	Role(s)/Representatives	Contact Details
		July 20, 2022 Invitation to AVFN to attend Prime Minister's announcement. August 3, 2022 Progress update to AVFN. October 5, 2022 Site visit and meeting with AVFN members. January 26, 2023 Progress update to AVFN.
Acadia First Nation	Chief Deborah Robinson Council	May 4, 2021 Introductory letter from the Mayor of the Town of Berwick on behalf of AREA (letter). November 1, 2021 Newsletter provided to the community. March 25, 2022 Second newsletter provided to the community.
L'sitkuk (Bear River) First Nation	Chief Carol Dee Potter	May 4, 2021 Introductory letter from the Mayor of the Town of Berwick on behalf of AREA (email). November 1, 2021 Newsletter provided to the community. March 25, 2022 Second newsletter provided to the community.
Eskasoni First Nation	Chief Leroy Denny General Manager	May 4, 2021 Introductory letter to the Chief and Council from the Mayor of the Town of Berwick on behalf of AREA (email). August 19, 2021 Introductory email to the General Manager. September 1, 2021 Call with the General Manager to introduce the Project, as well as participation/investment options. September 21, 2021 Provided the General Manager with a Project update.

First Nation / Organization	Role(s)/Representatives	Contact Details
		October 26, 2021 Follow-up email requesting a meeting. October 28, 2021 Provided a draft of the newsletter prior to sending. November 1, 2021 Newsletter provided to the community. November 25, 2021 General Manager expressed higher level of interest in the Project and invited Ellershouse 3 Wind LP to present at the December Council meeting. December 8, 2021 Meeting with the General Manager. December 9, 2021 Presentation to Council. Ellershouse 3 Wind LP to develop a MOU to present in the new year. December 21, 2021 Call with the General Manager to discuss the MOU. Conversations related to potential partnership including Millbrook First Nation. March 25, 2022 Second newsletter provided to the community.
Millbrook First Nation	Chief Robert Gloade Director of Commercial Operations	May 4, 2021 Introductory letter from the Mayor of the Town of Berwick on behalf of AREA. August 19, 2021 Introductory email from the Project Team. September 1, 2021 Video conference to introduce projects and discuss participation and investment options. September 20, 2021 Provided the Director of Commercial Operations with a detailed summary of the Project, our community partner, the

First Nation / Organization	Role(s)/Representatives	Contact Details
		upcoming RFP, potential capacity building benefits, and an overview of the potential economic partnership. October 14, 2021 Provided a slide deck to the Director of Commercial Operations. October 19, 2021 Presentation to Chief and Council. October 25, 2021 Follow-up email requesting feedback on the presentation from the Director of Commercial Operations. October 28, 2021 Provided a draft of the newsletter prior to sending. November 1, 2021 Newsletter provided to the community. January 7, 2022 Video call about partnering on equity investment in the Project. Also discussed future employment opportunities. March 25, 2022 Second newsletter provided to the community.
Pictou Landing First Nation	Chief Andrea Paul	November 1, 2021 Newsletter provided to the community. March 25, 2022 Second newsletter provided to the community.
Membertou First Nation	Chief Terrance Paul	November 1, 2021 Newsletter provided to the community. March 25, 2022 Second newsletter provided to the community.
Paqtnkek First Nation	(Late) Chief Tma Francis	November 1, 2021 Newsletter provided to the community. March 25, 2022 Second newsletter provided to the community.

First Nation / Organization	Role(s)/Representatives	Contact Details
Polotek First Nation	Chief Wilbert Marshall	November 1, 2021 Newsletter provided to the community. March 25, 2022 Second newsletter provided to the community.
Wagmatcook First Nation	Chief Norman Bernard	November 1, 2021 Newsletter provided to the community. March 25, 2022 Second newsletter provided to the community.
We'koqma'q First Nation	Chief Annie Bernard-Daisley	November 1, 2021 Newsletter provided to the community. March 25, 2022 Second newsletter provided to the community.
Organizations		
Office of L'nu Affairs	Consultation Advisors	January 5, 2021 Introductory letter from the Town of Mahone Bay Climate and Energy Outreach Coordinator on behalf of AREA. January 28, 2021 Virtual meeting to receive guidance on First Nations Engagement. May 4, 2021 Ellershouse 3 Wind LP requested official contact information for Mi'kmaq First Nations, which was received.
Kwilmu'kw Maw-klusuaqn	Twila Gaudet, Director of Consultation Energy and Mines Advisor	February 19, 2021 Introductory letter from the Town of Mahone Bay Climate and Energy Outreach Coordinator on behalf of AREA. March 18, 2021 Follow up email requesting a meeting. April 21, 2021 Zoom meeting with the Energy and Mines Advisor, who provided recommendations for the next steps in engagement and contact information for potential stakeholders.

First Nation / Organization	Role(s)/Representatives	Contact Details
		May 4, 2021 Follow-up email to the Energy and Mines Advisor. May 27, 2021 Follow up email to the Energy and Mines Advisor. November 1, 2021 Newsletter provided to the Director of Consultation. March 25, 2022 Second newsletter provided to the Director of Consultation. March 30, 2022 Project Team sent follow up email and requested an update call with Energy and Mines Advisor. April 15, 2022 Invitation to upcoming open house.
Ulnooweg	13 Chiefs Senior Manager of Finance and Investments	August 19, 2021 Introductory email from the Project Team. August 31, 2021 Virtual presentation to introduce the Project, as well as participation/investment options. September 23, 2021 Call to discuss the economic benefits of participating in the RFP. September – October 2021 Follow-up emails and video call about investment options. October 28, 2021 Provided a draft of the newsletter prior to sending. November 10, 2021 Project was presented as part of Council meeting. November 16, 2021 Virtual meeting to provide updates from the Chiefs Council meeting and meeting scheduled for December 2.

First Nation / Organization	Role(s)/Representatives	Contact Details
		December 2021 to April 2022 Ongoing discussions related to potential Project cooperation. May 2, 2022 Receipt of Project support letter from Senior Manager of Finance and Investments on behalf of Ulnooweg.
Confederacy of Mainland Mi'kmaq	Office Manager Anthony King, Project Manager Stephen Williams, Fisheries Biologist	October 18, 2012 Introductory email from the Project Team. October 21, 2021 Acknowledgement email received. April 28, 2022 Project Manager requested to attend the Open House on April 29 to discuss having CMM provide guidance to the Project. April 29, 2022 Meeting with the Project Manager and Fisheries Biologist to discuss recommendations, potential job shadowing options, and next steps. May 2, 2022 Meeting follow-up and request for recommendations for participation in environmental studies. Response received from Project Manager same day. July 13, 2022 Progress update on the EA activities, request participation in environmental studies and schedule a meeting. August 12, 2022 Meeting with MCG and CMM to arrange for participation in upcoming environmental fieldwork.
Native Council of Nova Scotia	Chief Augustine,	May 2, 2022 Introduction sent with an invitation to discuss the Project and current engagement with the Mi'kmaq community.

5.3.2 Review of Concerns

As described in Table 5.1, engagement with the Mi'kmaq of Nova Scotia focused on discussions related to wildlife and the environment, the St-Croix Reserve, community benefits, employment, and training opportunities. The Project is located within approximately 200 m of the St. Croix Reserve and the Project Team is committed to honouring the reserve's border and requested setbacks. It should be emphasized that the St. Croix Reserve is owned by the AVFN, and as Project partners, the AVFN will continue to be involved throughout the Project development.

Ellershouse 3 Wind LP's engagement with AVFN and other Mi'kmaq communities identified local employment and training opportunities as the main gap. As a result, Ellershouse 3 Wind LP negotiated and executed a benefits agreement and capacity building plan with AVFN that is focused on offering members of the Mi'kmaq of Nova Scotia community the opportunity to take advantage of educational and training benefits that will grant them with practical skills and help deepen their knowledge and skills in the field of renewable energy.

Section 7 of this EA describes the methods and results of the effects assessment for the biophysical components of the environment, including for fish (Section 7.3.2) and wildlife (Section (7.4.3). With the application of mitigation measures, the residual effects of the Project on these VCs are predicted to be not significant. The Project Team has met with CMM to discuss participation in the environmental monitoring and study activities and is committed to continuing these conversations and opportunities for participation.

5.3.3 Ongoing Engagement

Ellershouse 3 Wind LP 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.

6.0 ENGAGEMENT

Ellershouse 3 Wind LP is committed to meaningful engagement with government, the public, stakeholders, and the Mi'kmaq of Nova Scotia. To date, the Project Team has participated in meetings, delivered presentations, and hosted three public consultation (open house) events (two in-person and one virtual) to ensure the surrounding communities receive accurate information on all stages of the proposed Project, including planning, design, EA, construction, operation, decommission, and reclamation.

This section identifies engagement attempts and methods used to notify government, the public, and stakeholders. Associated presentations, posters, meeting agendas and minutes, advertisements, letters of support, and feedback are provided in Appendix C. Details on engagement with the Mi'kmaq of Nova Scotia is provided in Section 5.

6.1 Engagement with Government Departments, Agencies, and Regulators

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

Engagement has occurred with the Towns of Mahone Bay, Berwick, and Antigonish and the West Hants Regional Municipality. The Towns of Mahone Bay, Berwick, and Antigonish are partners in the AREA, which is the owner and operator of the existing Ellershouse Wind Farm.

Ellershouse 3 Wind LP met with the West Hants Regional Municipality in September 2021 to introduce the Project and review the requirements of the Municipality. A Development Application to West Hants Regional Municipality was subsequently submitted, which outlines the Project details and responds to the requirements outlined by the Municipality. Ellershouse 3 Wind LP has had ongoing engagement with the West Hants Regional Municipality to review comments on the Development Application, applicable bylaws, setbacks from turbines, and other requirements. In April 2022, this engagement identified setback requirements that Ellershouse 3 Wind LP addressed through redesign.

The Project Team has engaged with provincial and federal departments to introduce the Project and receive information on the requirements for the Project (Table 6.1).

Table 6.1: Government Meetings and Events

Government Departments, Agencies, & Regulators	Representative	Dates, Activities, Comments
	Federal Government	
Canadian Coast Guard (CCG) (Vessel Traffic Systems Radars)	Wind Farm Coordinator	Response received February 2023 indicating the Project Area is located outside of the coverage zone of their radars. Therefore, no interference issues are anticipated. Updated details to be provided, as necessary.
Department of National Defence (DND)	Military Air Defense and Air Traffic Control; Military Radio communication users	February 2022 Email received indicating turbine coordinates are required to conduct an impact analysis on radar and radio equipment. Standard form required to be submitted once turbine locations known. May 2022 EMI study notification letter sent. June 2022 Non-objection letter received. Updated details to be provided, as necessary.
ECCC	Weather Radars	May 2022 • EMI study notification letter sent. • Correction request received; hub height and blade length required. • Requested information returned. September 2022 Non-objection letter received. Updated details to be provided, as necessary.
ECCC - CWS	Physical Science Officer, Environmental Protection Operations Directorate	March 2022 • Received ECCC published guidance outlining advice for wind Project planning, baseline monitoring and consideration of potential impacts to migratory birds and species at risk, in preparation of an EA. • Minimum 2-year consecutive avian radar and acoustic monitoring during spring and fall is recommended to quantify and assess risk to migratory birds and avian species at risk.

Government Departments, Agencies, & Regulators	Representative	Dates, Activities, Comments
		April 2022 Introduction letter from Project Manager submitted for agency review and comment. May 2022 Received updated Wind Energy & Birds Environmental Assessment guidance document (Canadian Wildlife Service, 2022).
Innovation, Science and Economic Development Canada	Nova Scotia District Office	February 2023 EMI study notification letter sent. February 2023 Acknowledgement email received.
NAV CANADA		May 2022 EMI study notification letter sent. February 2023 Response letter received with proposed mitigation. March 2023 Meeting with NAV CANADA representatives to discuss modelled impacts and potential solutions. Engagement ongoing. Updated layout will be provided to NAV CANADA as required with final turbine model.
RCMP	Wind Farm Coordinator	May 2022 EMI study notification letter sent. May 2022 Response received requesting coordination with Bell (see Table 9.2), who are acting on behalf of the RCMP in the province with leased towers. Updated details to be provided, as necessary.

Government Departments, Agencies, & Regulators	Representative	Dates, Activities, Comments
Transport Canada	Aerodrome Standards Inspector	March 2022 Request for Aeronautical Assessment Form and spreadsheet with the coordinates (in degrees, minutes, seconds), turbine height and ground elevation of each of all proposed turbines. May 2022 Aeronautical Assessment documents submitted. June 2022 Aeronautical Assessment complete.
Provincial Government		
NSCCTH	Director of Special Places Protection	April 2022 Introduction letter from the Project Manager submitted for agency review and comment. October 2022 Email exchanges regarding the confidentiality of archaeological and cultural resources information and approach for incorporating results into the EA.
NSECC, Air Quality Unit	Air Quality Protection Advisor	November 2022 Meeting to discuss expectations for the assessment of low frequency noise.
NSECC, EA Branch	EA Officer Supervisor	January 2022 Email correspondence regarding data sensitivity for Mainland moose and what data should be provided in the EA versus to NSNRR directly. March 2022 Guide for Wind Energy Environmental Assessments received (Government of Nova Scotia, 2021). April 2022 Introduction letter from the Project Manager submitted for agency review and comment.

Government Departments, Agencies, & Regulators	Representative	Dates, Activities, Comments
		October 2022 One-Window Meeting with presentations from Ellershouse 3 Wind LP and Environmental Consultant. October 2022 Email exchanges regarding the confidentiality of archaeological and cultural resources information and approach for incorporating results into the EA, and to discuss the timing of the CCTH review of the Archaeological Resources Impact Assessment (ARIA).
NSECC, Protected Areas and Ecosystems Branch	Protected Areas and Ecosystems Branch	April 2022 Introduction letter from Project Manager submitted for agency review and comment.
NSECC, Regional Integration of Compliance and Operations	Business Relationship Manager	March 2023 Introduction and request for meeting from Business Relationship Manager. Introductory meeting and discussion of Project and EA process.
NSNRR	Species at Risk Biologist	January 2022 Email correspondence regarding data sensitivity for Mainland moose and what data should be provided in the EA versus to NSNRR directly. May 2022 Email correspondence regarding guidance for bat, bird, and wood turtle surveys. May 2022 Email correspondence regarding the criteria for determining if a site is considered "coastal". June 2022 Email discussions about bat monitoring, followed by a call on June 22, 2022.

Government Departments, Agencies, & Regulators	Representative	Dates, Activities, Comments
		July 2022 Provision of summary table on the status of flora, fauna, and habitat studies. Attempted to schedule a follow-up call.
NSNRR	Wildlife Division	April 2022 Introduction letter from the Project Manager submitted for review and comment.
NS Service Nova Scotia	Director of Public Safety and Field Communications	June 2022 EMI study notification letter sent. July 2022 Non-significance impacts letter received.
OLA (formerly the Office of Aboriginal Affairs)	Consultation Advisors	January 2021 Introduction letter from Town of Mahone Bay on behalf of AREA. January 2021 Meeting with presentation. Project Team presentation to OLA about the expansions and received guidance on consultation. May 2021 Requested official contact information for First Nation Communities. February 2022 • Teams meeting with new consultation advisors. Project Team received recommendation to reach out to all communities directly, as some had recently departed KMKNO. CMM and MCG should also be contacted. Membertou Geomatics is currently the only company completing MEKS for EAs. Due to COVID, minimal in-person meetings or interviews are available.
Municipal Government		
Town of Antigonish	Mayor Laurie Boucher	May 2022 Letter of support received.

Government Departments, Agencies, & Regulators	Representative	Dates, Activities, Comments
Town of Berwick	Mayor Donald Clarke	May 2022 Letter of support received.
Town of Mahone Bay	Mayor David Devenne	May 2022 Letter of support received.
West Hants Regional Municipality	Mayor CAO Council Planner	September 2021 Meeting • Review of proposed Project with presentation. • Review of the coming RFP and the proposed Project. • Municipal attendees provided a review of application and application requirements, the appropriate bylaws, timelines and requirements, the EA process, and recommendations on potential CLC meeting locations. • Municipality requests safe road access and prefers Projects be capped at 100 MW per site. October 2021 Email • Municipality provided feedback on the application including setbacks and consultation requirements as well as CLC meeting locations. • Development Application submitted October 25, 2021. November 2021 Presentation to Council followed by a site visit with municipal government and Council members. February 2022 Update meeting with the Planning group. April 2022 Letter of support received from the CAO.

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.

Discussions with government officials will continue throughout all Project phases.

6.2 Public and Stakeholder Engagement

The Project Team has been involved in engagement activities with the public and stakeholders since January 2021 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 ensuring the public and surrounding communities received accurate information on all stages of the proposed Project, including planning, design, EA, construction, operation, decommission, and reclamation. Various methods were used to achieve this goal such as mail-outs, digital communications, community open houses, and joining the existing CLC. Stakeholder engagement was primarily related to EMI notifications.

A summary of engagement and meetings is included in Table 6.2, with additional details provide in the sections that follow. Associated presentations, posters, meeting agendas and minutes, advertisements, letters of support, and feedback are provided in Appendix C.

Ellershouse 3 Wind LP has developed an engagement approach for the Project to provide the public and stakeholders with ample opportunity to receive information and provide feedback early in the development process. The intent of the engagement program is to provide the community with the opportunity to engage with Ellershouse 3 Wind LP as the Project evolves, and to allow Ellershouse 3 Wind LP to incorporate feedback and address any concerns. The Project Team recognizes that input from the community is an integral component to the success of a Project and, where applicable, feedback has informed Project design plans.

Table 6.2: Public and Stakeholder Engagement and Meetings

Community/Stakeholder Organization	Engagement
AREA	May 2022 Letter of Support received from the General Manager of AREA
Bell	June 2022 EMI study notification letter sent. June 2022 Response received indicating Bell's analysis results showed no land mobile stations requiring coordination. Bell also double-checked the coordinates and found their towers were outside the coordination zone. Based on this, their legal team did not see a need for a letter of non-objection. Updated details to be provided, as necessary.

Community/Stakeholder Organization	Engagement
Brooklyn Volunteer Fire Department	February 2023 EMI study notification letter sent. Updated details to be provided, as necessary.
CLC	November 2021 The Ellershouse CLC meets 2-4 times a year at the Ellershouse Community Hall. The CLC is open to anyone that applies and provides a forum for community members to ask questions, gain knowledge, and provide input on the Project. Ellershouse 3 Wind LP representatives began attending CLC meetings on November 8, 2021.
CLC	May 2022 Letter of Support received from the Chair of the CLC
Hantsport Fire Department	February 2023 EMI study notification letter sent. Updated details to be provided, as necessary.
Landowners and Interested Parties	November 2021 Community Newsletter #1 mailed to 564 property owners within 4 km of the Project inviting them to upcoming Open Houses. March 2022 Community Newsletter #2 mailed to 564 property owners within 4 km of the Project. March 2023 Community Newsletter #3 mailed to property owners within 4 km of the Project and emailed to 63 individuals.
Open House #1	November 10, 2021 This Open House took place from 6-9 pm at the St. Louise Union Church in Ellershouse.
Open House #2	November 23, 2021 This Open House was held virtually on November 23, 2021.
Rogers Communications	February 2023 EMI study notification letter sent. Updated details to be provided, as necessary.
Seaside Communications	February 2023 EMI study notification letter sent. Updated details to be provided, as necessary.
Uniacke & District Volunteer Fire Department	February 2023 EMI study notification letter sent. Updated details to be provided, as necessary.
Windsor Fire Department	February 2023 EMI study notification letter sent. Updated details to be provided, as necessary.

6.2.1 Digital Communications

A Project-specific website (www.ellershouseiiiwind.com) was established on November 1, 2021 as a key method for disseminating Project information and gathering comments from the general public. The website included the same content as the newsletter to ensure consistency in the information being communicated, including Ellershouse 3 Wind LP contact information, Project status and timeline, and information about the Nova Scotia RBP process.

An electronic, fillable comment form is included to gather input. All submitted electronic comment forms are auto forwarded to the Project email, which was provided on the electronic comment form along with the Project phone number and physical address. The website was updated on March 22, 2022 to include presentation material from the virtual and in-person open houses.

The Project email (ellershouseiiiwind@potentiarenewables.com) was set up to collect feedback and questions. The Project Team continually monitors incoming emails and responds to inquiries in a timely manner.

To assist in accessibility, the Project website has accessibility tools that allow those with visual challenges to alter the website to meet their visual needs.

To reach as many members of the public as possible, the website link was included in the newsletters and the newspaper notices.

6.2.2 Newsletters and Comment Forms

A physical and electronic newsletter was distributed in November 2021. The email list was populated by interested parties signing-up on the Project website or by making a request via phone, email, or mail.

The physical newsletter and comment form were distributed to 565 addresses based on a 4 km radius of the Project and included the following information:

- Overview of the Project and an introduction to Ellershouse 3 Wind LP.
- Project lead's name and contact information.
- Information on the upcoming in-person and virtual open houses.
- Map of the general area of the Project.
- Expected Project timeline.
- Explanation of the Nova Scotia RBP RFP.
- Economic and community benefits from the Project.
- Information on wind turbine technology.
- Regulatory process for obtaining environmental approval.
- Requests for community feedback including links to the Project website, a comment form, and provision of the Project email.

The March 2022 newsletter and comment form were distributed to 565 addresses based on a 4 km radius of the Project and included the following information:

- Update on the Project activities.
- Draft Project layout.
- Project lead's name and contact information (phone, email, and physical address).
- RBP RFP and Project timelines.
- Explanation of the Nova Scotia RBP RFP.
- Project development timeline.
- Map of the general area of the Project.
- Requests for community feedback including links to the project website, provision of the Project email.
- Fillable public consultation comment form.

In both mailings, fillable comment forms were provided with the newsletters and on the Project website to assist the public in providing feedback and to submit comments or questions on the Project. A Project-specific email address, fax number, and a mailing address were made available in the comment form. Various options for contact were provided to encourage feedback from recipients.

The March 2023 newsletter was distributed based on a 4 km radius of the Project and included the following information:

- Ownership update.
- Updated preliminary Project layout.
- RBP RFP results and Project timelines.
- Project development timeline.
- Map of the general area of the Project.
- Project lead's name and contact information (phone, email, and physical address).
- Project website address.

6.2.3 Open House Events

Three open houses were held for the Project: November 10, 2021 and April 29, 2022 in-person and November 23, 2021 virtually. The intent of the open houses was to provide Project information to members of the public and Mi'kmaq communities and seek feedback on the Project.

Ellershouse 3 Wind LP representatives were present to provide information on the Project and answer any questions or concerns brought forward by community members. Open houses featured posters or presentation slideshows sharing information on the Project, benefits to the area, and the EA process.

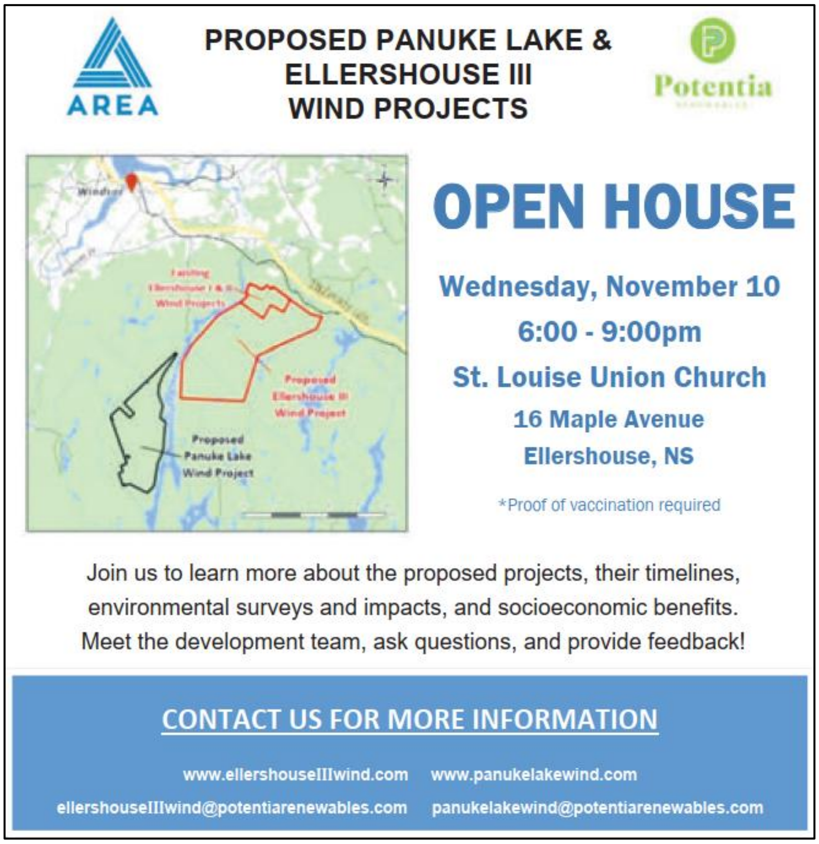

Figure 6.1: Advertisement for Open House #1

Open house #1 took place on Wednesday, November 10, 2021 from 6-9 pm at the St. Louise Union Church in Ellershouse, NS. The Open House was advertised in *The Chronical Herald*, The *Valley Wire,* and *The Valley Journal Advertiser,* in a community newsletter that was mailed to 564 residents within 4 km of the Project, and on the Project website. A sign-in sheet was available to collect contact details from participants for future follow-up. A total of 26 people signed-in to the first open house event. Two comment forms were received, both of which were supportive of the Project.

Open house #2 was held virtually on November 23, 2021. This event was advertised on the Project website. The Project Team presented a slide deck to attendees and requested feedback and questions. Six people attended the virtual open house. No comments were provided, and no questions were received during this virtual event.

In general, the participants of the November open houses were supportive of the Project.

The April 29, 2022 open house was held to review the Project and potential impacts within the AVFN St. Croix Reserve, which is part of the AVFN lands (see Section 5).

The presentation boards for the open houses generally covered the items listed below (Appendix C):

- Location and description of the Project.
- Draft Project layout.
- Introduction of the Project lead and team.
- Project contact information (email and website).
- Description of Project benefits.
- Description of how wind power works.
- EA process.
- CLC.
- Early visual assessment results.
- Description of sound and shadow flicker assessment results.
- Description of the Nova Scotia RBP RFP process and timeline.
- Project development timeline.
- Question and answer contact information for participants who wish to contact the Project outside of the open house forum.

6.2.4 Community Liaison Committee

As part of Ellershouse 3 Wind LP's ongoing commitment to community engagement, members of the Project Team joined the CLC established in 2013 for the neighbouring Ellershouse Wind Farm. Ellershouse 3 Wind LP representatives began attending and participating in CLC meetings in 2021 to help facilitate open communication between the Project Team and local communities. The establishment and operation of the CLC continues to follow the principles of NSECC's *Guide for the Formation and Operation of a Community Liaison Committee* (Government of Nova Scotia, 2010). The aim of the CLC is to bring together community members, business owners, government representatives, and other key stakeholders to bring local ideas, concerns, and interested to the table.

The CLC meets 2-4 times a year at Ellershouse Community Hall and are open to the public, with invites to nearby First Nations communities. Ellershouse 3 Wind LP representatives began attending CLC meetings on November 8, 2021 to provide introductions and a Project overview. The April 19, 2022 CLC meeting focused on Nova Scotia's RBP RFP.

The CLC provides a forum for meaningful and open dialogue between with Ellershouse 3 Wind LP and local residents, landowners, and other interested parties on matters related to construction, operation, maintenance, and decommissioning of the existing Ellershouse Wind Farm. It was determined that it was appropriate for the Ellershouse 3 Wind Project to be incorporated into the CLC and that new participants would be welcomed into the committee. The CLC is supportive of the Project.

6.2.5 Review of Concerns

The Project Team collected feedback in-person and virtually during the open house events, during stakeholder presentations, phone calls, and CLC meetings. In addition, questions and concerns were submitted through email to the Project email address or by regular mail via feedback forms provided with Project newsletters.

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

Table 6.3: Comments Received from the Public

Key Issues	Proponent Response	Section of EA
	Human Impacts	
How will the turbines/equipment get to the Project Area?	The turbine supplier, when selected, will assess the available transportation routes and determine the best option. The Project will endeavor to use existing roads to the extent possible; however, some modifications may be required to existing roads to accommodate delivers or ongoing maintenance.	Section 8.3 Traffic and Transportation
Will any roads be removed for this Project?	There is no plan to remove any roads for this Project.	Section 8.3 Traffic and Transportation
Will roads be maintained throughout winter? (Concern is maintenance will limit snowmobile access).	For safety reasons, the roads must be maintained. However, Ellershouse 3 Wind LP has requested those concerned to submit names of roads they would like preserved during the winter months for consideration.	Section 8.3 Traffic and Transportation
How will the community benefit from this Project?	As we continue to expand our local partners, Ellershouse 3 Wind LP is open to working with the community and participating in current programs that have already been established. Ellershouse 3 Wind LP has committed to a Community Fund of $1,000 per turbine per year to a local community fund for the duration of the 25-year renewable energy contract. These funds will be delegated to a charity or foundation under the direction of our local partners. The Project will provide additional tax revenue to the Municipality of the District of West Hants, create construction job, and increase demand for local supplies and services, such as food and lodging. As the Project develops further, opportunities for local employment will increase. A variety of full time and part time suppliers, contractors and local consultants will be required to build, operate and maintain the Project long-term.	Section 8.1 Economy
How far are the turbines from camps/cottages?	Setback distance requirements from camps and cottages are driven by regulatory requirements relating to sound, shadow flicker, and property lines. The final turbine layout abides by regulatory requirements.	10.3 Shadow Flicker 10.5 Sound

Key Issues	Proponent Response	Section of EA
	Environmental Impacts	
How will we address potentially adverse environmental impacts?	The EA process predicts potential environmental impacts and ways to avoid or mitigate to acceptable levels before proceeding with the Project.	Section 7.0 Biophysical
How will this Project impact wildlife?	Strum Consulting has conducted environmental surveys to assess the Project's potential to interact with wildlife. Ellershouse 3 Wind LP will be implementing necessary mitigations.	Sections 7.3.2 Fish and Fish Habitat 7.4.3 Terrestrial Fauna 7.4.4 Bats 7.4.5 Avifauna
	General	
Is there a way for the public to invest in the Project?	The Project is being privately funded. There are no opportunities to invest directly in the Project.	N/A
What is the timeline for this Project?	The preliminary development, construction, and operation schedule is as follows: • Clearing: Winter to Spring 2024 • Construction: Fall 2024 to Summer 2025 • Commissioning: Winter 2025 • Operation: Winter 2025 • Decommissioning: 2050 or beyond The final timelines are subject to change due to regulatory, procurement, engineering and construction, or other factors.	3.4 Project Schedule

6.2.6 Project Support

The Project has been met with significant support by government, stakeholders, and surrounding communities. The Project has received the following letters of support, which can be found in Appendix C:

- Chair of the Ellershouse CLC
- West Hants Regional Municipality
- General Manager of the AREA
- Mayor of Mahone Bay
- Mayor of Antigonish
- Mayor of Berwick
- Glooscap First Nation Economic Development Corporation
- Ulnooweg Development Group
- AVFN

6.2.7 On-going Engagement

The Project Team will continue to help address questions or concerns raised by stakeholders and members of the public over the life of the Project. Specifically, the Project Team plans to host an additional open house during the Project development phase. The Project website and email address will remain active for the duration of the Project to provide opportunity for stakeholders and the public to receive information and provide feedback or ask questions. The Project Team will also continue meeting with CLC members throughout the Project life to proactively address any concerns or questions.

7.0 BIOPHSYICAL ENVIRONMENT

7.1 Atmospheric Environment

7.1.1 Atmosphere and Air Quality

7.1.1.1 Overview

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

7.1.1.2 Regulatory Context

Relevant legislation includes:

- *Environment Act*, S.N.S. 1994-95, c.1
- Air Quality Regulations (NSAQR), N.S. 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 is located within the St. Margaret's Bay Ecodistrict (780) of the Nova Scotia Western Ecoregion, and the Rawdon/Wittenburg Hills odistrict of the Nova Scotia Eastern Ecoregion (Neily et al., 2017) (Drawing 7.1)

The St. Margaret's Bay Ecodistrict features lower elevations adjacent to the coastal waters of St. Margaret's Bay and Mahone Bay, which encourage more rain, fog, and high moisture levels (Neily et al., 2017).

The local temperature and precipitation data were obtained from the Pockwock Lake meteorological station (Climate ID 8204453) located approximately 23 km southeast of the Project at 44.766666 °N, 63.833333° W (Table 7.1).

Table 7.1: Climate Data from the Pockwock Lake Meteorological Station (2015-2022)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Temperature													
Daily Avg. (°C)	-5.1	-4.4	-1.0	4.2	9.9	14.8	18.9	19.4	15.6	10.2	4.1	-1.9	7.1
Daily Max. (°C)	-0.3	0.6	3.4	9.2	15.3	20.2	23.8	24.2	20.3	14.6	8.2	2.5	11.8
Daily Min. (°C)	-9.9	-9.3	-5.3	-0.7	4.3	9.4	14.0	14.5	10.9	5.7	-0.1	-6.3	2.3
Extreme Max. (°C)	13.5	18.5	26.5	24.0	30.5	32.0	32.5	31.0	38.0	23.0	20.5	15.0	-
Extreme Min. (°C)	-25.5	-26.0	-19.5	-12.5	-5.0	-2.0	4.0	1.5	0.5	-7.5	-14.0	-21.5	-
Precipitation													
Precipitation (mm)	95.7	83.6	74.6	104.2	63.4	93.4	78.7	59.9	89.3	98.2	100.3	136.4	1077.7

Source: ECCC 2022a

From January 2012 to December 2022, the mean annual temperature was 7.1°C, with a mean daily maximum of 11.8°C and a mean minimum of 2.3°C. January and February were the coldest months (mean daily average of -5.1°C and -4.4°C, respectively), while the warmest months were July and August (mean daily average of 18.9°C and 19.4°C, respectively). From January 2012 to December 2022, the meteorological station recorded precipitation, with most occurring in April and December (104.2 mm and 136.4 mm, respectively) (ECCC, 2022a).

The wind speed and direction data were obtained from the Kentville CDA CS meteorological station (Climate ID 8202810) located approximately 39 km northwest of the Project at 45.066667 °N, 64.483333° W (Table 7.2).

Table 7.2: Wind Data from the Kentville CDA CS Meteorological Station (2012-2022)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Maximum Hourly Speed (km/h)	82	98	84	82	80	65	83	57	82	74	77	80
Most Frequent Direction	NW	NW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW

Source: ECCC 2022b

The maximum hourly wind speeds recorded at the Kentville CDA CS meteorological station between 2012 and 2022 ranged from 57 km per hour (km/h) to 98 km/h. The wind direction most observed at the meteorological station is from the southwest; however, in January and February, wind occurred from the northwest. Note that wind directions may occur in all directions; however, during calm wind flows, the direction is not recorded at the meteorological station (ECCC, 2022b). A windrose plot provided for the Kentville CDA meteorological station (CXKT) demonstrates the wind directions from January 2012 to December 2022 (Figure 7.1).

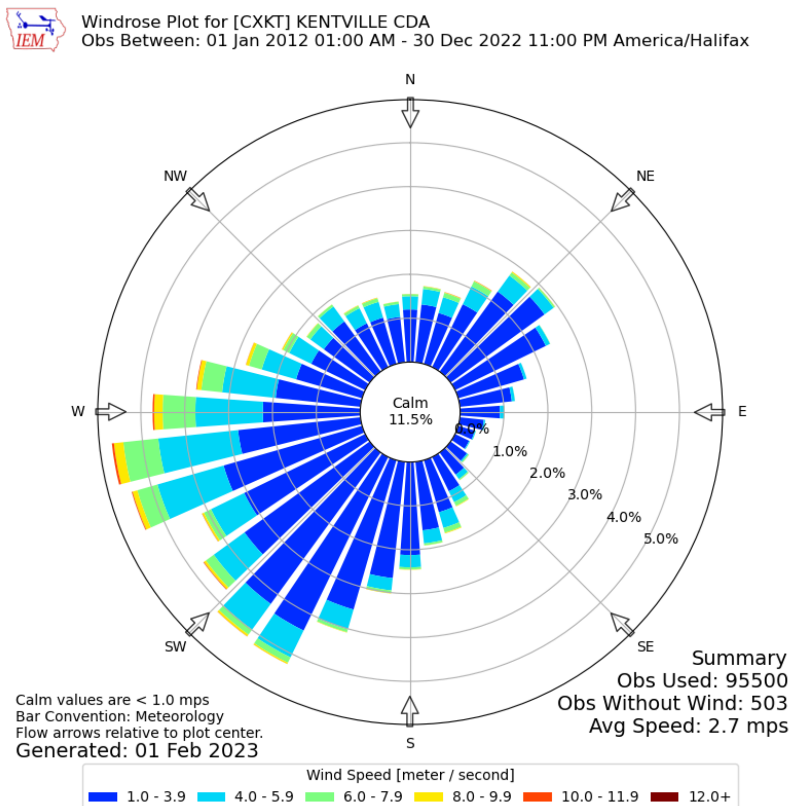

Figure 7.1: Windrose Plot for Kentville CDA Meteorological Station (CXKT) – January 1, 2012, through December 30, 2022 (Iowa State University, 2023)

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.), while the Government of Nova Scotia has legislated Air Quality Regulations (NSAQR), N.S. Reg. 8/2020 under the *Environment Act,* S.N.S. 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); these proposed values are provided in Table 7.3 for comparative purposes (Table 7.3).

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

Contaminant	Averaging Period	Regulatory Threshold (µg/m³)	
		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) [Nova Scotia Air Quality Regulations, N.S. Reg. 8/2020].
[2] Proposed Ambient Air Quality Standards (subject to change) (NSECC, 2022b).
[3] Geometric mean.
[4] Ozone is no longer included as an ambient air quality standard in the Proposed Provincial Guidelines.

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

- carbon monoxide (CO)
- ground-level ozone (O_3)
- nitrogen oxides (NO_x)
- nitric oxide (NO)
- nitrogen dioxide (NO_2)
- particulate matter ($PM_{2.5}$)
- 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, 2023; 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, 2023).

The air quality monitoring station closest to the Project is in Kentville, NS, approximately 39 km northwest of the Project at 45.071717° N, 64. 479792° W.

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

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

Parameter	Averaging Period	O_3 (ppb)	SO_2 (ppb)	NO_X (ppb)	NO (ppb)	NO_2 (ppb)	$PM_{2.5}$ (ug/m^3)	TSP (ug/m^3)	CO (ppb)	H_2S (ppb)
Kentville Ambient Monitoring 2018-2022	1 hour	67.3	-	34.1	24.3	20.3	66.1	-	-	-
	24 hours	53.5	-	7.0	4.1	5.1	29.9	-	-	-
	Annual	29.3	-	1.2	0.3	0.8	5.3	-	-	-
NS AAQS Schedule A	1 hour	82	340	-	-	210	-	-	30,000	30
	24 hours	-	110	-	-	-	-	120	-	6
	Annual	-	20	-	-	50	-	70*	-	-
Fraction of NS AAQS Schedule A	1 hour	82%	-	-	-	10%	-	-	-	-
	24 hours	-	-	-	-	-	-	-	-	-
	Annual	-	-	-	-	2%	-	-	-	-

Source: NSECC 2022a
*geometric mean

As seen in Table 7.4, existing air quality conditions (i.e., baseline data) indicate that most of the measured contaminants are well below their respective NS AAQS Schedule A limits except O_3, which is at 82% of the 1-hour limit. The reported AQHI is typically scored 'low' at all times of the year (ECCC, 2023).

7.1.1.5 Effects Assessment

Project-Atmospheric Interactions

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

Table 7.5: Potential Project-Atmospheric Interactions

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

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

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

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

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

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

The interaction with local receptors was assessed to determine environmental impacts on ambient air quality from fugitive dust emissions. The closest non-participating receptors are located over 673 m from the Project (Drawings 7.2). These receptors are located beyond the extent to which fugitive dust emissions are expected to travel, and, as a result, no impacts are anticipated as fugitive dust emissions are considered short-term (construction), intermittent, and within the LAA.

Construction of the Project may result in an increase of combustion residuals and/or exhaust tailpipe emissions, primarily PM, NO_x, SO_2, and CO from vehicles (i.e., travel by Project personnel, transport/delivery activities) and heavy equipment. The closest non-participating receptors are located over 673 m from the Project (Drawings 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 required for construction activities.
- Stabilize exposed soil surfaces 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.
- 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 approved alternative dust suppressant technologies to minimize airborne emissions.
- Monitor the need for dust suppression and its effectiveness.
    - Consider changes in speed limits, alternative routes, and timing of activities, where appropriate.
- 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.
- Require 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:

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

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

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

7.1.2 Climate Change

7.1.2.1 Overview

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

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

7.1.2.2 Regulatory Context

The climate change assessment considered the following Acts and Regulations:

- *Environment Act*, S.N.S. 1994-95, c. 1
    - Regulations Respecting Greenhouse Gas Emissions, N.S. Reg. 260/2009
- *Environmental Goals and Sustainable Prosperity Act,* S.N.S. 2007, c. 7
- *Canadian Environmental Protection Act* (*CEPA*), S.C. 1999, c. 33
    - 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

Regulatory guidance was used to determine the appropriate assessment methodologies, mitigation controls, best management practices, 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 estimates based on the assumptions outlined throughout Section 7.1.2 and are expressed in tonnes of carbon dioxide equivalent (tCO_2e).

7.1.2.4 Sources of Greenhouse Gas Emissions

The main GHGs of concern include:

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

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

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

Methane

Methane (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 the disturbance of wetlands (which act as methane sinks).

The Project's construction phase requires heavy- and light-duty equipment, which may contribute to methane emissions. Alteration of wetlands for constructing access roads and wind turbine laydowns, and the decay of waste (i.e., decomposing cleared vegetation, workforce waste production) could also contribute to methane emissions.

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

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

The Project's construction phase requires heavy- and light-duty equipment, which can contribute to nitrous oxide emissions. Land restoration activities (i.e., soil amendments and reclamation) following construction will also contribute to 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 (USEPA, 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 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.

Based on the wind turbine design capacity and a capacity rating of 34.59% (Hatch, 2008), the Project will be capable of producing approximately 199,985,544[2] kiloWatt hours per year (kWh/year). The lifespan of the Project is estimated at a minimum of 25 years.

Quantifying GHGs in terms of tCO_2e 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).

[2] $66MW \times 0.3459 \times 365 \frac{days}{year} \times 24 \frac{hours}{day} \times 1000 \frac{kW}{MW} = 199{,}985{,}544 \frac{kWh}{year}$

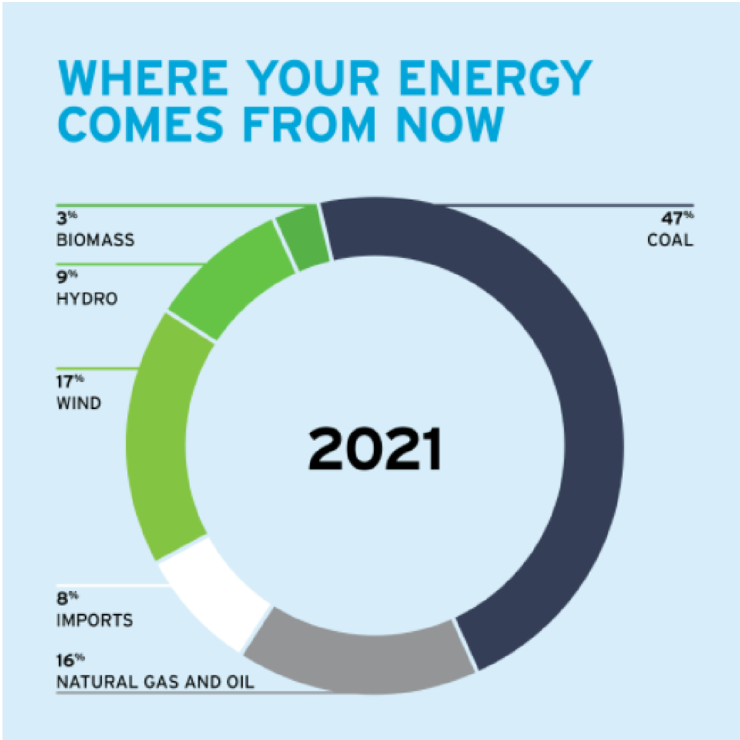

Figure 7.2: NS Power 2021 Energy Statistics

In 2021, electricity generated in Nova Scotia 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% (Biomass, Wind, Hydro and Tidal), 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 considers wind at 29%.

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

Table 7.6: Electricity Fuel Source Emission Factors

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

Source: USEIA, 2022

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

Table 7.7: Baseline Quantification Summary

Electricity Fuel Source	Electricity Generation (kWh/yr)	Emissions (tCO_2e)
Coal	97,992,917	100,454.40
Natural Gas	21,998,410	9,678.96
Oil	21,998,410	24,347.07
Wind	57,995,808	0
Total	**199,985,544**	**134,480.43**

The total annual GHG emissions generated in Nova Scotia for the same electrical capacity of the Project is **134,480,43 tCO_2e.**

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

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 100 m x 100 m = 10,000 m^2 each) are intended to store equipment temporarily and include the turbine pad foundation and crane pad. These areas will be prepped by removing the vegetation and overburden and placing competent soils.

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

Concrete Foundation

A concrete tower foundation will be required for each wind turbine. As such, the Project will require concrete to be produced and delivered to each wind turbine location. The exact dimensions and volume of concrete required will depend on the final Project engineering, and as such, an estimate based on a previous project has been used for the purposes of this assessment.

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 of the Project; as such, for the purpose of this assessment, the Casey Concrete Ltd. quantities will be assumed for GHG quantification. The quantification of the GHG emissions requires the following inputs:

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

Heavy-duty diesel concrete trucks will be required to transport concrete to the Project Area. For the purposes of this assessment, transportation distances are based on the nearest known concrete supplier, which is located approximately 14 km from the Project Area. Given the turbine locations are scattered across the Project Area, transportation distances range from 20 km to 26 km (Table 7.8).

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

Wind Turbine	Approximate Distance (km)
1	20.72
2	20.18
3	23.06
4	22.38
5	21.41
6	21.11
7	22.03

Wind Turbine	Approximate Distance (km)
8	24.30
9	23.93
10	24.91
11	24.96
12	25.21
Total	**274.21**

Based on Table 7.8, the total distance between the wind turbines and the nearest concrete supplier is 274.21 km. Assuming 140 truckloads per wind turbine, the total one-way distance travelled is 38,388.98 km. GHG quantification considered travel to and from the nearest concrete supplier to the wind turbine locations.

For this assessment, it is assumed that each concrete truck will carry approximately 17.86 tonnes[3] of concrete per delivery for a total of 2,500 tonnes of concrete per wind turbine.

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

Table 7.9: Concrete Manufacturing and Transportation Emission Factors

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

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

Given the travelling distances, the quantity of concrete required for the Project, and the emission factors (Table 7.9), the CO_2e emissions are expected to be approximately **9,135.00 tCO_2e** for constructing all the tower foundations.

Detailed CO_2e calculations are provided in Table 2, Appendix D.

Turbine

The Project will require wind turbines to be manufactured and delivered to the Project Area. For this assessment, the wind turbine for the Project is assumed to be the Nordex N163. This turbine has a rotor diameter of 163 m and can generate up to 5.9 MW of power.
To quantify GHG contributions from the turbines during the construction phase, the following items were assessed:

[3] $2{,}500\,\frac{Tonnes\ of\ Concrete}{Turbine} \div 140\,\frac{Trucks}{Turbine} = 17.86\,\frac{Tonnes\ of\ Concrete}{Truck}$

- 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: Jonesboro, Arkansas (AR), USA
- Nearest US Shipping Port: Norfolk, Virginia (VA), USA
- NS Shipping Port: Port of Sheet Harbour, Sheet Harbour, 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 (2017), the total weight of manufacturing material is equivalent to approximately 120,000 kg/MW. Given the Project's wind turbine model capacity of 5.9 MW, the total weight of a wind turbine is assumed to be approximately 708,000 kg.

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

Table 7.10: Wind Turbine Manufacturing Emission Factor

Component	Emission Factor (tCO_2e/kg)
Wind Turbine Material (Steel)*	1.5×10^{-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, the assumptions provided above, and the emission factor (Table 7.10), the estimated CO_2e emissions from the manufacturing of all the wind turbines are predicted to be approximately **12,744 tCO_2e**. Nordex SE occupies an onshore turbine manufacturing plant in Jonesboro, AR (Nordex SE, 2010). For the purposes of this assessment, Project turbines are assumed to be manufactured at this location, then will travel to Norfolk, VA, by heavy diesel hauler (transport), where they will be shipped via diesel cargo vessel to the Port of Sheet Harbour, Sheet Harbour, NS. Table 7.11 summarizes the estimated transportation distances from the manufacturer to the Project.

Table 7.11: Wind Turbine Transportation Distances

Originating Destination	Final Destination	Distance (km)
Jonesboro, AR	Norfolk, VA	1,600 (Land)
Norfolk, Va	Sheet Harbour, NS	1,500 (Marine)
Sheet Harbour, NS	Ellershouse 3 Wind Farm (Project)	165 (Land)

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

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

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

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

Wind Turbine	Approximate Distance (km)
1	21,260.66
2	21,254.16
3	21,288.72
4	21,280.61
5	21,268.94
6	21,265.28
7	21,276.36
8	21,303.65
9	21,299.18
10	21,310.97
11	21,311.47
12	21,314.47
Total	**255,434.48**

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

Based on Table 7.12, the total land transportation distance between the wind turbine manufacturer and the wind turbine laydowns (not including marine transportation) is **255,434.48 km**. The total marine transportation distance associated with getting the wind turbines from Norfolk, VA, to Sheet Harbour, NS, is **18,000 km**. The distances travelled consider travel from the manufacturer to the Project Area only; an equivalent return distance is not considered as the hauling companies would likely have commitments with other clients, and those GHG emissions would not be attributable to the Project.

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

Table 7.13: Wind Turbine Transportation Emission Factors

Component	Emission Factor (tCO_2e/tonne·km)
Heavy Duty Truck (Diesel) with freight	1.35×10^{-4}
Marine Cargo and Container Vessel (Diesel) with Freight	1.51×10^{-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 assumed emission factors (Table 7.13), the CO_2e emissions from land transportation of the wind turbines are calculated to be approximately **2,034.54 tCO_2e**. In addition, the marine transportation distances required to deliver the wind turbines from the United States to Canada is calculated to emit **192.43 tCO_2e**.

Detailed CO_2e calculations are provided in Table 3, Appendix D.

7.1.2.7 Operations Phase

Following the construction phase, the turbines will be operational, and the Project will contribute a net reduction in GHG emissions compared to the baseline conditions. Based on the wind turbine design capacity and a capacity rating of 34.59% (Hatch, 2008), the Project will be capable of producing approximately 199,985,544 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 to 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 GE Renewable Energy (2018) and the European Wind Energy Association (u.d.), nacelle weights range from 59,200 kg to 61,400 kg, and blade assembly weights range from approximately 28,000 kg to 35,000 kg. For the purposes of this assessment, a conservative estimation of 61,400 kg and 35,000 kg was assumed for the nacelle and blade weights, respectively. Given the replacement rates, nacelle material accounts for approximately 9,210 kg and blade replacement 11,667 kg throughout the wind turbine lifetime. The total emission from the replacement material for all the Project's wind turbines is **375.78 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 7.14).

Table 7.14: Potential Project-GHG Interactions

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

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

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

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

Effects
The Project will have a net positive effect on the GHG environment (Table 7.15).

Table 7.15: Project GHG Baseline and Emission Summary

Component	Emissions (tCO_2e)
Baseline	
Electricity Generated from Coal	100,454.40
Electricity Generated from Natural Gas	9,678.96
Electricity Generated from Oil	24,347.07
Electricity Generated from Wind	0
Total	**134,480.43**
Construction Phase	
Concrete Production and Transportation	9,135.00

Component	Emissions (tCO_2e)
Wind Turbine Manufacturing	12,744.00
Wind Turbine Transportation	2,226.97
Total	**24,105.97**
Operations Phase	
Electricity Generated from Wind	0
Wind Turbine Maintenance	375.78*
Total	**375.78**

Note: The values in this table may differ from those presented in Appendix D, as a result of rounding errors; however, the rounding errors are negligible and do not change their representation.
*Project lifespan emissions (single event)

As mentioned, the current GHG emissions for the quantity of electricity required by the Project using Nova Scotia Power's conventional generation methods contribute to **134,480.43 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 **24,105.97 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 **375.78 tCO_2e**.

Following the commissioning of the Project, the annual Project GHG emission reduction is expected to be **134,480.43 tCO_2e** compared to GHG emissions that would typically be emitted from conventional production methods employed by NS Power. A one-time **375.78 tCO_2e** may be subtracted from any annual reduction; however, the annual reduction rate will be applied for the lifespan of the Project (25+ years). The Project is anticipating a 0.2-year[4] payback period to offset the construction-related GHG emissions.

The assumptions considered in this assessment propose a conservative estimate of predicted GHG emissions, which may vary if turbine and concrete manufacturer locations are at a different distance 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 GHG emissions.**

4 $\frac{Construction\ Emissions}{Offset\ Emissions} = \frac{24{,}105.97tCO2e}{134{,}480.43tCO2e/year} = 0.2years$

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.
- 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).
- Require 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.
- Require that construction equipment with an improperly functioning emission control system is not operated.
- Require that regular equipment maintenance is undertaken to maintain good operations and fuel efficiency.
- Require that 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.
- Require that 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.
- 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

Blasting is an anticipated activity for the construction of the Project, but the need/requirement will be assessed as part of subsequent geotechnical investigations. Where blasting is determined to be required, groundwater wells within 800 m will undergo assessment according to NSECC's Procedure for Conducting a Pre-Blast Survey (1993).

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

- Arial imagery and topography
- Ecological Land Classification for Nova Scotia (Neily et al., 2017)
- Nova Scotia Geoscience Atlas (NSNRR, 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)

Detailed geotechnical investigations/engineering will also be completed within the Assessment Area as part of the Project's design process.

7.2.4 Assessment Results

Topography

The northwestern portion of the Study Area lies within the Rawdon/Wittenburg Hills Ecodistrict (410) of the Eastern Ecoregion (Neily et al., 2017). This Ecodistrict is located on two slate ridges which rise notably above the surrounding valleys of the Stewiacke, Musquodoboit, and Shubenacadie rivers. The northeast trending ridges are comprised of folded Meguma Group slate with sandy clay loams along the side slopes. The southeastern portion of the Study Area lies within the St. Margaret's Bay Ecodistrict (780) of the Western Ecoregion which encompasses the eastern portion of the South Mountain granitic batholith. This gently tilting upland ranges from 150 m near Panuke Lake to sea level along the Atlantic coast (Neily et al., 2017).

Within the Study Area, topography ranges from flat to strongly rolling with ridges of hard rock exposed in areas of thin till (NSNRR, 2021a). Elevations within the Study Area range between approximately 130 m to 185 m above sea level (masl) (Drawing 7.3).

Surficial Geology

Based on surficial geology mapping, surficial features present within the Study Area primarily consist of ground moraines and streamlined drifts composed of stony granitic glacial till material derived from the local bedrock (NSNRR, 2021a) (Drawing 7.4). Till thickness associated with these features ranges between 2 m and 20 m. With this till, the acid rain buffer capacity of the soil is limited, though it is rapidly draining as a result of its stony nature. The remaining portion of the Study Area is characterized by glacially scoured basins and knobs overlain by a thin and discontinuous layer of till. In addition, ridges of exposed bedrock can be found within the Study Area where till layers are thin (NSNRR, 2021a).

Bedrock Geology

The bedrock located within the Study Area belongs primarily to the Liscomb Complex and is defined as Middle - Late Devonian granodiorite (M-LDgd) (Drawing 7.5). This bedrock is part of the larger South Mountain Batholith (a massive granitoid formation) that extends between Yarmouth and Halifax, and has been a target for mineral exploration since the late 1800's (NSNRR, 2021a). In the northern extent of the Study Area, there are also occurrences of the Goldenville and Halifax Formations (part of the Meguma Group). 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).

General Hydrogeologic Conditions
Less than 1% of the Rawdon/Wittenberg Hills Ecodistrict is comprised of freshwater lakes and streams. This Ecodistrict does however contain headwater streams for the following rivers:

- St. Andrews River
- South Branch Stewiacke River
- Musquodoboit River
- Herbert River
- Meander River
- Kennetcook River
- Nine Mile River

Extensive floodplains can be found where the aforementioned river systems enter lowland areas. Within the St. Margaret's Bay Ecodistrict, there are several large lakes along with small streams, swamps, and bogs. The largest river in this ecodistrict is known as the Gold River, which drains the western extent of the ecodistrict (Neily, et al. 2017).

The nearest protected water area is Windsor – Mill Lakes, a 4,394 ha watershed servicing Windsor, located approximately 2 km west of the Study Area. The next nearest protected water area is Pockwock Lake, a 5,661 ha watershed located approximately 13 km east of the Study Area. This watershed is located on both private and Crown land; managed jointly by Halifax Water, NSNRR, and the Municipality of East Hants to provide water to the Halifax metro area (Halifax Water, 2022).

The nearest wellhead protection area is the Five Island Lake Wellhead Protection Area located over 25 km southeast of the Study Area. This water collection system is managed by Halifax Water and was constructed in 1993, providing water to one nearby commercial consumer and nine residential consumers (Halifax Water, 2010).

Groundwater Quality and Quantity
The Study Area is predominantly underlain by plutonic rocks (mainly granite) which carry groundwater through fractures and cracks within the bedrock. Groundwater sourced from plutonic rock is generally classified as plutonic water and is typically associated with lower quantities of groundwater and consequently lower well yields compared to other regions. Wells located in plutonic rock typically have lower dissolved solids, hardness, and well water yields as a result of groundwater only flowing through cracks and fractures in the rock (NSECC & NSNRR, 2009).

Groundwater Wells
According to the NSECC Well Logs Database (2022c), 178 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 (151), public (not municipal) (2), industrial (1), or unspecified (24). A summary of

well properties within 2 km of the Study Area is presented in Table 7.16, and a complete characterization log of wells within 2 km is provided in Appendix E.

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

	Drilled Date (year)	Well Depth (m)	Casing Depth (m)	Depth to Bedrock (m)	Static (m)	Estimated Yield (Lpm)
Minimum	1946	4.87	2.13	0.61	-0.03	0.00
Maximum	2020	176.61	59.38	45.68	86.78	363.20
Average	n/a	44.06	13.51	9.73	6.10	32.72

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 32.67 Lpm (litres per minute) with an average well depth of approximately 43.57 m. These measurements represent very short-term yields estimated by the driller at the completion of well construction (NSECC, 2022c).

Two of the 178 water wells identified are located within the Study Area (none of which are within the Assessment Area) (Table 7.17).

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

Well ID	Community	Use	Depth (m)	Casing (m)	Bedrock (m)	Static (m)	Yield (Lpm)	Easting	Northing	Distance to AA*
830709	Ellershouse	Domestic	44.15	8.22	7.00	7.00	31.78	418633	4976525	0.11 km
901835	Ellershouse	n/a	25.88	6.09	4.87	3.04	22.70	416500	4971500	0.31 km

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

In addition to the above, an observation well was discovered during surveying activities (summer 2022) at 44.8733 N, 64.0815W (Drawing 7.6). Records of this well could not be identified in the provincial databases and the landowner on which the well was located could not provide any further information. This well is located within the Study Area <10 m from the Assessment Area.

The NSNNR Pumping Test Database (2022a) provides longer term yields for select wells throughout the province. A test well located within 3 km of the Study Area in the community of Lakelands (Well #140054) indicates a long-term safe yield of 13.065 Lpm and an apparent transmissivity of 0.16 m^2/day. This well is located in metamorphic bedrock of the Goldenville Formation and was tested for the Terra Firma Development Corp. (Forest Lakes Country Club) in 2014 (NSNRR, 2022a).

NSECC maintains the Nova Scotia Groundwater Observation Well Network (2015a). The nearest observation well to the Study Area is located approximately 11 km north, in Smileys Provincial Park, near the community of McKay Section. This well was drilled to a depth of

9.80 m through clay and gravel. The well had been constructed in 1967 as a water supply for the park and was converted to an observation well in 2011 because it was no longer in use as a water supply well. In 2014, the average water elevation was 29.05 masl and the annual water level fluctuation was 2.85 m. The average depth to water in this well since 2014 was 5.95 m below top of casing (NSECC, 2015a).

7.2.5 Effects Assessment

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

Table 7.18: Potential Project-Geophysical Interactions

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

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

Assessment Criteria
Assessment criteria provided in Section 4.6 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, 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). Within the Assessment Area, there is a low risk of acid generating bedrock, except along the most northern extent where sulphide-bearing slates have been recorded in the Goldenville and Halifax Formations (NSNRR, 2002). No turbine pads or new access roads are located in bedrock regions at risk for ARD. The presence of sulphide-bearing minerals and likelihood of ARD will be determined following the results of the geotechnical evaluation.

According to the Karst Risk Map (Drawing 7.7), 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 7.8) shows the Assessment Area is primarily located in “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.

Groundwater risk mapping shows that the Assessment Area is situated in a “High Risk” region for arsenic and uranium containing bedrock (Drawings 7.9 and 7.8) (NSNRR, 2021b).

Construction activities (primarily blasting, as required), can result in the disturbance of naturally occurring arsenic and uranium within underlying bedrock. Disturbed arsenic/uranium also has the potential to be mobilized through groundwater and subsequently degrade nearby groundwater well quality. Arsenic and uranium containing bedrock (and groundwater) is a common occurrence across Nova Scotia, and as a result, groundwater well owners are encouraged by the province to frequently test wells to ensure adherence to applicable standards (NSECC & NSNRR, 2009). The maximum acceptable concentration of arsenic in well water is 0.01 mg/L while the maximum acceptable concentration of uranium in well water is 0.02 mg/L (Health Canada, 2006; Health Canada, 2019). Potential impacts to nearby groundwater well quality from arsenic and uranium are not anticipated based on:

- Construction activities will primarily consist of clearing, grubbing, and grading within the surficial layer. Contact with/disturbance of groundwater is not anticipated.
- No issues/concerns regarding groundwater, arsenic, or uranium were identified during previous blasting activities completed as part of the existing Ellershouse Wind Farm. Blasting was completed within both temporary and operational quarries as a source of aggregate required the construction of the roadways.
- Prior to blasting activities, blasting monitoring and mitigation plans will be developed in adherence with regulatory guidelines.
- Desktop resources identified only one groundwater well within 800 m of a turbine pad (component most likely to require bedrock disturbance/blasting). This well (ID# 901835) was drilled in the 1990s, has no listed water use type, and aerial imagery shows the well is located in an active forestry area with no structures nearby.
- The observation well (unknown ID) discovered during surveying activities has been recorded, presented, and will be incorporated into mitigation and monitoring (where required for blasting).

In addition to water quality, groundwater quantity can potentially be impacted if blasting activities alter local hydrogeological flow regimes, resulting in groundwater draining from or flowing towards existing wells. Where blasting is required, wells located within 800 m of blasting activities will undergo monitoring per NSECC’s Procedure for Conducting a Pre-Blast Survey (1993). The requirement for blasting and pre-blast surveys will be confirmed and assessed further during geotechnical investigations.

Uranium also carries the risk of potential health impacts from exposure to radioactive material. Uranium is naturally occurring radioactive element that can be found throughout the earth’s crust, that when disturbed/exposed, may release radiation (alpha, beta, and some gamma radiation). People are exposed to background levels/low levels of radiation continually from sources such as the sun, ground surface, medical procedures, etc. (US EPA, 2022b). Potential impacts to human health (e.g., cancer risk) arise when individuals are exposed to radiation levels at high concentrations and/or for prolonged durations (Health Canada, 2021). For the Project, the receptor with the greatest potential for exposure to uranium is construction workers from direct contact/inhalation of uranium containing material (e.g., soil, dust, bedrock) during earthwork activities. Potential impacts to human health from uranium containing bedrock are not anticipated based on:

- Disruption of uranium containing material is anticipated to be minimal as construction activities will primarily occur within the surficial geologic layer. Blasting activities will be localized and contained. Mitigation measures for blasting in areas of high-risk for uranium will also be included as part of the Project's blasting plan.
- Construction (where exposures are most likely) will be temporary, short term, and outdoors.
- Concerns or issues regarding uranium containing bedrock were not identified during the construction/operation of the existing Ellershouse Wind Farm.

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 further assessed in upcoming geotechnical investigations. In addition, the use of existing road networks, siting in previously disturbed areas, and use of existing right-of-way's minimize the Project's impact to the overall geologic environment.

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

- Conduct blasting, where required, in accordance with provincial legislation and subject to terms and conditions of applicable permits.
  - Require that all blasts are conducted and monitored by certified professionals.
  - Require that all protective measures outlined in the EPP are implemented in advance of blasting activities. This will include a review for potential impacts related to uranium and associated mitigation and monitoring, as required.
  - 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. This will include a review for potential impacts related to uranium and associated mitigation and monitoring, as required.
  - 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.
- Require rock removal in known areas of elevated sulphide potential to 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.
- Temporarily store any soil needed for backfilling (e.g., after foundations have been poured) adjacent to the excavations until needed. Any remaining excavated material will be used on the site or removed and sent to an approved facility.
- Install temporary erosion controls immediately after a disturbance in an erosion prone area and maintain and reinstall as necessary. Inspect controls on a regular basis.
- Remove temporary erosion and sedimentation controls once the area has stabilized.

Monitoring
Based on the presence of Halifax and Goldenville Formations within the Study Area, the presence of acid generating rock/potential for 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.

Blasting is an anticipated activity for the construction of the Project, but the need/requirement will be assessed as part of subsequent geotechnical investigations. Where blasting is determined to be required, groundwater wells within 800 m will undergo assessment as per the NSECC Procedure for Conducting a Pre-Blast Survey (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 objective of the waterbody and watercourse assessment was to inform the Project's design and collect the information necessary to assess potential impacts to waterbodies, watercourses, and fish habitat (assessed separately in Section 7.3.2) resulting from the Project. This was accomplished using the following approach:

- Identify watercourses and waterbodies within the Study Area using desktop resources (Drawings 7.10).
- Use the information collected to inform Project design (e.g., avoid/minimize impacts to waterbodies and watercourses) and develop an Assessment Area.

- Traverse the entirety of the Assessment Area to ground truth waterbodies and watercourses and provide characterization of any identified features (Drawings 7.11A to 7.11J).
- 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,* SNS 1994-95, c. 1, NSECC has the authority to promote the sustainable management of water resources in Nova Scotia. More specifically, as per section 5A of the Activities Designation Regulations, NS Reg 47/95, the alteration of a watercourse or the flow of water within a watercourse is an activity that requires an approval from NSECC, or a notification to NSECC if the work will be completed in accordance with the Nova Scotia Watercourse Alterations Standards.

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

7.3.1.3 Desktop Review

Waterbodies

A desktop review was conducted to identify mapped and potential waterbodies within the Study Area. A review of the federal CanVec Database – Hydrographic Features (NRCAN, 2022a) identified Halls Lake and a ponded section of Sucker Brook within the Study Area, along with 57 named and unnamed features within 5 km. Hall's Lake is the largest open body of water within the Study Area, approximately 9.5 ha in size, located near the centre. A complete list of named waterbodies located within 5 km of the Study Area is provided in Table 7.19.

Table 7.19: Named Waterbodies Within 5 km of Study Area

Name of Waterbody	Location
Waterbodies Within the Study Area	
Hall's Lake	Central north extent
Ponded section of Sucker Brook	Central south extent
Waterbodies Within 5 km of Study Area*	
Taylor Lake	0.11 km north
Panuke Lake	0.14 km west
Bog Lake	0.78 km east
Starks Lake	1.03 km west
Shady Lake	1.12 km south

Name of Waterbody	Location
Big Pine Lake	1.52 km east
West Lake	1.76 km east
Bearskin Lake	2.00 km east
King Lake	2.18 km east
Mill Lakes	3.17 km west
Euchre Lake	3.23 km south
Five Mile Lake	3.82 km east
Bennett Lake	4.49 km east
Smiley Lake	4.54 km east
Little Pine Lake	4.75 km south
Mosquito Lake	4.93 km west

*Measurement from the nearest point of the Study Area.

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

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

- NS Topographic Database – Water Features (GeoNOVA, 2022)
- CanVec Database – Hydrographic Features (NRCan, 2022a)
- 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 23 watercourse segments within the Study Area and 326 segments within 5 km of the Study Area. Two named watercourses were identified within the Study Area, including Halls Lake Brook and Sucker Brook. Furthermore, several named watercourses were identified within 5 km of the Study Area including:

- Piney Stream
- Black Brook
- Bog Brook
- Eagle Cove Brook
- Dawson Brook
- Lebreau Creek Brook
- Stoney Brook
- Maple Brook
- Weir Brook
- Shady Lake Brook

- St. Croix River
- Sams Brook

The Study Area is located within the St. Croix River Primary Watershed (1DE) and the St. Croix River Secondary Watershed (1DE-1) (Drawing 7.12). Positioned higher in the watershed, the Study Area has an average elevation of roughly >150 m asl. However, natural forces have created extensive topographical diversity, with high points surpassing 180 m, and low points closer to 60 m. WAM data shows groundwater to range from 0 m to >10 m of the surface, with the majority being within >10 m of the surface on account of the area being rapidly to well drained (Drawing 7.13) (NSNRR, 2012a). Drainage within the Study Area is primarily routed through three main watercourses – Halls Lake Brook, Sucker Brook, and an unnamed watercourse.

The unnamed watercourse drains the northern portion of the Study Area, with several small tributaries eventually directing flow into one major tributary and discharging into Panuke Lake just below the Salmon Hole dam. The headwaters of this watercourse are likely groundwater fed, as no mapped waterbodies exist upstream.

Halls Lake Brook runs through the centre of the Study Area. The headwaters of this watercourse begin at Halls Lake, which is fed by drainage from a large wetland complex to the east. It has several smaller tributaries along its main reach, with all flow eventually discharging into Panuke Lake.

Sucker Brook drains the southwest extent of the Study Area. The headwater source for this watercourse is a large wetland complex to the east. It has several smaller tributaries draining adjacent land as the flow continues west, and eventually discharges into Panuke Lake.

Panuke Lake is an artificial lake that was created from damming portions of the St. Croix River to facilitate the generation of hydroelectricity. After flowing through a series of generating stations, water from Panuke Lake drains to the northwest via the St. Croix River, and eventually discharges into the Bay of Fundy.

7.3.1.4 Field Assessment Methodology

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

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

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

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

7.3.1.5 Field Assessment Results

Nine watercourses were identified within the Assessment Area (Appendix F and Drawings 7.11A to 7.11J), including large permanent (6), small permanent (2), and ephemeral (1) features ranging in bankfull width from 1.25 m to 4.2 m. There were no incidental observations of aquatic species at risk (SAR) identified during the watercourse assessment. Potential turtle habitat is discussed in Section 7.4.3.

Permanent watercourse features see flow for the vast majority, if not the entirety, of the year. Their continuous flow is often attributed to their direct connection to stable sources of water, including lakes and groundwater springs (US EPA, 2013). Small permanent features include streams, brooks, and creeks. These features are often first- and second-order streams fed by springs, groundwater, and run-off, and often act as tributaries to larger features, creating larger permanent features at their confluence. Large permanent features often exhibit lower flow path gradients, larger channel dimensions, and an increased flow (US EPA, 2013).

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

Three of the identified watercourses are located along pre-existing roads and have evidence of alteration in the form of either metal culverts or clear span bridges to facilitate forestry activity. The remaining six watercourses are in undisturbed areas, with no signs of alterations along the surveyed reaches.

7.3.1.6 Effects Assessment

Project-Watercourse Interactions

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

Table 7.20: Potential Project-Watercourse Interactions

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

Assessment Boundaries

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

Assessment Criteria

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

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

Direct Effects
A geographic information system (GIS) suitability analysis was conducted to design a Project Area that would optimize the placement of Project infrastructure to avoid waterbodies and watercourses, to the greatest extent possible. The Assessment Area considered multiple options/configurations of infrastructure components such as roads, transmission lines, a substation, and a laydown area.

Road Upgrades
Pre-existing logging roads cross an unnamed watercourse via a metal culvert as well as Halls Lake Brook and Sucker Brook with clear span bridge structures. Should the structures require upgrading, the unnamed watercourse will be fitted with an adequately sized culvert and the bridges will be replaced with open-bottom structures to ensure characteristics of each watercourse stay as true to pre-construction conditions as possible. Furthermore, Project engineers will assess the load requirements and refine the bridge and culvert requirements during the detailed design phase.

Transmission Line
The remaining six identified watercourses within the Assessment Area are along the proposed transmission line route. None of these crossings are anticipated to impact the respective watercourses, as the transmission lines will span the watercourses. Further, any activity related to the installation of poles or structures to string or pull the transmission lines will be confined to the area above the ordinary high-water mark and will ensure a sufficient vegetative buffer is preserved along the riparian zone.

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

Table 7.21: Watercourse Alteration Summary

Watercourse	Existing Alteration Present?	Forecasted Alteration
WC1	Yes, clear span bridge for road crossing.	Bridge alterations or replacement expected.
WC2	Yes, clear span bridge for road crossing.	Bridge alterations or replacement expected.
WC3	None observed.	Potential transmission line corridor – no alteration expected.
WC4	None observed.	Potential transmission line corridor – no alteration expected.
WC5	None observed.	Potential transmission line corridor – no alteration expected.
WC6	None observed.	Potential transmission line corridor – no alteration expected.
WC7	None observed.	Potential transmission line corridor – no alteration expected.

Watercourse	Existing Alteration Present?	Forecasted Alteration
WC8	None observed.	Potential transmission line corridor – no alteration expected.
WC9	Yes, metal culvert for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.

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

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

Changes in Surface Water Quantity
Changes to the amount of flow can alter channel morphology, increase flood potential, and disrupt habitat characteristics that support vulnerable species (MTO, 2009). These impacts could result from the alteration of bank or channel grades for road development, the compaction of soil from the heavy machinery required for turbine assembly, or the redirection of overland flow via roadway construction.

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. Further, the

EPP will incorporate proven practices 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 (2015b) and executed by a certified Watercourse Alteration Installer/Sizer. For work requiring an approval, specific and detailed mitigation will be developed and submitted to NSECC as part of the application process.

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

Habitat Loss

- Educate Project personnel on the sensitivity of aquatic habitat.
- Clearly mark watercourses 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.
- Conduct any work within the bed of a watercourse or along the banks of a watercourse between June 1 and September 30, where possible, to avoid sensitive periods in the life cycles of fish, to better control water flow, and to allow for a faster revegetation period (NSECC, 2015b).

Altered Hydrology

- Plan any activities within the bed of a watercourse or along the banks of a watercourse to align with low-flow periods, where possible.
- 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 or Engineer.

Changes in Surface Water Quality

- Leave riparian vegetation as intact as Project developments will allow.
- Require that if concrete is to be used in surface water, it is pre-cast and cured for at least one week prior to use at a crossing site (NSECC, 2015c) if crossing upgrades are required.
- 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, 2015c).
- Utilize rock material that is clean, coarse granular, non-ore-bearing, non-watercourse-derived, and non-toxic to aquatic life (NSECC, 2015c).

Monitoring

If crossing structure replacement is required and the replacement structure is 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 Alterations Standard (2015c). Monitoring requirements for crossings requiring an approval will be determined on a crossing-specific basis during the detail design phase.

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

Table 7.22: General Watercourse Monitoring Parameters and Methods of Assessment

Monitoring Parameter	Tasks	Method of Assessment	
		General Monitoring	Detailed Monitoring
Erosion and Sedimentation	Examine stability of watercourse banks both upstream and downstream of the crossing. Examine grade of slope at the crossing, taking note of any erosive channeling in substrate that would indicate the slope may be too steep.	Yes	Yes
	Inspect sediment control measures for effectiveness and look for evidence of sedimentation within the watercourse.	Yes	No
Water Quantity	Examine flow velocity, taking note of any undercutting or abrasive channeling, leftover construction debris, or obstruction to flow resulting from alteration activities.	No	Yes

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

The effects to watercourses are expected to be low. The effects to watercourses are expected to be minimized, 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 objective of the fish and fish habitat assessment was to inform the Project's design and collect the information necessary for the assessment of fish species and associated habitat within the Study Area. This was accomplished using the following approach:

- Identify potential fish habitat (waterbodies, watercourses, and wetlands) within the Study Area using desktop resources.

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

7.3.2.2 Regulatory Context

For species designated as rare or at risk, said species and/or their dwellings are provided protection provincially under the NS *ESA* and *Biodiversity Act*, and federally under *SARA*. Throughout this EA, Species of Conservation Interest (SOCI) are defined as follows:

- Species listed under *SARA* as "Endangered", "Threatened", or "Special Concern" (Government of Canada, 2022).
- Species listed by the 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, 2022a).

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

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

7.3.2.3 Desktop Review

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

- Completed watercourse assessments (Section 7.3.1)
- Completed wetland assessments (Section 7.3.3)
- NS Topographic Database – Water Features (GeoNOVA, 2022)
- Aquatic Species at Risk Map (DFO, 2022)
- NS Significant Species and Habitats Database (NSNRR, 2018)
- Atlantic Canada Conservation Data Centre (ACCDC) Data Report (ACCDC, 2022b)

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

The Aquatic Species at Risk Map (DFO, 2022) is a federal database showing the distribution of SAR and their associated critical habitat within Canadian waters. A review of this database determined the Study Area to include critical habitat for Atlantic salmon - Inner Bay of Fundy (IBoF) pop. (*Salmo salar pop. 1*).

According to the Nova Scotia Significant Species and Habitat Database (NSNRR, 2018) there are no records pertaining to significant aquatic species and/or their habitat within the Study Area, and 21 unique records pertaining to significant aquatic species and/or their habitat within a 100 km radius of the Study Area. These records include:

- Six "Species of Concern" records relating to Triangle floater (*Alasmidonta undulata*) (5), and unknown molluscs (*Mollusca spp.*) (1).
- A total of 14 "Species at Risk" records relating to Triangle floater (10), Delicate lamp mussel (*Lampsilis cariosa*) (3), Brook floater (*Alasmidonta varicose)* (1).
- One "Other Habitat" record relating to Ribbed mussel (*Geukensia demissa*) (1).

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

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

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS ESA Status[3]	NS S-Rank[4]
Fish					
Alewife / Gaspereau	*Alosa pseudoharengus*	---	---	---	S3B
American eel	*Anguilla rostrata*	Threatened	---	---	S3N
Atlantic salmon - Gaspe-Southern Gulf of St Lawrence pop.	*Salmo salar pop. 12*	Special Concern	---	---	S1
Atlantic salmon - Inner Bay of Fundy pop.	*Salmo salar pop. 1*	Endangered	Endangered	---	S1
Atlantic salmon- NS Southern Upland pop.	*Salmo salar pop. 6*	Endangered	---	---	S1
Atlantic sturgeon	*Acipenser oxyrinchus*	Threatened	---	---	S2S3N
Atlantic whitefish	*Coregonus huntsmani*	Endangered	Endangered	Endangered	S1
Brook trout	*Salvelinus fontinalis*	---	---	---	S3
Lake trout	*Salvelinus namaycush*	---	---	---	S3

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS ESA Status[3]	NS S-Rank[4]
Striped bass	*Morone saxatilis*	Endangered / Special Concern	---	---	S2S3B, S2S3N
Striped bass - Bay of Fundy pop	*Morone saxatilis pop. 2*	Endangered	---	---	S2S3B, S2S3N
Aquatic Invertebrates					
Brook floater	*Alasmidonta varicosa*	Special Concern	Special Concern	Threatened	S3
Creeper	*Strophitus undulatus*	---	---	---	S3
Eastern pearlshell	*Margaritifera margaritifera*	---	---	---	S2
Tidewater mucket	*Atlanticoncha ochraea*	---	---	---	S1
Triangle floater	*Alasmidonta undulata*	---	---	---	S2S3

Source: ACCDC, 2022a; [1]Government of Canada, 2022; [2]Government of Canada, 2022; [3]Government of Nova Scotia, 2022; [4]ACCDC, 2022b

The ACCDC (2022) report also identified seven marine aquatic species observations within 100 km of the Study Area (Appendix G). These species are not discussed further as the Study Area is contained inland and will not impact the marine environment.

No fish or aquatic invertebrate SOCI have ACCDC-documented observations within 5 km of the Study Area (ACCDC, 2022b).

7.3.2.4 Field Assessment Methodology

Fish presence and existing habitat were documented as part of the watercourse surveys (Section 7.3.1). For each watercourse, notes on the visual observance of fish were recorded along with any habitat characteristics that may influence fish presence such as pool/riffle sequences, barriers to fish passage, and substrate composition. This information, along with the results of the desktop review, was then used to select ideal watercourses for detailed fish habitat assessments and qualitative electrofishing (Drawing 7.14). Locations selected also considered the position of the watercourse within the watershed and attempted to utilize notable, permanent features that offered a representation of the surficial hydrology across the entire Study Area. Furthermore, DFO was consulted to avoid watercourses in the area due to fry releases as part of a DFO-related initiative.

Fish Habitat Assessment

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

- *Physical Makeup*

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

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

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

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

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

- *Water Chemistry*

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

  Dissolved Oxygen (DO)
  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 (west Territories, 2013).

pH

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

Electrofishing Surveys

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

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

7.3.2.5 Field Assessment Results

Fish Habitat Assessment

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

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

Table 7.24: Fish and Fish Habitat Assessment Results

Watercourse	Surveyed Reach	Possible Barriers to Passage	Fish Seen	Habitat Characteristics			Ranking of Fish Presence
				Spawning [1]	Rearing [2]	Overwintering [3]	
Shady Lake Brook	Downstream	Yes	Yes	Poor	Poor	Moderate	High
	Crossing	Yes	Yes	Poor	Poor	Poor	High
	Upstream	Yes	Yes	Poor	Poor	Poor	High
Sucker Brook	Downstream	Yes	No	Moderate	Poor	Poor	Moderate
	Crossing	Yes	No	Moderate	Poor	Poor	Moderate
	Upstream	Yes	No	Poor	Poor	Poor	Moderate
Halls Lake Brook	Downstream	Yes	Yes	Poor	Moderate	Poor	High
	Crossing	Yes	Yes	Moderate	Moderate	Poor	High
	Upstream	Yes	Yes	Poor	Moderate	Moderate	High

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

Electrofishing Surveys

Electrofishing was conducted during summer 2022. Given the confirmed presence of the Atlantic salmon IBoF subspecies, a *SARA* permit was obtained prior to any electrofishing proceeding (*SARA* Permit No: DFO-MAR-2022-35). Qualitative electrofishing was conducted along Shady Lake Brook, Sucker Brook, and Halls Lake Brook (Drawing 7.14). The electrofishing surveys resulted in 59 individual fish being caught in two of the three surveyed watercourses (Table 7.25).

Table 7.25: Electrofishing Survey Results

Watercourse	Count	Common Name	Scientific Name	COSEWIC Rank[1]	*SARA* Rank[2]	NS *ESA*[3]	S-Rank[4]
Shady Lake Brook	9	Ninespine stickleback	*Pungitius pungitius*	Not Listed	Not Listed	Not Listed	S5
	8	Lake chub	*Couesius plumbeus*	Not Listed	Not Listed	Not Listed	S5
	2	White sucker	*Catostomus commersonii*	Not Listed	Not Listed	Not Listed	S5
Sucker Brook	0	---	---	---	---	---	---
Halls Lake Brook	38	Brook trout	*Salvelinus fontinalis*	Not Listed	Not Listed	Not Listed	S3
	2	Ninespine stickleback	*Pungitius pungitius*	Not Listed	Not Listed	Not Listed	S5

Source: [1]Government of Canada, 2021; [2]Government of Canada, 2021; [3]Government of Nova Scotia, 2022; [4]ACCDC, 2022b

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 (*Salmo salar*)
The Atlantic salmon – IBoF subspecies is listed as 'Endangered' by *SARA* and COSEWIC and as "S1" by ACCDC (2022). IBoF Atlantic salmon are a genetically distinct population of Atlantic salmon that encompass 48 rivers, including the Minas Basin and Chignecto Bay (COSEWIC, 2011). For freshwater habitat, Atlantic salmon prefer 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, 2021a). 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, 2021a). Furthermore, Atlantic salmon prefer a circumneutral pH ranging from 6.5-7.5 (Maine Department of Environmental Protection, 2022).

Atlantic salmon species undertake long feeding migrations to the ocean as older juveniles and adults and return to freshwater streams to reproduce. Marine requirements for IBoF salmon are not as well understood, but temperature is thought to be important. IBoF salmon smolts migrate seaward from rivers during May-July and adults return to the rivers in the late fall to spawn (COSEWIC, 2011).

The closest ACCDC observation of Atlantic salmon IBoF subspecies is 11.2 ± 0.0 km from the Study Area (ACCDC, 2022b).
Atlantic salmon – Nova Scotia southern upland (NSSU) subspecies is listed as 'Endangered' by COSEWIC and as "S1" by ACCDC (2022a). NSSU Atlantic salmon are a genetically distinct population of Atlantic salmon that occupy rivers in both the Eastern Shore and South Shore, draining into the Atlantic, as well as Bay of Fundy Rivers south of Cape Split (DFO, 2013). The exact number of rivers that contain NSSU Atlantic salmon is unknown; however, they have been historically considered present in 72 of the regions 585 watersheds. They are managed under Salmon Fishing Area 20, 21, and part of 22 (DFO, 2013). As the Bay of Fundy rivers interacting with the Project are located to the northeast of Cape Split, it is unlikely that the population would interact with the Project.

The closest observation of Atlantic salmon NSSU subspecies is 13.2 ± 0.0 km from the Study Area (ACCDC, 2022b).

Brook Trout (*Salvelinus fontinalis*)
Brook trout are not listed under federal (*SARA*) or provincial (NS *ESA*) legislation as a SAR; however, they are listed as 'S3' by ACCDC (2022a). This species of trout is typically found in cold, clear, and well oxygenated rivers and lakes with plenty of shade and gravel substrate

(US Fish and Wildlife Service, 2021b). They prefer water temperatures that do not exceed 20° C, though adult fish can tolerate temperatures of up to 25° C for short periods of time. Furthermore, despite being able to reproduce in waters with a pH as low as 4.5, they do best in a pH range of 5.0 to 7.5 (Maryland Department of Natural Resources, 2012).

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

The closest observation of Brook trout is within Hall's Lake Brook, where field staff recorded 38 individuals during electrofishing surveys.

Brook Floater (*Alasmidonta varicosa*)
The Brook floater is listed as 'Special Concern' under *SARA* and COSEWIC, 'Threatened' under NS *ESA*, and as 'S3' by ACCDC (2022). Brook floaters are medium sized freshwater mussels that are confined to only 15 watersheds in Nova Scotia and New Brunswick, including the Salmon/Debert watershed and the Phillip/Wallace watershed (COSEWIC, 2009), both watersheds which are located within the Study Area (further details supplied in Section 7.3.1). This species of mussel is typically found in shallow rivers or streams with moderate to high water flow, and substrate consisting of a rocky bottom with cobble and sand or fine gravel (DFO, 2016). Furthermore, Brook floaters prefer environments with dissolved oxygen levels above 6 mg/L, and a pH greater than 5.4 (DFO, 2016).

Brook floaters are considered long-term brooders, known to hold onto their larvae (called glochidia) for almost a year (US Fish and Wildlife Service, 2018). From there, larvae are released into the water column when temperatures rise above 14° C, where they attach to the body, gills or fins of fish, remaining there through fall and winter until being released in the following spring (US Fish and Wildlife Service, 2018). After development on the host fish, juveniles burrow into the substrate of rivers where they grow into adults. As sessile organisms, Brook floaters require areas of flow refuge with stable substrate (US Fish and Wildlife Service, 2018) and in this life stage, like other mussels, Brook floaters feed on algae, bacteria, and other particles filtered from the water column (COSEWIC, 2009).

The closest ACCDC observation of Brook floater is 54.1 ± 0.0 km from the Study Area (ACCDC, 2022b).

7.3.2.6 Effects Assessment

Project-Fish and Fish Habitat Interactions
Project activities, primarily those that involve watercourse crossing, earth moving, or

vegetation removal, have the potential to impact fish and fish habitat (Table 7.26). These potential impacts could include habitat removal, disruptions to hydrology, and/or displacement of sediment.

Table 7.26: Potential Project-Fish and Fish Habitat Interactions

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

Assessment Boundaries

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

Assessment Criteria

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

- Negligible – no loss of fish habitat or impact 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

As detailed in Section 7.3.1, there is a potential for three watercourse alterations that may impact fish and fish habitat (Table 7.27). Pre-existing logging roads cross an unnamed watercourse via a metal culvert as well as Halls Lake Brook and Sucker Brook with clear span bridge structures. Should the structures require upgrading, the unnamed watercourse will be fitted with an adequately sized culvert and the bridges will be replaced with open-bottom structures to ensure the characteristics of each watercourse stay as true to pre-construction conditions as possible.

It is unlikely that any of the surveyed wetlands within the Project Area are fish-bearing, based on inadequate surface water levels and a lack of connectivity to surrounding stream networks. As such, direct effects to fish and associated habitat, including habitat loss and altered hydrology are anticipated to be negligible.

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

Feature ID	Existing Alteration	Forecasted Alteration
WC1	Yes, clear span bridge for road crossing.	Bridge alterations or replacement expected.
WC2	Yes, clear span bridge for road crossing.	Bridge alterations or replacement expected.
WC9	Yes, metal culvert for road crossing.	Culvert 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 related to the construction and upgrading of access roads and crossing structures. The alteration or removal of riparian vegetation can also result in bank instability and erosion, further exasperating these effects (MTO, 2009).

Changes in Surface Water Quantity
Changes to the amount of flow can alter channel morphology, increase flood potential, and disrupt habitat characteristics that support vulnerable species (MTO, 2009). These impacts could result from the alteration of catchment area grades for road development, the compaction of soil from the heavy machinery required for turbine assembly, or the redirection of overland flow via roadway construction.

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 new watercourse crossings and only three potential upgrades to pre-existing watercourse 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.

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

In addition, the following mitigative measures will be implemented:

Habitat Loss
- Educate Project personnel on the sensitivity of aquatic habitat.
- Flag watercourses 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.
- Conduct any work within the bed of a watercourse or along the banks of a watercourse between June 1 and September 30, where possible, to avoid sensitive periods in the life cycles of fish, to better control water flow, and to allow for a faster revegetation period (NSECC, 2015c).

Altered Hydrology
- Plan any activities within the bed of a watercourse or along the banks of a watercourse to align with low-flow periods, where possible.
- 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 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.
- Require that 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 or Engineer.

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

Monitoring

If bridge and/or culvert replacement is required and the replacement structure is 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 (2015b). Monitoring requirements for crossings requiring an approval will be determined on a crossing-specific basis during the detail design phase.

A watercourse monitoring plan, if required as part of the permitting phase, will consist of detailed monitoring and general spot checks. Detailed monitoring will include hydrological, sediment, and stability assessments upstream, downstream, and at the crossing of the watercourse. Spot checks will involve a general overview of vegetative, hydrological, and substrate conditions, focusing on evidence of significant hydrologic alterations, sedimentation, and degradation of fish habitat. An example is included in Table 7.28.

Table 7.28: 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

The effects to fish and fish habitat are expected to be low, such that there may be a small loss of fish habitat or impact to fish behaviour that can be minimized through the implementation of effect-specific active management and mitigation measures. Timing and seasonality of effects is expected to be applicable, with a potential for the indirect effects to be exasperated by high precipitation events in the spring and fall. Indirect 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 findings of the desktop study to design the Project (e.g., avoid/minimize impacts to wetlands), and establish an Assessment Area, thus informing planning and logistics for field studies.
- Ground-truth and delineate wetland habitat within the Assessment Area.
- Complete functional assessments for delineated wetlands identified within the Assessment Area.
- Identify the potential for, and confirm the presence of, Wetlands of Special Significance (WSS) within the Assessment Area.

7.3.3.2 Regulatory Context

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

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

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

7.3.3.3 Desktop Review

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

- Wetlands Inventory (NSNRR, 2021d)
- WSS Database (NSNRR, 2014)
- NS Topographic Database – Water Features (GeoNOVA, 2022)
- Nova Scotia WAM Database (NSNRR, 2012a)
- Nova Scotia Digital Elevation Model (DEM) (2018)
- Provincial Landscape Viewer (NSNRR, 2017)
- Satellite and aerial imagery

The NSNRR Wetland Inventory (2021d) identified five wetlands within the Study Area, which are classified as swamp (4) or fen (1). The wetlands range in size from 0.6 to 2.16 ha (Drawing 7.15).

According to the WSS database (2014), there are no WSS located within the Study Area. Outside the Study Area, there is a mosaic of WSS (determined to contain SAR) 3 km to the west, associated with the Mill Lakes Protected Watershed Area.

The NS Topographic Database – Water Features (GeoNOVA, 2022) was used in conjunction with the Nova Scotia WAM database and Nova Scotia DEM layer to further assess the distribution of confirmed and potential wetland habitat within the Study Area. These sources identified potential wet areas and predicted flow based on the assumed depth-to-water generated from digital elevation data (Drawing 7.13) (NSNRR, 2017). The depth-to-water ranged from 0 m to >10 m from the surface across the Study Area, with the majority of the Study Area being rapidly to well drained.

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

Satellite and aerial imagery were used as a quality assurance/quality control tool when reviewing desktop resources. The results of the desktop review assisted in scoping field studies and were ultimately used to conduct a constraints analysis thus refining turbine/road siting locations to avoid known wetlands.

7.3.3.4 Field Assessment Methodology

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

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

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

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

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

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

Dominant plant species observed in each wetland were classified according to indicator status (probability of occurrence in wetlands), in accordance with the U.S. Fish and Wildlife Service National List of Vascular Plant Species that Occur in Wetlands: NE Region (Region

1) (Reed, 1988) (Table 7.29). These indicators are used as this region most closely resembles the flora and climate regime of Nova Scotia. Further relevant information was reviewed in Flora of Nova Scotia (Zinck, 1998).

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

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

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

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

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

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

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

Table 7.30: Indicators of Wetland Hydrology

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

Functional Assessments

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

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

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

The most recent version of WESP-AC is available as a separate Excel file for each of the Atlantic provinces, and each calculator has been calibrated to a series of nontidal reference wetlands within their respective province. The calibrated wetlands were selected with minimal bias through a statistical procedure intended to encompass as much variation as possible. WESP-AC scores are presented in their raw form and as a normalized score, relative to the calibrated wetlands.

7.3.3.5 Field Assessment Results

General

Field surveys completed during summer 2022 identified 25 wetlands either partially or fully within the Assessment Area (Drawings 7.11A to 7.11J). Detailed results are found in Appendix I.

Of the 25 identified wetlands, the most prominent wetland type was treed swamps (17). Treed swamps are characterized by an environment that is not as waterlogged as other wetland types, such as shrub swamps or marshes, and typically experience their highest hydroperiod during spring and fall precipitation events (Province of NS, 2018). As a result, treed swamps provide deciduous trees (e.g., red maple and yellow birch) and coniferous trees (e.g., black spruce and balsam fir) the opportunity to establish themselves and adapt to the inconsistent inundation periods (Province of NS, 2018).

Most treed swamps are situated in either a basin landscape position that showed signs of historic forestry activity (i.e., moss covered tree stumps), or along saturated slopes. Typical species composition consisted of three-seeded sedge (*Carex trisperma*), cinnamon fern (*Oundastrum cinnamomeum*), sensitive fern (*Onoclea sensibilis*), winterberry (*Ilex verticillata*), black spruce (*Picea mariana*), and balsam fir (*Abies balsamea*). Surface water was typically not observed, though saturation was often present as identified through the excavation of small soil pits.

The second most prominent wetland type identified within the Assessment Area was shrub swamps (8). 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 cinnamon fern (*Osmundastrum cinnamomeum*), bunchberry (*Cornus canadensis*), speckled alder (*Alnus incana*), Northern wild raisin (*Viburnum cassinoides*), and red maple (*Acer rebrum*). Surface water was more common than within treed swamps, though the temporal extent of the surficial hydroperiod seemed to be seasonal.

Two of the identified shrub swamps contained areas that displayed characteristics typical of marsh environments. Marshes 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 portions of WL6 and WL15, with evidence of herbaceous encroachment along the edges of sparsely vegetated concave surfaces. The vegetative composition of these areas included bluejoint reed grass (*Calamagrostis canadensis*), fringed sedge (*Carex crinita*), and common woolly bulrush (*Scirpus cyperinus*).

A minor layout modification was made to the Project following the 2022 field season (Drawings 7.11A to 7.11J), which included the following:

- Updated substation location
- Updated interconnection line to and from the substation
- Modification of portions of the collector line routes

A high-level, out-of-season, assessment was completed at the substation location to identify the potential for wetlands in December 2022. No wetlands or suspected "wet areas" were noted during the assessment. A seasonally-appropriate wetland survey will be completed in these areas during the 2023 field season to confirm the presence and extent of any wetlands, and if future permitting is required.

WESP-AC Functional Assessments
Functional assessments were completed during summer 2022 for each of the 25 wetlands located within the Assessment Area (Drawings 7.11A to 7.11J). Detailed WESP-AC results are found in Appendix I and a summary is provided in Table 7.31.

The majority of wetlands were determined to be in high ecological condition, with 15 of 25 wetlands receiving this result. However, 21 of 25 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.

None of the wetlands within the Assessment Area were determined to be WSS as dictated by the Functional WSS Interpretation Results within the WESP-AC spreadsheet calculator. The WESP-AC WSS determination is based on an evaluation of individual habitat function scores.

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

Wetland ID	Tertiary Watershed	Wetland Type(s)	WESP-AC Determined WSS[1] (Yes/No)	Condition[2]	Risk[3]
WL1	1DE-1	Treed swamp	No	Moderate	Higher
WL2	1DE-1	Treed swamp	No	Higher	Moderate
WL3	1DE-1	Treed swamp	No	Lower	Higher
WL4	1DE-1	Treed swamp	No	Higher	Higher
WL5	1DE-1	Shrub swamp	No	Higher	Higher
WL6	1DE-1	Shrub swamp; Marsh	No	Higher	Moderate
WL7	1DE-1	Treed swamp	No	Higher	Higher
WL8	1DE-1	Treed swamp	No	Higher	Higher

Wetland ID	Tertiary Watershed	Wetland Type(s)	WESP-AC Determined WSS[1] (Yes/No)	Condition[2]	Risk[3]
WL9	1DE-1	Treed swamp	No	Moderate	Higher
WL10	1DE-1	Shrub swamp; Treed swamp	No	Higher	Higher
WL11	1DE-1	Treed swamp	No	Higher	Higher
WL12	1DE-1	Treed swamp	No	Higher	Higher
WL13	1DE-1	Shrub swamp	No	Higher	Higher
WL14	1DE-1	Shrub swamp	No	Higher	Higher
WL15	1DE-1	Shrub swamp; Marsh	No	Lower	Moderate
WL16	1DE-1	Treed swamp	No	Higher	Higher
WL17	1DE-1	Treed swamp	No	Moderate	Moderate
WL18	1DE-1	Treed swamp	No	Moderate	Higher
WL19	1DE-1	Treed swamp	No	Moderate	Higher
WL20	1DE-1	Treed swamp	No	Moderate	Higher
WL21	1DE-1	Treed swamp	No	Higher	Higher
WL22	1DE-1	Treed swamp	No	Higher	Higher
WL23	1DE-1	Shrub swamp	No	Moderate	Higher
WL24	1DE-1	Treed swamp	No	Lower	Higher
WL25	1DE-1	Treed swamp	No	Higher	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.

Wetlands of Special Significance

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 field assessments show the presence of two at-risk species within field-delineated wetlands within the Assessment Area.

WL1 was determined to be a WSS due to the presence of Black ash (*Fraxinus nigra*). Black ash is designated as 'Threatened' under NS ESA as of 2013 (NSNRR, 2015). As per the NSNRR Recovery and Action Plan for Black ash (2016), a 150 m protective buffer is to be maintained between seed-bearing black ash and any forest harvest or industrial activity that may harm it.

Six individual Black ash trees were found in the Study Area; however, it could not be determined during the field assessment if the trees are seed bearing. To be conservative, the buffer for seed-bearing trees was applied to the wetland these trees were found in. An existing road is located approximately 90 m to the east of the wetland and therefore within the buffer. The installation of the collector system along this road will be designed such that there is no additional disturbance within the buffer (i.e., confined within the existing right-of-way/disturbed area), unless otherwise authorized by NSECC and/or NSNRR.

WL10 had a confirmed sighting of a lone male Canada Warbler (*Cardellina canadensis*) within the Assessment Area (see Section 7.4.5). Canada Warbler is designated as ‘Threatened’ under *SARA* as of 2010 and ‘Endangered’ under NS *ESA* as of 2013 (Government of Canada 2022; NS *ESA*, 2022). However, given the highly mobile nature of the species, and the fact that the individual did not display probable or confirmed breeding behaviour, this wetland was not deemed to be a WSS. Mitigation and minimization of impacts to WL10 will be assessed during the detailed design and permitting stage of the Project.

7.3.3.6 Effects Assessment

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

Table 7.32: Potential Project-Wetland Interactions

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

Assessment Boundaries
The LAA for wetlands is the Assessment Area. The RAA for wetlands is the St. Croix River Secondary Watershed (1DE-1) (Drawing 2.2).

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

- Negligible – no direct loss of wetland habitat or alteration to wetland functions expected.

- Low – direct loss of wetland habitat, but overall wetland functions remain intact.
- Moderate – direct loss of wetland habitat and impact to wetland functions, but wetland area loss will not impact the hydrology of the wetland's watershed and/or the impacted wetland areas are not part of a WSS.
- High – direct loss of wetland habitat and impact to wetland functions; and wetland area loss will affect the hydrology of the wetland's watershed and/or the impacted wetland areas are part of a WSS.

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

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

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

A GIS suitability analysis was conducted to design a Project Area that would optimize the placement of Project infrastructure to avoid and minimize loss of wetland area and function, to the greatest extent possible. A summary of the wetlands identified within the Assessment Area and how they may be affected by the Project is provided in Table 7.33 and shown on Drawings 7.11A to 7.11J.

Table 7.33: Habitat Alteration for Wetlands within the Assessment Area

ID	Wetland Type	Delineated Area (m^2)	Area Of Potential Alteration (m^2)[1]	Activity
WL1	Treed swamp	5181.44	0	No activity. Wetland located within a previous iteration of the Project Area.
WL2	Treed swamp	7463.36	0	No activity. Wetland located within a previous iteration of the Project Area.
WL3	Treed swamp	3133.32	0	No activity. Wetland located within a previous iteration of the Project Area.
WL4	Treed swamp	411.05	0	Transmission line route – wetland expected to be spanned.
WL5	Shrub swamp	345.13	0	Transmission line route – wetland expected to be spanned.
WL6	Shrub swamp; Marsh	778.68	0	Road upgrade – wetland expected to be avoided.
WL7	Treed swamp	7146.19	0	Road upgrade – wetland expected to be avoided.
WL8	Treed swamp	4411.87	1051.55	Road upgrade.
WL9	Treed swamp	1982.37	315.24	Road construction. Wetland expected to be avoided at the turbine pad.
WL10	Shrub swamp; Treed swamp	7845.72	2036.49	Road upgrade and road construction.
WL11	Treed swamp	4049.03	0	Road upgrade – wetland expected to be avoided.
WL12	Treed swamp	4751.18	0	No activity. Wetland located within a previous iteration of the Project Area.
WL13	Shrub swamp	248.98	0	Transmission line route – wetland expected to be spanned.
WL14	Shrub swamp	232.96	0	Transmission line route – wetland expected to be spanned.
WL15	Shrub swamp; Marsh	171.82	0	Road upgrade – wetland expected to be avoided.

ID	Wetland Type	Delineated Area (m^2)	Area Of Potential Alteration (m^2)[1]	Activity
WL16	Treed swamp	2008.18	0	Turbine pad – wetland expected to be avoided.
WL17	Treed swamp	2341.09	820.79	Road construction.
WL18	Treed swamp	2769.56	0	Road upgrade – wetland expected to be avoided.
WL19	Treed swamp	927.10	0	No activity. Wetland located within a previous iteration of the Project Area.
WL20	Treed swamp	2467.58	0	No activity. Wetland located within a previous iteration of the Project Area.
WL21	Treed swamp	1871.90	1510.44	Road construction
WL22	Treed swamp	447.93	0	No activity. Wetland located within a previous iteration of the Project Area.
WL23	Bog	1865.33	0	No activity. Wetland located within a previous iteration of the Project Area.
WL24	Treed swamp	3462.11	0	Transmission line route – wetland expected to be spanned.
WL25	Treed swamp	567.70	0	No activity. Wetland located within a previous iteration of the Project Area.

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

Despite there being 25 wetlands identified within the Assessment Area, the Project layout was modified such that only five wetlands are expected to require alteration. Significant effort was made to maximize existing disturbed areas, with only approximately 4 km of new road being constructed, and approximately 16 km of previously existing road being utilized. Potential alterations would arise from road upgrades and/or road construction, if determined to be required during the detailed design phase. The total area of potential impact is approximately 0.57 ha.

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

Provincial wetland data supplied by NSNRR was used to estimate the total amount of wetland habitat within the 70,435 ha RAA. An estimated 2,562 ha of wetland habitat was identified, which equates to approximately 3.64% of the RAA. As such, field delineated wetland habitat that may be directly impacted by the Project comprises approximately 0.0008% of the total area within the RAA, approximately 0.02% of the potential wetland habitat within the RAA, and approximately 0.55% of the total area within the LAA.

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

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

Dust
The potential for dust deposition will likely be highest during the construction phase, though the risk will be present throughout the Project’s lifecycle. Dust primarily impacts vegetative health, with particle size influencing the scale of the impact (Farmer, 2003). Smaller particulate can result in clogged pores, hindering vital biochemical processes including photosynthesis, respiration, and transpiration; and larger particulate can result in lacerations in plant tissues, thus jeopardizing the health of the plant (Farmer, 2003).

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

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

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

Habitat Loss

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

Hydrology

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

Erosion and Sedimentation

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

- Avoid surface run-off containing suspended materials or other harmful substances.
- Direct run-off from construction activities away from wetlands.
- Maintain existing vegetation cover, where possible.

Dust Deposition

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

Invasive Species

- Use quarried, crushed materials for road construction to reduce the introduction of invasive vascular plant species, where possible.
- Clean and inspect equipment prior to arrival on site to prevent the introduction of invasive/non-native species.

Compaction

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

Monitoring

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

Table 7.34: General Wetland Monitoring Parameters and Methods of Assessment

Monitoring Parameter	Tasks	Method of Assessment	
		General Monitoring	Detailed Monitoring
Hydrology	A shallow monitoring well will be installed within the remaining wetland habitat of the partially infilled wetland.	No	Yes
	Standing water depth measurements will be noted within the existing wetland (if applicable).	No	Yes
	Evidence of positive indicators of hydrology (e.g., drainage patterns, water-stained leaves, saturated surfaces, raised tree roots, development of a hydrogen 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
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 Study Area is a relatively remote swathe of land that is most frequently used for forestry operations, quarry operations, wind energy production, and light recreation during all months of the year. The Project is directly south of the existing Ellershouse Wind Farm, which consists of 10 operating wind turbines. Additionally, the northern portion of the Study Area overlaps with Hartville Quarry. These activities have established a relatively expansive road and trail network that allows for access to most of the Assessment Area.

The terrestrial habitat assessment focused on the identification of sensitive and important habitats that have yet to be disturbed through a combination of desktop review and field surveys. 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 objectives of the terrestrial habitat assessment include the following:

- Identify habitat types and key areas of interest using available desktop resources, prior to the commencement of field activities.
- Use the information collected during desktop review to inform the design of targeted field surveys to assess all habitat types known to be present within the Assessment Area.
- Ground truth the presence of habitat types identified through desktop review, including natural and anthropogenic habitat, as provincial landscape databases are not always accurate in determining habitat features and/or the extent of these features.
- Use the information collected to inform and refine project design – i.e., avoid sensitive habitat and habitat known to support SOCI (see Section 7.3.2.2 for definition of SOCI species) through a constraints assessment.
- Use the information collected 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 and guidance for avoiding development within 100 m of a confirmed old-growth stand. The entirety of the Assessment Area is on private land, and while no legal protection is granted to habitat on private land, the best practices described within the policies were still carefully considered.

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)
- Old-Growth Policy Layer (Province of NS, 2022)
- Significant Species and Habitat Database (NSNRR, 2018)
- NSECC Parks and Protected Areas Map (2022d)

The Assessment Area falls within the Rawdon/Wittenburg Hills Ecodistrict (410) of the Eastern Ecoregion, and in the St. Margarets Bay Ecodistrict (780) of the Western Ecoregion (Neily et al. 2017). The Rawdon/Wittenburg Hills Ecodistrict is located on two slate ridges which rise notably above the surrounding valleys of the Stewiacke, Musquodoboit, and Shubenacadie rivers. These hills are significant features on the landscape, rising 180-210 masl; the Assessment Area lies in the southwestern extent of the Rawdon Hills and reaches an elevation of just below 100 masl. This ecodistrict features cool temperatures, particularly in the winter, and moister air than in surrounding lowlands. The northeast trending ridges are comprised of folded Meguma Group slate with sandy clay loams along the side slopes. The lower slopes of this ecodistrict favour moderately-well drained to imperfectly drained gravel soils which support mixed wood forests containing red spruce (*Picea rubens*), Eastern hemlock (*Tsuga canadensis*), and yellow birch (*Betula alleghaniensis*). Extensive forestry has historically occurred across the entire ecodistrcit, leading to higher abundances of early successional species such as red maple (*Acer rubrum*), paper birch (*Betula papyrifera*), and balsam fir (*Abies balsamea*). This is one of the most highly treed ecodistricts in Nova Scotia, with non-forested ecosystems consisting of mainly wetlands, with some rock outcrops and shrublands scattered throughout.

The St. Margaret’s Bay Ecodistrict extends from western Halifax County to eastern Lunenburg County, including areas further inland such as Hants County; the Assessment

Area occupies the northern extent of this ecodistrict. This ecodistrict is characterized by its moist climate due to close proximity to cool coastal waters, with increased levels of precipitation, fog, and soil moisture. The St. Margaret's Bay Ecodistrict contains elevations ranging between sea level and 175 masl, with a mean elevation of approximately 100 masl. Most of the ecodistrict has shallow stony soils derived from granitic till, with an abundance of surface stones and intermittent glacial erratics (large granitic boulders) throughout the landscape. These characteristics have been a limiting factor for forestry development in the area, as the abundance of surface stones impedes machine operability and stocking levels of trees. The topography near the Project is an irregular arrangement of hummocks and low rounded hills, with a number of rivers, lakes, and wetlands throughout. The dominant vegetation in this ecodistrict is red spruce forests, with pockets of hemlock stands in lower elevations and along watercourses (Neily et al., 2017).

The Provincial Landscape Viewer was reviewed to identify the land cover within the Study Area (Table 7.35, Drawing 7.16), which is mainly forested, with the majority consisting of mixed wood forest (71% cover). Other, non-forested areas make up a small percentage of the Study Area, including aquatic features and built infrastructure (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 (91% cover) (Province of NS, 2021). The Nova Scotia Forest Inventory is based on aerial imagery from 2012, and more recent imagery shows that many 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 7.35: 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	16.97
Hardwood	9.60
Mixed Wood	71.45
Brush	0.060
Bog or Wetland	0.34
Utility Corridor	0.55
Water	0.62
Urban, Landfill, Quarry, or Transport Corridor	0.42

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 no forest stands protected under the Old-Growth Forest Policy (2022) within 500 m of the Assessment Area. The Old-Growth Potential Index ranks forest stands to determine where with the highest potential for old-growth can be found. No highest-ranking stands were found to intersect with the Assessment Area.

A review of the NSNRR Significant Species and Habitat Database (2018) within 100 km of the Study Area identified 30 records:

- Two records classified as 'Species at Risk', which relate to caves.
- 26 records classified as 'Other Habitat', which relates to a bay (1), a brook (1), a cave (1), cliffs (4), estuaries (9), an island (1), karst (4), lakes (3), and talus slopes (2).
- Two records classified as 'Species of Concern', which relate to karst and a valley.

None of these features are located within the Study Area.

The NSECC Parks and Protected Areas Map (2022d) was screened to identify any protected areas in/near the Study Area (Drawing 7.17), which include:

- Eagles Nest Nature Reserve
- Panuke Lake Nature Reserve
- Panuke Lake Nature Reserve Addition (Pending designation)
- South Panuke Wilderness Area
- South Panuke Wilderness Area Addition (Pending)

All pending and designated areas noted above are outside the Study Area and will therefore have no direct interactions with the Project.

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 a variety of mixed wood stands and softwood stands, while tolerant hardwood stands were found to be lacking. Extensive forestry activity, beyond what was suggested through aerial imagery, was found across the Study Area, likely having occurred within the last five years. The forestry work in the area 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. The remaining undisturbed forests stands are varied in their composition and successional stage. One area of mature, undisturbed softwood forest can be found in the St. Croix Reservation Lands of AVFN. This area does not intersect with the Assessment Area; however, it is found between two PIDs included in the Study Area. Wildlife utilizing this undisturbed forest may interact with habitat within the Study Area.

Primary native tree species include balsam fir (*Abies balsamea*), red maple (*Acer rubrum*), red spruce (*Picea rubens*), black spruce (*Picea mariana)*, and yellow birch (*Betula alleghaniensis*). Sugar maple (*Acer saccharum*), and white birch (*Betula papyrifera*) were found throughout; however, these species did not dominate the canopy. Owing to the well-drained nature of the soils, wetland habitat is limited within the Assessment Area. Wetlands present are for the most part treed- or shrub swamps that form in flat areas and at the base of slopes and are covered by a dense layer of speckled alder (*Alnus incana*), or other hardwood shrubs such as yellow or white birch (*Betula papyrifera*), growing under a hardwood or mixed-wood tree canopy. Wetlands also occur in open areas that may have been disturbed by forestry activities.

Areas supporting flora SOCI, such as wetlands or mature forests were surveyed to identify SOCI and determine their capacity to support SOCI. No habitat supporting SOCI was found within the Assessment Area, as important habitat identified within the Study Area such as a wetland supporting Black ash (see Section 7.3.3.5), was avoided during the Project design. 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. Late successional forests were found within the northeastern portion of the Study Area and the Project design avoided these areas.

7.4.1.6 Effects Assessment

Project-Terrestrial Habitat Interactions

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

Table 7.36: Potential Project-Terrestrial Habitat Interactions

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

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

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

- Negligible – no loss of terrestrial habitat or alteration to habitat functions expected.
- Low – 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 SOCI, old-growth forest, priority habitat features, areas of special concern for conservation or protection, and unfragmented, undisturbed areas.

No habitat for SOCI was identified within the Assessment Area through the NSNRR Significant Species and Habitat Database (2018) and field surveys. No confirmed old-growth forest will be impacted by the Project. No pending or designated conservation areas, wilderness areas, or otherwise protected areas are found within the Study Area. According to photo-interpreted aerial imagery, the majority of land cover within the Study Area is natural, untreated mixed wood forests. Field surveys confirmed that the proportion of treated or cleared stands is greater than aerial imagery suggests, as a result of forestry activity over the last 10 years. Of the remaining natural forested areas within the Assessment Area, a large amount of this habitat exists within 25 m of a pre-existing road or otherwise cleared area. The Project Area will consist of approximately 4 km of new roads and utilize 16 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, and the introduction of road salt may attract ungulates. New and widened road rights-of-way and turbine pads may become new habitat for nesting birds who prefer rocky or grassy surfaces to nest in. Roadside ditches, edges of turbine pads, 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

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.
- 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.
- 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 (NSNRR, 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 plants 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 (2022b)
- Boreal Felt Lichen Habitat Layer (NSNRR, 2012b)

ACCDC Data Report (2022b) identified 500 flora species within 100 km of the Study Area (Appendix G). Of the 500 species, 300 are vascular plants and 200 are non-vascular plants.

A summary of plant and lichen SOCI identified by the ACCDC records as being known to occur within 5 km of the center of the Assessment Area is provided in Table 7.37. A shortlist of rare plants and lichens found within 10 km of the center of the Assessment Area was built into a flora guide that was used during field surveys to aid in accurate identification of SOCI (Drawing 7.18A to 7.18C). The guide included photos and descriptive language of anatomical features, preferred habitat features, and specific characteristics designed to help in distinguishing flora SOCI from other similar, non-SOCI flora.

Table 7.37: ACCDC Plant and Lichen SOCI Identified within 5 km of the Centre of the Assessment Area

Common Name	Scientific Name	COSEWIC[1]	*SARA*[2]	NS *ESA*[3]	S-Rank[4]
Plants (Vascular)					
American Beech	*Fagus grandifolia*	---	---	---	S3S4
Canada Lily	*Lilium canadense*	---	---	---	S2
Hyssop-leaved Fleabane	*Erigeron hyssopifolius*	---	---	---	S3S4
Narrow-leaved Evening Primrose	*Oenothera fruticosa ssp. tetragona*	---	---	---	S2S3
Northern Maidenhair Fern	*Adiantum pedatum*	---	---	---	S1
No Lichens (Non-vascular) Found					

Source: ACCDC 2022b; [1] Government of Canada 2022; [2] Government of Canada 2022; [3] [3]Government of Nova Scotia, 2022; [4]ACCDC 2022a

American beech (*Fagus grandifolia*) was assigned an S-Rank of 'S3S4' in March 2022, indicating that it is uncommon in the province and/or widespread, common, and apparently secure in the province (ACCDC, 2022b). Although historically a common tree species in Nova Scotia, the quality and mast production of American beech trees have been devastated by Beech scale disease. While still present across the province, the ecological role that this tree has played in tolerant hardwood forest has changed in recent years, shifting from an overstory tree to an intermediate or understory species (NSNRR, 2021e). The closest ACCDC recorded observation of the American beech is 2.6 ± 0.0 km from the center of the Assessment Area (Appendix G).

The Canada lily (*Lilium canadense*) is a large reddish-orange to yellow lily with dark spots on the inside of the petals (University of Texas, 2016). This species of lily can be found in a wide range of habitats such as man-made or disturbed areas, river and stream floodplains, forests, meadow fields, and along wetland boundaries. In Nova Scotia this species has an S-rank of S2, indicating it is considered to be 'imperiled' because its restricted range makes it a rare species with very few populations. Steep declines, possibly due to the introduction of non-native lily leaf beetle (*Lilioceris lilii*) which has been found feeding on native lilies, including the Canada lily, make it vulnerable to extirpation. The closest ACCDC recorded observation of the Canada lily is 3.1 ± 7.0 km from the center of the Assessment Area (Appendix G).

Hyssop-leaved fleabane (*Erigeron hyssopifolius*) is predominantly found across Canada but has also been documented further south in Vermont and Maine (Go Botany, 2021). This species prefers habitats containing high-pH bedrock such as ridges, ledges, and cliffs, but has also been found near the shores of lakes and rivers (Go Botany, 2021). The closest ACCDC recorded observation of the Hyssop-leaved fleabane is 3.1 ± 7.0 km from the center of the Assessment Area (Appendix G).

Narrow-leaved evening primrose (*Oenothera fruticosa ssp. tetragona*) can be found across eastern Canada, from Manitoba to Nova Scotia, and further south into eastern US. This species can be found in a variety of habitats from floodplains, meadows, and edges of wetlands to anthropogenically disturbed habitats (Go Botany, 2021). The closest ACCDC recorded observation of the Narrow-leaved evening primrose is 3.1 ± 7.0 km from center of the Assessment Area (Appendix G).

Northern maidenhair fern (*Adiantum pedatum*) can be found across eastern Canada and eastern US (University of Texas, 2016). This species of fern prefers cool moist habitats in shaded wooded areas and can often be found near groundwater springs and seeps. Northern maidenhair ferns typically grow in clusters, characterized by the almost perfectly circular pinnae pattern and burgundy red fiddleheads that appear in early spring (University of Texas, 2016). The closest ACCDC recorded observation of the Northern maidenhair fern is 3.1 ± 10.0 km from the center of the Assessment Area (Appendix G).

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 (2022b). The Boreal Felt Lichen Layer identified no suitable boreal felt lichen habitat across the Study Area.

7.4.2.4 Field Assessment Methodology

Plant surveys were completed across the Assessment Area on July 12, 13, 15, and 16, 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 7.19). 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 also searched.

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 Chris 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, 186 vascular plant species and 33 non-vascular plant species were identified, including one plant and one lichen SOCI (Drawings 7.11A to 7.11J). Additional species were added to this list from observations made in late summer and fall of 2021 during wetland surveys. A complete list of plant and lichen species identified during targeted surveys and incidental observations is provided in Appendix J. All SOCI plants and lichen are summarized in Table 7.38. There were 12 non-native plants encountered during surveys (Table 7.39). Because some of the Assessment Area was surveyed out of flowering season (December) due to a minor layout modification (see Section 7.3.3), these areas will be revisited during flowering season before any construction takes place to survey for plant and lichen SOCI.

Table 7.38: Flora SOCI Encountered During Field Surveys

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]	Habitat
American Beech	*Fagus grandifolia*	---	---	---	S3S4	Understory of hardwood and mixed-wood stands
Black Ash	*Fraxinus nigra*	Threatened	Threatened	---	S1S2	In treed swamp wetland influenced by flooding
Frosted Glass-whiskers Lichen	*Sclerophora peronella*	---	Special Concern	Special Concern	S3S4	In wooded riparian area along small waterbody

Source: ACCDC 2022b; [1,2]Government of Canada 2022; [3]Government of Nova Scotia, 2022; [4]ACCDC 2022a

Table 7.39: Non-native Flora Encountered During Field Surveys

Common Name	Scientific Name	Exotic Status[1]	S-Rank[2]
Black Knapweed	*Centaurea nigra*	Widespread	SNA
Common Hawkweed	*Hieracium lachenalii*	Widespread	SNA
Common Plantain	*Plantago major*	Widespread	SNA
Common Speedwell	*Veronica officinalis*	Widespread	SNA
Common St John's-Wort	*Hypericum perforatum*	Widespread	SNA
Garden Sorrel	*Rumex acetosa*	Widespread	SNA
Moth Mullein	*Verbascum blattaria*	Rare	SNA
Mouse-ear Hawkweed	*Pilosella officinarum*	Fairly Common	SNA
Multiflora Rose	*Rosa multiflora*	Uncommon	SNA
Oxeye Daisy	*Leucanthemum vulgare*	Widespread	SNA
Streambank Groundsel	*Packera pseudaurea*	---	SNA
Tall Hawkweed	*Pilosella piloselloides*	Widespread	SNA

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

American beech was also identified by ACCDC records within the Study Area and was found in numerous locations across the Study Area during field surveys. Because of the commonality of this species, locations of observations were not recorded. This was the only flora SOCI found during field surveys that was also identified by ACCDC (Appendix G).

Black ash (*Fraxinus nigra)* is designated as 'Threatened' under COSEWIC in 2018 and NS *ESA* in 2013 (NSNRR, 2015; Government of Canada, 2022). Although widespread in distribution across Nova Scotia, this species is considered to be extremely rare. Approximately 1000 individuals were known to exist as of 2013, and only 12 seed-bearing individuals have been documented. Black ash prefer areas with poorly drained, muck or peat soils that experience seasonal flooding and high sun exposure. This species has low abundance due to a number of factors which generally relate to a state of poor health. The main threat to Black ash, historically and presently, is habitat loss and alteration (NSNRR, 2015). Six mature Black ash trees were found in the Study Area. To be conservative, the appropriate buffer for seed-bearing trees was applied to the wetland habitat these trees were found in.

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, 2022a; 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, pose a serious threat to the survival of this species. One observation of this lichen was made within the Study Area, in a wooded riparian area nearby a small waterbody. To obtain an accurate identification, one apothecium with spores was collected, leaving behind multiple other apothecia so as not to extirpate the lichen from this tree. The specimen was identified using a microscope at a later date. The specimen was collected over 200 m from the Assessment Area and will therefore be avoided.

7.4.2.6 Effects Assessment

Project-Terrestrial Flora Interactions

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

Table 7.40: Potential Project-Flora Interactions

Valued Component	Site Preparation and Construction											Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Terrestrial Flora		X		X	X	X				X			X	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 (including Black ash) and lichen SOCI were found. Therefore, loss of plant and lichen SOCI is negligible to low.

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 4 km of new roads will be required compared to 16 km or pre-existing road), road widening may be required. All new roads and areas of potential impact along pre-existing roads were surveyed for rare flora within specialized habitats (i.e., wetlands, mature forests stands). Additionally, incidental observations were recorded when field surveys occurred in hotspots for SOCI. Black ash was recorded in a wetland with conditions well suited to this species.

The Project design has avoided habitat that is known to support plant and lichen SOCI within the Study Area. 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). Construction 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 non-native plants have 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

- Complete in-season rare plant and lichen surveys for areas subject to minor layout modifications (further discussed in Section 7.3.3).
- Minimize overall area to be cleared by utilizing pre-existing roads (and rights-of-way) 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.
  - Additional surveys will be conducted to determine presence (if any) of flora SOCI in the Assessment Area which have not yet been surveyed during flowering season.
- Educate project personnel about the potential for plant or lichen SOCI during construction and subsequent Project phases that may require removal or disturbance of vegetation.
  - Guidance will be provided to Project personnel to raise awareness of terrestrial flora SOCI that are known to exist within and nearby the Study Area to increase the number of trained eyes looking for these species.
  - Consult with NSNRR if an unexpected flora SOCI is encountered during construction activities. Potential mitigation measures based upon recognized practices to transplant or collect seeds can be used as a contingency if flora SOCI are unexpectedly encountered during construction activities. A transplantation plan will be developed along with a monitoring protocol through consultation with NSNRR should this be required during construction.

Habitat Loss

- Minimize overall area to be cleared by utilizing pre-existing roads and previously altered areas (i.e., clearcuts, rights-of-way).
- 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, in consultation with the landowner.
- Clean equipment to prevent the introduction of non-native species into previously undisturbed areas.
  - Because non-native species are already present within the Study Area, care will be taken when travelling from developed areas to undisturbed 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. 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 following resources:

- NSNRR Significant Species and Habitat Database (2018).
- ACCDC Data Report (2022b) for mammal, herpetofauna, butterfly, and Odonate species recorded within a 100 km radius from the center of the Assessment Area.
- Provincial Landscape Viewer (NSNRR, 2017).

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 41 unique species and/or habitat records pertaining to terrestrial mammals within a 100 km radius of the Study Area. These records include:

- 24 records that are classified as “Deer Wintering”, which relate to known over-wintering habitat for White-tailed deer (*Odocoileus virginianus*).
- Nine records classified as “Species at Risk”, which relates to the Southern Flying Squirrel (*Glaucomys volans*) (1), the American Marten (*Martes americana*) (6), and the Fisher (*Martes pennanti*) (2).
- Two records classified as “Other Habitat”, which relate to American beaver (*Castor canadensis*) and Black bear (*Ursus americanus*).
- Six records classified as “Species of Concern”, which relates to the Southern Flying Squirrel (*Glaucomys volans*) (1), the Fisher (*Martes pennanti*) (4) and the Long-tailed Shrew (*Sorex dispar*) (1).

The closest records identified were two deer wintering areas 11 and 13 km away from the Study Area, and the closest “Species at Risk” or “Species of Concern” record was over 30 km away.

The ACCDC Data Report (2022b) indicates that seven terrestrial mammal SOCI (excluding bats) have been recorded within a 100 km radius of the Study Area (Table 7.41). None of the identified SOCI have records within the Study Area.

Table 7.41: Mammal SOCI 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]
Atlantic Marten	*Martes americana*	---	---	Endangered	S2S3
Canada Lynx	*Lynx canadensis*	Not at Risk	---	Endangered	S2S3
Fisher	*Martes pennanti*	---	---	---	S3
Long-tailed Shrew	*Sorex dispar*	Not at Risk	---	---	S2
Moose	*Alces alces americanus*	---	---	Endangered	S1
Southern Bog Lemming	*Synaptomys cooperi*	---	---	---	S3
Southern Flying Squirrel	*Glaucomys volans*	Not at Risk	---	---	S2S3

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

The Study Area overlaps with the most northern tip of a Mainland moose concentration area, as mapped by the Provincial Landscape Viewer (NSNRR, 2017). Because some of the Project activities will occur in this Special Management Practice Zone, an in-depth analysis was undertaken to better understand the presence and distribution of high-quality habitat within the Study Area and its nearby surroundings.

Mainland Moose Habitat Suitability Modelling
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, 2021f) defines suitable moose habitat as areas where a maximum distance of 200 m separates a mixed wood forest from a wetland. 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 mostly informed by the Mainland Moose Recovery Plan (NSNRR, 2021f), with some information coming from other sources (NSEL, 2002; NSNRR, 2021g; NWF, u.d.) to determine characteristics of high-quality moose habitat.

Wetland environments were a required component in the 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 for the benefits they provide to Mainland moose, such as winter cover, summer shelter, calving shelter, foraging opportunities in the forms of new growth and broad leaves, and provision of winter diet requirements. Within the model, this habitat was defined as a forest stand composed of 26-74% softwood by basal volume. Mixed wood forests are considered ideal for a generalist species, which includes moose, due to the diversity of ecosystems supported by both the deciduous and coniferous canopy. Common species found in the canopy of these mixed wood forests include yellow birch (*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 meet 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, 2021f).

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). Areas with over 500 m between mixed wood forest and wetland were not considered suitable moose habitat in this model.

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

Table 7.42: Moose Habitat Suitability Model Weighting Scheme

Score	Distance Between Wetland and Mixed Wood Forest
110	up to 100 m
90	over 100 m but no more than 120 m
83	over 120 m but no more than 140 m
76	over 140 m but no more than 160 m
72	over 160 m but no more than 180 m
66	Upper limit of 200 m specified in recovery plan (over 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 70% of the Assessment Area is not suitable habitat for Mainland moose, and the mean suitability score for moose habitat in the Assessment Area is 74, falling within the parameters for suitable habitat as defined in the Mainland Moose Recovery Plan. A large tract of land running northeast to southwest along the eastern side of the Study Area features a gradient of habitat quality with high connectivity, indicating the presence of suitable habitat connected to the Mainland Moose concentration area that will not be impacted by Project infrastructure. Additionally, the highest scoring habitat patches are all found in areas with pre-existing roads or forestry activity. The results of this model have not been provided within this EA and have been provided directly to the appropriate regulators. Potential impacts to this habitat and connectivity are discussed in Section 7.4.3.6.

Herpetofauna

The NSNRR Significant Species and Habitat Database (2018) contains 116 unique species and/or habitat records pertaining to reptiles and amphibians within a 100 km radius of the Study Area. These records include:

- 114 records classified as "Species at Risk", which relate to the Snapping turtle (*Chelydra serpentina*) (3), the Blanding's turtle (*Emydoidea blandingii*) (21), the Wood turtle (*Glyptemys insculpta*) (80), and the Ribbon snake (*Thamnophis sauritus*) (10).
- Two records classified as "Species of Concern", which relate to the Painted turtle (*Chrysemys picta*) (2).

The closest records identified were for Wood turtles in the Herbert River 6 km away; however, these records are across Highway 101 and will therefore experience no impacts from the Project.

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

Table 7.43: Herpetofauna SOCI 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 saurita*	Threatened	Threatened	Threatened	S2S3
Four-toed Salamander	*Hemidactylium scutatum*	---	---	---	S3
Painted Turtle	*Chrysemys picta*	Special Concern	Special Concern	---	S4
Snapping Turtle	*Chelydra serpentina*	Special Concern	Special Concern	Vulnerable	S3
Wood Turtle	*Glyptemys insculpta*	Threatened	Threatened	Threatened	S2

Source: ACCDC 2022b
[1]Government of Canada 2022; [2]Government of Canada, 2022; [3]Government of Nova Scotia, 2022; [4]ACCDC 2022a

While none of these species are known to occur within the Study Area, three of these species have records in close proximity to the Study Area (2022a): Snapping turtle (*Chelydra serpentina*), Eastern painted turtle (*Chrysemys picta picta*), and Four-toed salamander (*Hemidactylium scutatum*).

Butterflies and Odonates

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

- Seven records classified as "Species of Concern", which relate to Jutta arctic (*Oeneis jutta*) (2), Northern bluet (*Enallagma cyathigerum*) (2), Sphagnum sprite (*Nehalennia gracilis*) (1), Elfin skimmer (*Nannothemis bella*) (1), and Kennedy's emerald (*Somatochlora kennedyi*) (1).
- One record classified as "Other Habitat", which relates to Hoary elfin (*Callophrys polios*).
- One record classified as "Species at Risk", which relates to Ebony boghaunter (*Williamsonia fletcheri*).

The database contains no records of butterflies or Odonates within a 20 km radius of the Study Area.

The ACCDC Data Report (2022b) contains records of 46 unique butterfly and Odonate SOCI within a 100 km radius of the Study Area (Table 7.44), none of which have been recorded within the Study Area.

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

Common Name	*Scientific Name*	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
Acadian Hairstreak	*Satyrium acadica*	---	---	---	S2
Aphrodite Fritillary	*Speyeria aphrodite*	---	---	---	S3S4
Arctic Fritillary	*Boloria chariclea*	---	---	---	S1S2
Banded Hairstreak	*Satyrium calanus*	---	---	---	S3
Blue dasher	*Pachydiplax longipennis*	---	---	---	S1
Bog Elfin	*Callophrys lanoraieensis*	---	---	---	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

Common Name	*Scientific Name*	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
Extra-Striped Snaketail	*Ophiogomphus anomalus*	---	---	---	S1
Forcipate Emerald	*Somatochlora forcipata*	---	---	---	S3
Gray Hairstreak	*Strymon melinus*	---	---	---	S3
Green Comma	*Polygonia faunus*	---	---	---	S3
Greenish Blue	*Icaricia saepiolus*	---	---	---	SH
Harlequin Darner	*Gomphaeschna furcillata*	---	---	---	S3S4
Harpoon Clubtail	*Gomphus descriptus*	---	---	---	S3
Hoary Comma	*Polygonia gracilis*	---	---	---	SH
Jutta Arctic	*Oeneis jutta*	---	---	---	S3S4
Kennedy's Emerald	*Somatochlora kennedyi*	---	---	---	S2S3
Lance-Tipped Darner	*Aeshna constricta*	---	---	---	S3S4
Maine Snaketail	*Ophiogomphus mainensis*	---	---	---	S3
Milbert's Tortoiseshell	*Aglais milberti*	---	---	---	S2S3
Monarch	*Danaus plexippus*	Endangered	Special Concern	Endangered	S2B,S3M
Monarch	*Danaus plexippus plexippus*	Endangered	Special Concern	---	S2B,S3M
Mottled Darner	*Aeshna clepsydra*	---	---	---	S3S4
Northern Cloudywing	*Thorybes pylades*	---	---	---	S3S4
Ocellated Darner	*Boyeria grafiana*	---	---	---	S3S4
Pepper and Salt Skipper	*Amblyscirtes hegon*	---	---	---	S3S4
Prince Baskettail	*Epitheca princeps*	---	---	---	S3
Quebec Emerald	*Somatochlora brevicincta*	---	---	---	S1S2
Question Mark	*Polygonia interrogationis*	---	---	---	S3B
Rusty Snaketail	*Ophiogomphus rupinsulensis*	---	---	---	S3
Satyr Comma	*Polygonia satyrus*	---	---	---	S1?
Seaside Dragonlet	*Erythrodiplax berenice*	---	---	---	S3S4
Skillet Clubtail	*Gomphus ventricosus*	Endangered	Endangered	---	SH
Skimming Bluet	*Enallagma geminatum*	---	---	---	S2S3
Spot-Winged Glider	*Pantala hymenaea*	---	---	---	S2?B
Taiga Bluet	*Coenagrion resolutum*	---	---	---	S2
Vernal Bluet	*Enallagma vernale*	---	---	---	S3
Vesper Bluet	*Enallagma vesperum*	---	---	---	S3S4
Zebra Clubtail	*Enallagma vesperum*	---	---	---	S2S3

Source: ACCDC 2022b
[1]Government of Canada 2022; [2]Government of Canada, 2022; [3]Government of Nova Scotia, 2022; [4]ACCDC 2022a

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 (Drawing 7.19; Table 7.45). Trail cameras were also placed across the Study Area to capture the presence of wildlife without any interference from human disturbance (Drawing 7.19). The goal of the surveys was to cover all relevant habitat types across the Study Area, including roadways, wetlands, various forested habitats, riparian areas along watercourses and waterbodies, and previously disturbed areas (i.e., clearcuts).

Table 7.45: Mammal Assessment Survey Information

Survey Type	Dates	Transect Number/Location	Transect Length (km)
Winter Tracking	January 25, 2021 (Round 1); March 22, 2021 (Round 2)	8	1.00
		7	0.79
		2	1.80
	January 26, 2021 (Round 1); March 22, 2021 (Round 2)	6	0.83
		5	0.91
		9	0.67
		1	1.18
		3	1.52
		4	0.59
Pellet Surveys	April 8, 2021	5	1.71
		6	1.30
		7	2.72
		8	0.92
		9	2.10
		12	0.66
		14	1.51
	April 9, 2021	1	1.13
		2	0.99
		3	1.39
		4	0.52
		10	1.50
		11	0.64
		13	0.88
		15	0.87
		16	0.80
		17	0.68

Methods were adapted from those recommended by the NSNRR Wildlife Division (2012c). Updated procedural recommendations were provided by the department in 2022 (NSNRR, 2022c, d) after wildlife tracking and pellet surveys were completed, however the methods used remain in alignment with the most up to date recommendations. Winter wildlife tracking surveys were completed in two rounds, with the first round completed between January 25 and 26, 2021, and the second round completed on March 22, 2021. Survey dates were all within seven days of the most recent snowfall of 10 cm or more, and when possible, within two to three days of the most recent snowfall. This timeline allowed sufficient time for animals to leave their tracks, and limited opportunities for tracks to deteriorate or disappear as a result of excessive snowfall, melting, or rain. Care was also taken to ensure surveys were not completed during rain or snow events. Recent, intact tracks in fresh snow allow for the most accurate track identification. Pellet surveys were completed on April 8 and 9 of 2021 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 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 waypoints and field notes. 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 the September 2020 to November 2022. Locations were selected to include various habitat types, and to capture more information from locations previously found to have signs of wildlife (Drawing 7.19). For example, one trail camera was placed near a mature forest stand within a Mainland moose Concentration Area (NSNRR, 2017). 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 14, 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 the Study Area were identified from desktop resources; 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).

Areas 200 m upstream and downstream of any proposed upgraded infrastructure on watercourses were prioritized during surveys to 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 was recorded and georeferenced in the field using an ArcGIS Survey123 form. Any additional incidental observations of herpetofauna made during wetland or watercourse surveys, as well as observations of suitable turtle habitat, were also recorded.

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
There were five confirmed species identified during field assessments (including winter tracking, pellet surveys, and incidental observations) conducted within the Study Area, and an additional two unidentified species were noted (Table 7.46, Drawings 7.11A to 7.11J).

Table 7.46: Summary Results of the Mammal Field Assessments

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
Eastern Coyote	*Canis latrans*	---	---	---	S5
Red Fox	*Vulpes vulpes*	---	---	---	S5
Red Squirrel	*Tamiasciurus hudsonicus*	---	---	---	S5
Snowshoe Hare	*Lepus americanus*	---	---	---	S5
Unknown deer mouse	*Peromyscus sp.*	---	---	---	S5
Unknown rodent	*N/A*	N/A	N/A	N/A	N/A
White-tailed Deer	*Odocoileus virginianus*	---	---	---	S5

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

Seven mammals were recorded by trail cameras (Table 7.47, photo log provided in Appendix K).

Table 7.47: Summary of Trail Camera Results

Trail Camera Location	Dates Employed	Animals Observed	Number of Observations*
Regenerating Clear Cut	September 30, 2020 – January 25, 2021; March 4, 2021 – April 15, 2021	White-tailed Deer	9
		Eastern Coyote	15
		Raccoon	1
Mixed Wood Forest	September 30, 2020 – January 25, 2021; March 4, 2021 – April 15, 2021	Bobcat	3
		Eastern Coyote	10
		White-tailed Deer	22
		Fisher	2
		Snowshoe Hare	2
Wetland Edge	September 30, 2020 – January 25, 2021; March 4, 2021 – April 15, 2021	American Black Bear	1
		Bobcat	3
		Eastern Coyote	11
		White-tailed Deer	6
Mature Forest in Moose Concentration Area	September 30, 2020 – January 25, 2021; March 4, 2021 – April 15, 2021	White-tailed Deer	17
Dead End Road	May 5, 2022 – November 2, 2022	White-tailed Deer	8
		Eastern Coyote	2
Radar	May 5, 2022 – November 2, 2022	White-tailed Deer	4
Softwood Forest	June 15, 2022 – August 14, 2022	---	---

*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)

Mainland moose (*Alces alces americanus)* are listed as “Endangered” under the NS *ESA* with a subnational ranking of ‘S1’ (highest priority) (ACCDC, 2022a). 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, 2021f). 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. While no evidence of Mainland moose was observed during field surveys, the Study Area is within the northern extent of a Mainland Moose Concentration Area [a Special Management Practice Zone determined by NSNRR (2017)].

Fishers prefer dense, mature to old-growth forests with continuous overhead cover (Allen, 1983). Generally considered forest-interior species (OMNR, 2000), fishers require large tracts of well-connected habitat (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 75 fishers have been harvested from Hants County since 2010, representing 4.8% of the provincial total during that time (NSNRR, 2021h). There were two confirmed fisher observations in the Study Area from one trail camera located along an old trail adjacent to softwood and mixed wood forest stands. Suspected tracks were also observed during winter tracking surveys on a transect found southeast of the current Study Area. These tracks were found in close proximity to a confirmed old-growth forest stand. 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.

Herpetofauna

There were no herpetofauna SOCI identified in the Study Area during field studies. Non-SOCI species of frogs and snakes were observed across the Study Area in various habitats, but details were not recorded due to the ubiquity of these species. Ideal turtle habitat was noted along various watercourses through the Study Area, characterized by sandy/gravelly shores, clear, flowing water, and adequate sun exposure.

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

- Eastern Painted Turtle (*Chrysemys picta picta*) – Special Concern (COSEWIC, *SARA*)
- Four-toed Salamander (*Hemidactylium scutatum*) – S3 (ACCDC)
- Snapping turtle (*Chelydra serpentina*) – Special Concern (COSEWIC, *SARA*), Vulnerable (NS *ESA*), S3 (S-Rank)
- Wood turtle (*Glyptemys insculpta*) – Threatened (COSEWIC, *SARA*, NS *ESA*), S2 (S-Rank)

Eastern Painted Turtle
The Eastern painted turtle is considered relatively common in mainland Nova Scotia and has a provincial S-Rank of 'S4' (Nova Scotia Museum, u.d.a; ACCDC, 2022a). Eastern painted turtles are usually found in the slow-moving waters of shallow ponds, marshes, lakes, or creeks with soft bottoms and debris suitable for basking. These turtles also require dense vegetation in the riparian zone for protection from predators, such as racoons and skunks (NCC, 2022; Nova Scotia Museum, u.d.a). While these turtles nest on land, these nests generally occur within 200 m of water (NCC, 2022).

This species can be commonly found in southwestern Nova Scotia, becoming less common in northeastern areas of the province, and with no records in Cape Breton (Nova Scotia Museum, u.d.a). ACCDC records indicate that the closest observation of this species to the center of the Assessment Area was 3.1 ± 10.0 km away. No indication of Eastern painted turtle was observed during field studies, and it is unlikely that Eastern painted turtle will be impacted by Project activities.

Four-toed Salamander
The four-toed salamander has a limited range in Canada (Desroches and Rodrigue 2004), with Nova Scotia situated near the species' northern range limit. Although not believed to be sensitive or at risk in Nova Scotia, the four-toed salamander has been found at a relatively small number of widely separated localities (Gilhen 1984). The species is closely associated with sphagnum bogs, particularly during the spring breeding season (Nova Scotia Museum, u.d.b).

No indication of four-toed salamander was observed during field studies. ACCDC data indicate that the closest observation of this species to the center of the Assessment Area was 5.0 ± 0.0 km away. Multiple areas of treed swamp wetland habitat exist within the Study Area; however, there were few areas of sphagnum bog identified. It is unlikely that four-toed salamander will be impacted by Project activities.

Snapping Turtle
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, 2020a). Established populations are typically found in ponds, lakes, and river edges (COSEWIC, 2008). ACCDC records indicate that the closest observation of this species to the center of the Assessment Area was 3.1 ± 10.0 km away. No indication of Snapping turtle was observed during field studies, and it is unlikely that Snapping turtle will be impacted by Project activities.

Wood turtle
Wood turtle requires three key habitat components: a watercourse, sandy substrate for nesting, and a forested area for thermal relief during the summer months (MacGregor & Elderkin, 2003). Ideal streams have a clear, moderate flow, a hard bottom composed of sand or gravel, and are 7-100 feet wide (MacGregor & Elderkin, 2003).

The species is found throughout the province but seems to be most abundant in central Nova Scotia (MacGregor & Elderkin, 2003). ACCDC data indicate that the closest observation of this species to the center of the Assessment Area was 6.4 ± 5.0 km away. No indication of Wood turtle was observed during field studies, though small areas containing potentially suitable habitat were identified.

It is possible that dispersing turtles may travel from nearby known habitats through the Assessment Area in search of territories in surrounding lands, but due to a lack of signs or sightings in the Assessment Area, the likelihood that Wood turtles breed or nest in the Assessment Area is relatively low.

Butterflies and Odonates
There were no records of butterfly and Odonate SOCI occurring within Study Area (ACCDC, 2022b). There were, however, multiple instances of the monarch butterfly (*Danaus plexippus*) observed during summer field surveys. Based on the results of the field and desktop assessments, the following species was identified as priority species and is discussed in further detail below:

- Monarch (*Danaus plexippus*) – Endangered (COSEWIC, NS *ESA*), Special Concern (*SARA*), S2?B, S3M (S-Rank)

Monarch
The monarch can be found in open habitats with abundant wildflower growth. Milkweed (*Asclepias sp.*) is a critical element of breeding habitat, whereas asters (*Asteraciae sp.*) and goldenrods (*Solidago sp*.) provide necessary food resources during migration (NSNRR, 2021i). Nova Scotia falls within the breeding range of this migratory species, and individuals can be found throughout the province from May to October (Maritime Butterfly Atlas, 2016; NSNRR, 2021i). Open habitat within the Study Area is prevalent, particularly in cutovers areas and along roadsides. All monarch observations occurred along roads/roadsides during the migratory period (late summer/early fall).

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	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 7.20).

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 Study Area falls within the most northern extent of the Chebucto Peninsula concentration area. The Mainland Moose Recovery Plan (NSNRR, 2021f), however, focuses on only three main localized groups of Mainland moose within the province, excluding the Chebucto group. The Recovery Plan has defined Core Habitat of each group through habitat suitability modeling and has also mapped Core Habitat for the remainder of mainland Nova Scotia, including areas between each group to maintain connectivity. 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, 2021f). 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 5,466 ha within the RAA was developed to assess the quality of Mainland moose habitat within the RAA. Of the 3,321 ha of habitat determined to be suitable for Mainland moose within the RAA, 32 ha lie within the Assessment Area, representing 0.95% of suitable moose habitat within the RAA. Most of this area is associated with upgrading the 16 km of existing roads that have been incorporated into the Project design. Only approximately 4 km of new road construction will be required and all new road construction will occur outside the provincially designated Mainland Moose Concentration Area. 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.

Eleven 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 78, while the average score within the LAA is 74. 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. The amount of suitable habitat within the LAA, and the quality of said habitat is likely lower than modelled, as model results are based on 2012 imagery which has undergone drastic changes due to past forestry and industrial activities.

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, 2021f). 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.

Most of the Project Area will utilize pre-existing roads, thus minimizing habitat fragmentation with only approximately 4 km of new roads needing to be constructed (while the remaining 16 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. While collector lines could also create linear fragmentation in the Study Area, the collector line corridor does not interrupt continuity of habitat between the Mainland Moose Concentration Area and the pre-existing road network.

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) within the RAA that will remain unfragmented due to the limited construction of new roads and strategic placement of the LAA where less suitable Mainland moose habitat can be found.

Based on the abundance of moderately high-quality moose habitat, lack 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, 2021f).

There was no 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 adjacent to the Assessment Area and will not be directly impacted (a maximum of 0.95% 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, 2021f). 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 no evidence 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, 2021f). 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 lack of evidence of Mainland moose in the Study Area, poaching is not expected to affect Mainland moose within the LAA or RAA from 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, 2021f). 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

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

There is no confirmed old-growth forest within the Study Area and very little mature hardwood cover within the Assessment Area. The observed Fisher was found along a road within a large softwood area made up of large patches of regenerating forest. The Project Area will not extend to this location, and therefore no additional habitat will be lost in this area. Areas identified as potential old-growth within the Study Area have been avoided, thus conserving high quality Fisher habitat.

Habitat Fragmentation
Fishers 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 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; by heavy machinery operators associated with the quarry on site, by technicians to access pre-existing transmission lines; 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 approximately 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 have 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 wind turbines, 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). Considering the pre-existing traffic load and the minimal traffic to be associated with the Project (see Section 8.3 Traffic and Transportation), 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, which 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. No herpetofauna SOCI were observed within the Study Area during field surveys, and the majority of aquatic habitats currently supporting herpetofauna are outside of the Study Area on the western side of Panuke Lake or across Highway 101. 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). Monarchs were observed during field surveys despite the presence of pre-existing turbines. 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 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 utilize habitat modelling results, field survey results, and guidance from NSNRR through the detail design phase to minimize impacts to terrestrial fauna through habitat loss.
- 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.
- Maintain 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
    - Turtles (Wood, Eastern painted, and Snapping) – May to June (nesting) and October to April (overwintering)
    - Four-toed salamander – March to April (nesting) and Fall (mating)
    - Monarch – Late summer (July) to early fall (October) (congregation of migratory groups)
- Minimize loss of important habitat required by priority species for reproduction events, migration, or hibernation, including:
    - Mainland moose – wetlands and isolated islands/peninsulas
    - Fisher – large snags, large woody debris, or live, hollow standing trees in intact forests
    - Wood turtle – clear, meandering streams with gravel shores, gravel roadsides
    - Eastern painted turtle – open/sloped south-facing areas with gravel, sand, or loam substrates
    - Snapping turtle – sand, gravel or soil of wooded areas

    - Four-toed salamander – sphagnum moss and peat bogs that border watercourses
    - Monarch – goldenrod and aster for food sources during migration
- Minimize overall area to be cleared to maintain refugia and cover for protection from predators.
- Maintain all equipment and machinery in good working condition to reduce noise and vibration emissions. Where practicable, use 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.

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).
- Assess nearby hibernacula for bat activity.
- Assess for summer roosting activity in the suitable areas of the Study Area (e.g., mature hardwood forests).
- Use the information collected to inform and refine the Project design (i.e., avoid impacts to SOCI and their habitats).
- Use the information collected to inform mitigation and management practices.

7.4.4.2 Regulatory Context

There are six species of bats in Nova Scotia, of which three are resident species that reside in the province year-round and three 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)
- Nova Scotia Significant Species and Habitats Database (NSNRR, 2018)
- ACCDC Data Report (2022b)

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 these sites' location and use (ECCC, 2015; NSNRR, 2020). As a result, information on potential maternity roosts near the Project was supplemented through field studies.

Migration is one of the most poorly understood components of bat biology, at both a regional (<200 km) and long distance (>1000 km) scale. Migratory stopovers utilized for short term rest or sanctuary are thought to be located on islands or shorelines of large bodies of water and along geographic features such as riparian zones or mountain ranges (McGuire et al., 2011). During terrestrial habitat mapping, riparian and shoreline habitats were identified and used to guide field studies.

Locations of Known Bat Hibernacula

Moseley (2007) provides an overview of the known and recorded bat hibernacula located within Nova Scotia. This research indicates 16 known hibernacula within a 100 km radius of the Study Area (Table 7.49).

Table 7.49: Known Bat Hibernacula within 100 km of the Study Area

Hibernaculum	Approximate Distance to Study Area*	Direction
Frenchman's Cave I & II	2 km	N
Miller's Creek Cave	9 km	N
Woodville Ice Cave	14 km	N
Centre Rawdon Gold Mine	25 km	NE
Cheverie Cave	27 km	N
Walton Barite Mine	33 km	NE
Peddlar's Tunnel	36 km	NE
Minasville Ice Cave	41 km	NE
Cave of Bats	44 km	E
Hayes Cave	49 km	NE
Gayes River Gold Mine	53 km	E
Black Brook	56 km	E
The Ovens	62 km	SW
Lear Shaft	68 km	NE
Vault Cave	79 km	W
Lake Charlotte Gold Mine	81 km	SE

*Distance measured to the nearest point of the Study Area.

Source: Moseley (2007)

Four 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). These hibernacula include:

- Frenchman's Cave I & II
- Miller's Creek Cave

- Woodville Ice Cave
- Centre Rawdon Gold Mine

Frenchman's Cave I and II, the closest known hibernaculum, are a series of dissolutional caves with an active and connected stream system located in gypsum deposits near St. Croix, Nova Scotia. This site is considered to be a small hibernaculum, suspected of supporting between 10 and 50 over-wintering bats. All three resident bat species were documented at this hibernaculum during surveys conducted in 2003. Bats have been recorded using this cave during fall, winter, and summer seasons (Moseley, 2007).

Miller's Creek Cave was a major hibernaculum site where approximately 2000 bats were reported; however, this cave was quarried/destroyed in 1981 (Moseley, 2007).

Woodville Ice Cave is a minor site that is suspected to support <10 bats, as only solitary Little brown myotis species have been observed here. This habitat is not considered to be significant due to the cave's low temperatures, large opening/entrance, and unsuitable microclimate (Moseley, 2007).

Lastly, the Centre Rawdon Gold Mine is an abandoned gold mine measuring approximately 293 m in length. This is a significant hibernaculum suspected of supporting approximately 650 bats, in which the composition of species has not been determined (Moseley, 2007).

It should be noted that the aforementioned hibernacula were assessed prior to the onset of white-nose syndrome in Nova Scotia, and therefore, populations of bats using these habitats are likely less than originally estimated.

Abandoned Mine Openings
There is only one recorded abandoned mine opening located within the Study Area, a private gold shaft approximately 6 m in depth (Drawing 7.21). Outside of the Study Area, there are several clusters of mine openings, documented gold shafts, pits, and open cuts to the northeast (6 km) and east (14 km and 18 km) of the Study Area (NSNRR, 2021a).

Significant Species and Habitat Records
The NSNRR Significant Species and Habitats Database (2018) contains 31 unique species/habitat records pertaining to bats and associated habitat within 100 km radius of the Study Area. These records include:

- One "Species of Concern" record relating to karst.
- Five "Other Habitat" records relating to karst (four) and a cave (one).
- 25 "Species at Risk" records which relate to caves (two) and little brown myotis (23).

None of the aforementioned records are located within the Study Area (NSNRR, 2018).

ACCDC Records
A search of the ACCDC database indicated four bat species of concern 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 2022b
[1]Government of Canada 2022; [2]Government of Canada 2022; [2]Government of NS, 2022; [4]ACCDC 2022a

According the ACCDC Report (2022b), a "bat hibernaculum or bat species occurrence" is known to exist within the Study Area.

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

- Little brown myotis
- Northern myotis
- Tri-colored bat

The Little brown myotis is the most common species in Nova Scotia and is likely ubiquitous in the province (Broders et al., 2003). During the day, the Little brown myotis will roost in buildings, trees, under rocks, in wood piles, and in caves, congregating in tight spaces to roost at night (Fenton & Barclay, 1980). As a non-migratory species, Little brown myotis hibernates from September to early or mid-May in abandoned mines or caves (Fenton & Barclay, 1980; Mosely, 2007). ACCDC data indicates that there are no records of Little brown myotis within the Study Area; the closest observation is 6.1 ± 0.0 km from the center of the Assessment Area (ACCDC, 2022b).

The Northern myotis, once considered uncommon throughout Nova Scotia (Moseley, 2007), is likely ubiquitous in the forested regions of the province (Broders et al., 2003). This species is widely distributed in the eastern United States and Canada and is commonly encountered during swarming and hibernation (Caceres & Barclay, 2000). During the day, Northern myotis show a preference for roosting in trees; however, the habitat preferences of females may vary according to their reproductive status (Garroway & Broders, 2008). Females appear to prefer shade tolerant deciduous trees over coniferous trees, whereas males roost alone in coniferous or mixed-stands in mid-decay stages (Broders & Forbes, 2004). Northern myotis are also non-migratory and are typically associated with the Little brown myotis during hibernation, being found in caves or abandoned mines also inhabited by this species (Moseley, 2007). Hibernation of the Northern myotis is thought to begin as early as September and can last until May (Caceres & Barclay, 2000). ACCDC data indicates that there are no records of Northern myotis within the Study Area; the closest observation is 7.5 ± 0.0 km from the center of the Assessment Area (ACCDC, 2022b).

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 there are no records of Tri-colored bat within the Study Area; the closest observation is 7.5 ± 1.0 km from the center of the Assessment Area (ACCDC, 2022b).

7.4.4.4 Field Assessment Methodology

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

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

Incidental Observations

Incidental observations of significant bat habitat features were recorded throughout the 2021 and 2022 field assessments 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 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) are assessed in other biophysical sections, and therefore, are not considered further here.

Passive Bat Assessment
Passive acoustic monitoring was conducted within the Study Area across various representative habitats such as clear cuts, riparian areas, and forest edges (Drawing 7.21). Monitoring stations were chosen based on habitat mapping and accumulated knowledge from field studies to represent various habitats types present on the site, along with ideal bat habitat for the bat species present in Nova Scotia. The passive acoustic bat monitoring program was completed using a combination of Anabat SD2 Detectors from Titley Scientific and Song Meter SM4BAT/Mini's from Wildlife Acoustics. The detectors were programed to monitor between 30 mins before sunset to 30 mins after sunrise to correspond with peak times of bat activity. GPS points along with supplementary information (i.e., habitat descriptions) of each monitor location and detector set up were recorded.

Acoustic monitoring data (i.e., sonograms) was processed using Kaleidoscope software from Wildlife Acoustics, which can process data from both detector types used. Sonograms were processed for potential bat generated ultrasonic vocalizations and speciated where possible. Identification codes for Nova Scotia bat species are listed below:

- MYOT Myotis (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 (O'Farrell et al., 1999), so these calls are typically not identified to species. Bat generated calls were identified as Unknown (UNKW) if the recording was within the correct frequency range for bats (20-40 kHz for low frequency bats and 40-120 kHz for high frequency bats) but was unable to be speciated based on the quality or length of the recording.

Passive acoustic bat monitoring was conducted for 157 consecutive days within the Study Area between the dates of May 30 and November 2, 2022, encompassing the spring, summer, and fall active bat seasons. Five detectors were deployed in habitats representative of the Study Area and in areas expected to provide suitable foraging habitat for bats (e.g., wetlands).

Detector 001 was deployed in the riparian area of a marsh wetland. Detector 002 was deployed at the bottom of the meteorological tower to incorporate an open/cleared habitat type. In addition, Detector 003 was elevated on the meteorological tower to a height of 30 m to capture bat activity, as per recommendations from NSNRR to monitor at elevated heights. Detector 004 was deployed near the location of the radar trailer, in a clear cut (formerly mixedwood). Lastly, Detector 005 was deployed in a hardwood dominant stand within the riparian area of Sucker Brook. Detector information is summarized in Table 7.51 and locations are found on Drawing 7.21.

Table 7.51: Monitoring Periods for each Detector.

ID	Detector Location	Detector Type	Habitat	Monitoring Duration (2022)	Consecutive Days	Number Of Recordings
001	Marsh	Anabat	Riparian zone	May 30 to November 2	157	58,759
002	Met Tower (Bottom)	Wildlife Acoustics	Open Area	August 16 to November 2	80	370
003	Met Tower (30 m)	Wildlife Acoustics	Open Area	August 16 to November 2	80	339
004	Radar Trailer	Anabat	Open Area	July 19 to November 2	107	*
005	Hardwood Stream	Anabat	Riparian zone	May 30 to November 2	157	78,194

*The acoustic detector was originally positioned too close to the radar system resulting in over +180,000 audio files.

7.4.4.5 Field Assessment Results

Incidental Observations

Bat habitat features such as snags, downed trees, and living trees in the early stages of decay were found across the Study Area; especially in bogs, treed swamps, and riparian areas where waterlogged sediments resulted in the decay of large diameter trees. These freshwater habitats (i.e., waterbodies, watercourses, wetlands, and riparian areas) encountered during field studies were all considered potential over-day habitat and/or potential foraging 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 Sections 7.3.1 and 7.3.3 (see Drawings 7.11A to 7.11J for freshwater habitat locations). Locations of old growth are discussed in Section 7.4.1.

No areas of significant bat habitat (i.e., hibernacula, maternity colonies, or migratory stopovers) were identified/incidentally discovered during the field assessments.

Passive Bat Assessment

In total, over 317,000 files were recorded by the acoustic detectors, of which 4600 were determined to be bat generated ultrasound using Kaleidoscope software. The remaining files were determined to be caused by extraneous noise from sources such as vegetation, wind, or precipitation. The passive acoustic survey identified the following bat species: Myotis (Little brown myotis or Northern myotis), Eastern red bat, Hoary bat, Silver-haired bat, and Tri-colored bat (Table 7.52).

Table 7.52: Results of the Passive Acoustic Bat Survey (2022)

Detector ID	MYOT	LABO	LACI	LANO	PESU	UKWN	Calls per Detector
001: Marsh	368	30	0	2	0	46	**446**
002: Met Tower (Bottom)	8	4	7	0	0	3	**22**
003: Met Tower (30 m)	1	1	3	0	0	0	**5**
004: Radar Trailer	112	40	8	3	4	25	**192**
005: Hardwood Stream	2710	396	3	2	10	814	**3935**
Calls per Species	**3199**	**471**	**21**	**7**	**14**	**888**	***Survey Total*** **= 4600**

The detector located in the riparian area of a hardwood stream (005) recorded significantly higher call counts compared to all other detectors. Riparian zones are important foraging grounds for bats as a result of high insect activity which may explain the concentrated number of bat calls associated with this detector. In addition, river valleys (especially those dominated by mature hardwoods) serve as important travel corridors for bats as they contain relatively clearer understories and covered canopy layers. The detector located in a marsh recorded the second highest call counts; wetlands serve as important foraging grounds for bats and large snags in wetlands (that develop as a result of water logged soils) can serve as over-day habitat for bats. The remaining detectors recorded significantly less bat calls; these detectors were located in open/cleared areas that also experience frequent disturbance/visitation as a result of road traffic and possible disturbance from weather and radar monitoring equipment.

Across the entire Study Area (including all monitors), 4,600 bat calls were detected over a 157-day monitoring period resulting in an average of 29 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. Provided below are the average bat calls per day for each detector:

- 001 Marsh 2.84 bat calls/day *(157 monitoring days)*
- 002 Met Tower (Bottom) 0.28 bat calls/day *(80 monitoring days)*
- 003 Met Tower (30 m) 0.06 bat calls/day *(80 monitoring days)*
- 004 Radar Trailer 1.79 bat calls/day *(107 monitoring days)*
- 005 Hardwood Stream 25.06 bat calls/day *(157 monitoring days)*

Bat calls were also assessed hourly throughout the night (Figure 7.3). Peak hourly bat activity was observed primarily near dusk (19:00), and again near midnight (23:00-0:00). These findings are relatively consistent with the most current and available literature on bat species and nightly activity in Nova Scotia (NSNRR, 2020).

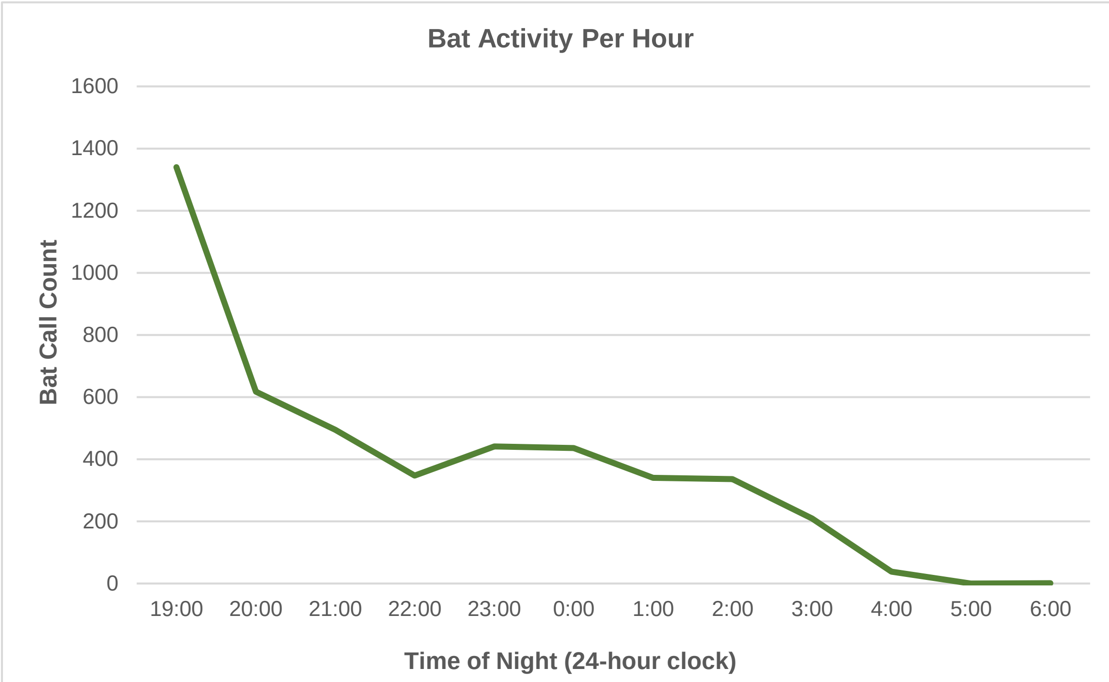

Figure 7.3: Bat Activity Per Hour Observed During the Passive Acoustic Survey (2022)

There is limited literature and research available for species specific levels of bat activity throughout the night. Factors that may influence the distribution of bat activity throughout the night include environmental conditions, foraging location, time of year, competition/resource partitioning, and/or diet (as cited in Fern et al., 2018).

Bat calls persisted throughout the monitoring period, with activity peaking during the spring and again during late summer/fall (Figure 7.4). Significantly less calls were recorded between July and mid-August, with calls steeply dropping in October, and no calls during November 2022. Concentrated acoustic activity during the spring and late summer/fall coincides with the migration season of resident bat species to/from hibernacula (four known within 25 km) and migratory species to/from southern US/South America. Decreased acoustic activity seen during October and November is likely a result of resident species congregating in/near hibernacula for over-wintering and migratory bats moving south for the winter. At a species level, echolocation calls across the monitoring period were dominated by Myotis species and Eastern red bat, which were both recorded in every month except for November. Hoary bat, Tri-colored bat, and Silver-haired bat were all recorded in low numbers and infrequently throughout the monitoring period. Hoary bat was only detected during the months of August and September. Tri-colored bat was found in May/June and again in August/September. Lastly, Silver-haired bat was only recorded during the months of June, September, and October.

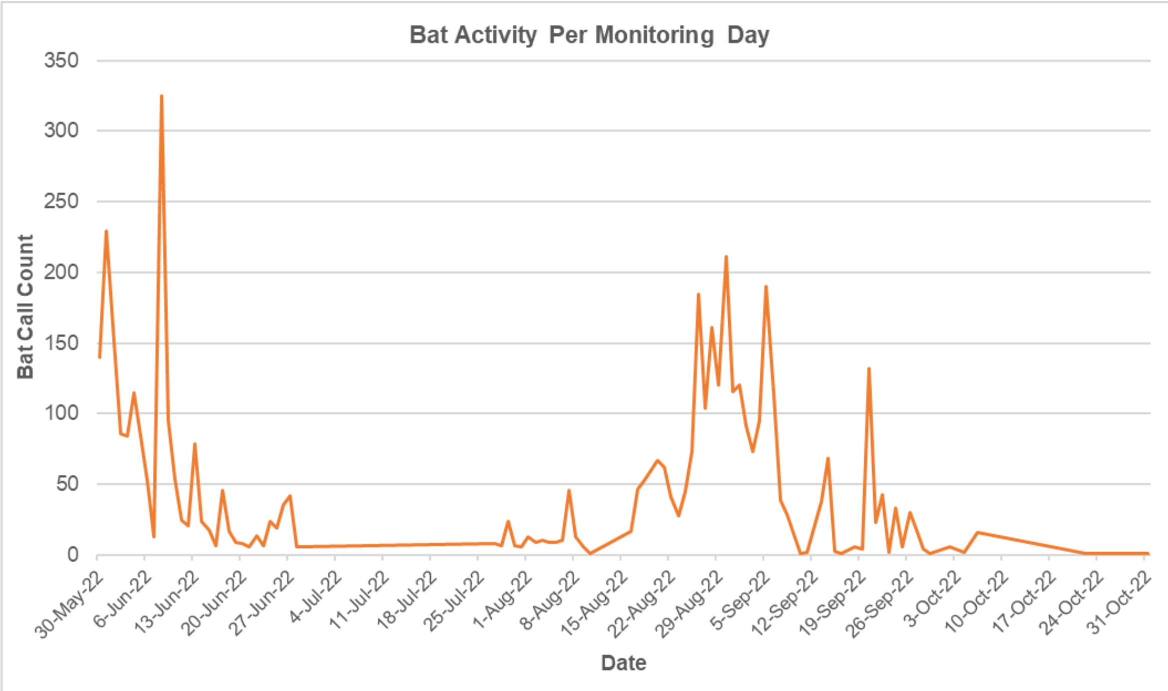

Figure 7.4: Bat Activity Per Day Observed During the Passive Acoustic Survey (2022)

7.4.4.6 Effects Assessment

Project-Bat Interactions

Project activities, primarily those involving vegetation removal and turbine operation, have the potential to impact bat and bat habitat (Table 7.53). These activities could result in habitat removal along with accidental injury/mortality. Other Project activities during construction and operation may impact bat behaviors such as increased noise and lighting.

Table 7.53: Potential Project-Bat Interactions

Valued Component	Site Preparation and Construction											Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and	Clearing and Grubbing	Access Road Upgrading and	Laydown Area and Turbine Pad	Transportation of Turbine	Turbine Assembly	Grid Connection	Removal of Temporary Works and	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.) 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).

Significant habitat features (i.e., hibernacula, maternity colonies, or migratory stopovers) were not identified within the Study Area or Project Area, however, there are several known hibernacula within close proximity (25 km) of the Project. Nearby hibernacula, coupled with 70.3% of recorded bat calls from resident species and concentrated acoustic activity during the spring/fall seasons, suggests that the Study Area is primarily utilized by residential bat species during migration to/from hibernacula. During the spring, resident bats emerge from hibernacula and travel to summer foraging/maternity colony grounds; while in the fall, resident bat species return to hibernacula openings where swarming events (i.e., mating) occur prior to overwintering (GOC, 2015). Recorded bat activity during the summer months (July and August), when maternity roosts are established, was significantly less than the spring/fall seasons. It is unlikely, based on the low bat call counts during summer months along with no previous documented history of maternity colonies in the area, that the Study Area supports maternity roosting habitat. Further, during field assessment, no areas of mature hardwood forests with the necessary density or clusters of snags (at ≥10 snags per hectare) required to support maternity colonies were identified (OMNR, 2022). It was also observed that the Project Area is already fragmented and disturbed from previous developments including power lines, existing wind farm, active and previous forestry, and recreational activity.

Impacts to bats as a result of habitat fragmentation and removal are anticipated to be minimal based on the widespread existing disturbance/fragmentation in the Study Area along with the Project's maximized use of existing roadways. Although there will be a small increase in habitat fragmentation and removal associated with newly constructed roads, only approximately 4 km of new road is required for the Project. Furthermore, areas where new road construction is proposed do not contain significant bat habitat.

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 or mortalities can result either from a direct collision with a turbine blade or from barotrauma which is caused by the sudden decrease in air pressure following rotating blades (GOC, 2015). Reasons for bats colliding with blades include the inability for bats to detect or avoid blades due to high speeds, which can be up to 300 km/h at the tip of the blade (Wellig et al., 2018). In addition, research suggests that bats are attracted to wind turbines because the tall structures dominate landscapes which may attract insects or be perceived as potential mating sites or roost trees (Wellig et al., 2018). A study 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; GOC, 2015). Alternatively, Myotis species of bats have lower fatality rates due to lower flight elevation and short migrating distances (GOC, 2015). In the Recovery Strategy for Little Brown Myotis, Northern Myotis, and Tri-colored Bat 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 summer, fall, and spring.

Bat activity and use of habitat within the Study Area was assessed through incidental observations and passive acoustic monitoring. Five bat species were identified as part of the field assessment which included both resident species (Myotis and Tri-colored bat) and migratory species (Eastern red bat, Hoary bat, and Silver-haired bats). In addition, numerous calls were classified as unknown as they were not able to be speciated due to poor quality recordings or too short of calls to accurately identify (representing 19.3% of the total recorded calls).

Myotis species (i.e., Little brown myotis and/or Northern myotis) were the most frequently detected bats within the Study Area representing 70% of recorded bat calls. Another resident species, the Tri-colored bat, was also recorded during the survey but only represented 0.3% of identified calls. Tri-colored bats are typically restricted to southwest Nova Scotia which may explain its low detection rate during the survey. Both Myotis and Tri-colored bats are resident species which reside in Nova Scotia year-round through the use of hibernacula during the winter months. As discussed above, resident species have been found to be at a lower risk for wind turbine related injuries and mortalities as a result of lower flight patterns and shorter migration routes. Migratory bat species, which are at a higher risk due to higher flight patterns and longer migration routes, comprised 10.7% of calls identified: Hoary bats (0.5%), Silver-haired bats (0.2%), and Eastern red bats (10%).

The Study Area has demonstrated bat activity and therefore has the potential to impact bat species individuals as a result of injury/mortality during Project activities (primarily vegetation clearing and turbine operation). Impacts to bat SOCI populations at a regional scale or population level are not anticipated based on:

- Low flight patterns of resident species (GOC, 2015).
- Insignificant levels of bat activity identified at 30 m height (0.1% of total calls).
- Results of previous mortality surveys completed for adjacent wind turbines (see below).

The existing Ellershouse Wind Farm Project (adjacent to the Project) was required to undertake post construction bat monitoring as a condition for EA approval (Minister of Environment, 2017). Bat mortality searches were completed between 2016 and 2018 in which no bat carcasses were found (Strum Consulting, 2020). In addition, Strum Consulting has completed post-construction bat mortality surveys for numerous wind turbine developments and have identified minimal/negligible levels of bat mortality across the Province of Nova Scotia.

Sensory Disturbance
Sensory disturbance generated primarily by lighting and noise during both construction and operation phases of the Project may also impact bat behaviours and/or impede movement, foraging, flight activity, and habitat use. Based on the pre-existing wind developments, traffic loads, forestry, and recreational activity within the Study Area, along with the minimal traffic to be associated with the Project, effects on bat behaviours are not anticipated within the LAA.

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

Habitat Fragmentation & Removal

- Minimize overall area to be cleared by utilizing pre-existing roads and previously altered areas (i.e., clearcuts).
- Schedule vegetation clearing during winter months when bats are overwintering in caves (end of September to late April) to the extent possible.
- Schedule blasting activities within proximity of abandoned mines/caves during the summer months to avoid risk of collapse/degradation of these potential habitats when bats would be present.
- Maintain avoidance of important potential bat habitat (i.e., abandoned mines) to the greatest extent possible.
- Avoid/minimize the removal of large diameter (≥25 cm) snags and hollow trees (bat over-day roosting habitat) within the Project Area during the detail design phase, to the greatest extent possible.
- Minimize fragmentation and habitat isolation during the design phase.
- Revegetate roadsides and cleared areas to minimize lost habitat as much as possible.

Injury/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 in an area demonstrated to contain low bat mortality as a result of wind development (i.e., adjacent existing Ellershouse Wind Farm). These considerations were 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 regulatory and 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
Effects of concern/discussion on bat species as a result of Project activities include: habitat fragmentation and/or removal, injury/mortality, and sensory disturbance. Based on this assessment and through the implementation of proposed mitigation and monitoring activities, effects are characterized as moderate magnitude, within the LAA, medium duration, intermittent, reversible, and not significant.

7.4.5 Avifauna

7.4.5.1 Overview
A desktop review, field program, and habitat modelling were undertaken to gather information on avian species and associated habitat in the Study Area. Objectives were as follows:

- Assess observations, species diversity and habitat utilization of avian species within the Study Area during all seasons.
- Use the information collected to inform and refine the Project design (i.e., avoid impacts to SOCI and their habitats).
- Assess migratory bird activity and assess the risk that the Project poses to migratory birds.
- Use the information collected to inform mitigation and management practices.

7.4.5.1 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.

7.4.5.2 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, 2022b)

The Study Area features predominantly softwood dominated mixed wood stands, with some hardwood dominated slopes. 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 the Southern Bight, Minas Basin, approximately 10 km northwest of the Project (Drawing 7.22). This IBA is made up of numerous salt marshes, tidal mudflats, and river delta estuaries that provide important feeding habitat for shorebirds at the beginning of their migration south in late July and August. Each year, approximately 1-2 million shorebirds gather for a feeding frenzy in the Minas Basin before heading south for the winter (IBA Canada, 2016).

The majority of the Assessment Area is contained within the map square 20MQ17 of the MBBA, and to a lesser extent 20MQ16 (MBBA 2012). In the most recent edition of the MBBA (2006-2010), 77 species were identified as being possible, probable, or confirmed breeders for square 20MQ17. The following SOCI are considered possible, probable, or confirmed breeders in the MBBA square:

- American Bittern (*Botaurus lentiginosus*) – “S3S4B” (ACCDC)
- Bank Swallow (*Riparia riparia*) – “Threatened” (*SARA* and COSEWIC), “Endangered” (NS *ESA*), “S2S3B” (ACCDC)
- Barn Swallow (*Hirundo rustica*) – “Threatened” (*SARA*), “Endangered” (NS *ESA*), “Special Concern” (COSEWIC), “S3B” (ACCDC)
- Black-backed Woodpecker (*Picoides arcticus*) – “S3S4” (ACCDC)
- Bobolink (*Dolichonyx oryzivorus*) – “Threatened” (*SARA* and COSEWIC), “Vulnerable” (NS *ESA*), “S3B” (ACCDC)
- Boreal Chickadee (*Poecile hudsonicus*) – “S3” (ACCDC)
- Canada Goose (*Branta canadensis*) – “SUB” (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)
- Gray Jay (*Perisoreus canadensis*) – “S3” (ACCDC)
- Killdeer (*Charadrius vociferus*) – “S3B” (ACCDC)
- Northern Harrier (*Circus cyaneus*) – “SU” (ACCDC), “Not At Risk” (COSEWIC)
- Northern Parula (*Parula americana*) – “SU” (ACCDC)
- Olive-sided Flycatcher (*Contopus cooperi*) – “Threatened” (*SARA*), “Special Concern” (COSEWIC), “Threatened” (NS *ESA*), “S2B” (ACCDC)
- Red Crossbill (*Loxia curvirostra*) – “S3, S4” (ACCDC)
- Spotted Sandpiper (*Actitis macularius*) – “S3S4B” (ACCDC)
- Winter wren (*Troglodytes troglodytes*) – “SU” (ACCDC)

The NS Significant Species and Habitats database contains 1568 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:

- 419 records classified in the database as “Other Habitat”, most of which relate to Bald Eagle (*Haliaeetus leucocephalus*) (362) and Osprey (*Pandion haliaetus*) (45).
- 222 records classified as “Species of Concern” most of which relate to Common Loon (*Gavia immer*) (65), and unclassified Tern (51).
- 195 records classified as “Migratory Bird” most of which relate to unclassified shorebirds (18), unclassified Cormorant (18), Double-crested Cormorant (*Phalacrocorax auritus*) (28), Great Blue Heron (*Ardea herodias*) (25), Canada Goose (*Branta canadensis*) (7), Common Eider (*Somateria mollissima*) (25), and American Black Duck (*Anas rubripes*) (10).
- 731 records classified as “Species at Risk” most of which relate to Blackpoll Warbler (*Dendroica striata*) (22), Piping Plover (*Charadrius melodus*) (57), Peregrine Falcon (*Falco peregrinus*) (34), Eastern Wood-Pewee (*Contopus virens*) (42), Canada Warbler (*Cardellina canadensis*) (45), Golden-crowned Kinglet (*Regulus satrapa*) (128), Boreal Chickadee (*Poecile hudsonicus*) (26), Ruby-crowned Kinglet (*Regulus calendula*) (50), Yellow-bellied Flycatcher (*Empidonax Flaviventris*) (28), and unclassified Tern (23).

The NS Significant Species and Habitats database contains 53 unique records pertaining to birds and/or bird habitat within a 10 km radius of the Project (7.18A to 7.18C). These records include:

- 16 records classified in the database as “Other Habitat”, all of which relate to Bald Eagle (*Haliaeetus leucocephalus*) (15) and Grey Partridge (*Perdix perdix*) (1).
- 7 records classified as “Species of Concern” which relate to Tree Swallow (*Tachycineta bicolor*) (1), Common Loon (*Gavia immer*) (5), and Eastern Kingbird (*Tyrannus tyrannus*) (1).

- 9 records classified as "Migratory Bird" which relate to unclassified shorebirds (1), American Black Duck (*Anas rubripes*) (1), Black-bellied Plover (*Pluvialus squatarola*) (1), Canada Goose (*Branta canadensis*) (1), Least Sandpiper (*Calidris minutilla*) (1), Semipalmated Plover (*Charadrius semipalmatus*) (1), Short-billed Dowitcher (*Limnodromus griseus*) (1), and Spotted Sandpiper (*Actitis macularius*) (2).
- 21 records classified as "Species at Risk" which relate to Pine Siskin (*Pinus spinus*) (1), Golden-crowned Kinglet (*Regulus satrapa*) (1), Eastern Kingbird (*Tyrannus tyrannus*) (1), Eastern Wood-Pewee (*Contopus virens*) (2), Canada Warbler (*Cardellina canadensis*) (2), Bay-breasted Warbler (*Dendroica castenea*) (1), Boreal Chickadee (*Poecile hudsonicus*) (2), Rose-breasted Grosbeak (*Pheucticus ludovicianus*) (1), Ruby-crowned Kingler (*Regulus calendula*) (4), Swainson's Thrush (*Catharus ustulatus*) (4) and Yellow-bellied Flycatcher (*Empidonax flaviventris*) (2).

The ACCDC database contains records of 112 bird species within a 100 km radius of the Study Area (Table 7.54).

Table 7.54: Bird Species Recorded within a 100 km Radius of the Study Area

Common Name	Scientific Name	*SARA* Status[1]	NS *ESA* Status[2]	COSEWIC[3]	NS S-Rank[4]
American Bittern	*Botaurus lentiginosus*	Not Listed	Not Listed	Not Listed	S3S4B,S4S5M
American Coot	*Fulica americana*	Not Listed	Not Listed	Not At Risk	S1B
American Golden-Plover	*Pluvialis dominica*	Not Listed	Not Listed	Not Listed	S2S3M
American Kestrel	*Falco sparverius*	Not Listed	Not Listed	Not Listed	S3B,S4S5M
Arctic Tern	*Sterna paradisaea*	Not Listed	Not Listed	Not Listed	S3B
Atlantic Puffin	*Fratercula arctica*	Not Listed	Not Listed	Not Listed	S2B
Baltimore Oriole	*Icterus galbula*	Not Listed	Not Listed	Not Listed	S2S3B,SUM
Bank Swallow	*Riparia riparia*	Threatened	Endangered	Threatened	S2B
Barn Swallow	*Hirundo rustica*	Threatened	Endangered	Special Concern	S3B
Barrow's Goldeneye	*Bucephala islandica*	Special Concern	Not Listed	Special Concern	S1N,SUM
Bay-breasted Warbler	*Setophaga castanea*	Not Listed	Not Listed	Not Listed	S3S4B,S4S5M
Bicknell's Thrush	*Catharus bicknelli*	Threatened	Endangered	Threatened	S1B
Black Tern	*Chlidonias niger*	Not Listed	Not Listed	Not At Risk	S1B
Black-backed Woodpecker	*Picoides arcticus*	Not Listed	Not Listed	Not Listed	S3S4
Black-bellied Plover	*Pluvialis squatarola*	Not Listed	Not Listed	Not Listed	S3M

Common Name	Scientific Name	*SARA* Status[1]	NS *ESA* Status[2]	COSEWIC[3]	NS S-Rank[4]
Black-billed Cuckoo	*Coccyzus erythropthalmus*	Not Listed	Not Listed	Not Listed	S3B
Black-headed Gull	*Chroicocephalus ridibundus*	Not Listed	Not Listed	Not Listed	S3N
Black-legged Kittiwake	*Rissa tridactyla*	Not Listed	Not Listed	Not Listed	S2S3B
Blackpoll Warbler	*Setophaga striata*	Not Listed	Not Listed	Not Listed	S3B,S5M
Blue-winged Teal	*Spatula discors*	Not Listed	Not Listed	Not Listed	S3B
Bobolink	*Dolichonyx oryzivorus*	Threatened	Vulnerable	Special Concern	S3B
Boreal Chickadee	*Poecile hudsonicus*	Not Listed	Not Listed	Not Listed	S3
Boreal Owl	*Aegolius funereus*	Not Listed	Not Listed	Not At Risk	S2?B,SUM
Brant	*Branta bernicla*	Not Listed	Not Listed	Not Listed	S3M
Brown Thrasher	*Toxostoma rufum*	Not Listed	Not Listed	Not Listed	S1B
Brown-headed Cowbird	*Molothrus ater*	Not Listed	Not Listed	Not Listed	S2B
Canada Jay	*Perisoreus canadensis*	Not Listed	Not Listed	Not Listed	S3
Canada Warbler	*Cardellina canadensis*	Threatened	Endangered	Special Concern	S3B
Cape May Warbler	*Setophaga tigrina*	Not Listed	Not Listed	Not Listed	S3B,SUM
Chimney Swift	*Chaetura pelagica*	Threatened	Endangered	Threatened	S2S3B,S1M
Cliff Swallow	*Petrochelidon pyrrhonota*	Not Listed	Not Listed	Not Listed	S2S3B
Common Eider	*Somateria mollissima*	Not Listed	Not Listed	Not Listed	S3B,S3M,S3N
Common Gallinule	*Gallinula galeata*	Not Listed	Not Listed	Not Listed	S1B
Common Goldeneye	*Bucephala clangula*	Not Listed	Not Listed	Not Listed	S2S3B,S5N,S5M
Common Murre	*Uria aalge*	Not Listed	Not Listed	Not Listed	S1?B
Common Nighthawk	*Chordeiles minor*	Threatened	Threatened	Special Concern	S3B
Common Tern	*Sterna hirundo*	Not Listed	Not Listed	Not At Risk	S3B
Cooper's Hawk	*Accipiter cooperii*	Not Listed	Not Listed	Not At Risk	S1?B,SUN,SUM
Eastern Bluebird	*Sialia sialis*	Not Listed	Not Listed	Not At Risk	S3B
Eastern Kingbird	*Tyrannus tyrannus*	Not Listed	Not Listed	Not Listed	S3B
Eastern Meadowlark	*Sturnella magna*	Threatened	Not Listed	Threatened	SHB

Common Name	Scientific Name	*SARA* Status[1]	NS *ESA* Status[2]	COSEWIC[3]	NS S-Rank[4]
Eastern Whip-Poor-Will	*Antrostomus vociferus*	Threatened	Threatened	Threatened	S1?B
Eastern Wood-Pewee	*Contopus virens*	Special Concern	Vulnerable	Special Concern	S3S4B
Evening Grosbeak	*Coccothraustes vespertinus*	Special Concern	Vulnerable	Special Concern	S3B,S3N,S3M
Fox Sparrow	*Passerella iliaca*	Not Listed	Not Listed	Not Listed	S3S4B,S5M
Gadwall	*Mareca strepera*	Not Listed	Not Listed	Not Listed	S2B,SUM
Great Cormorant	*Phalacrocorax carbo*	Not Listed	Not Listed	Not Listed	S2S3B,S2S3N
Great Crested Flycatcher	*Myiarchus crinitus*	Not Listed	Not Listed	Not Listed	S1B
Greater Yellowlegs	*Tringa melanoleuca*	Not Listed	Not Listed	Not Listed	S3B,S4M
Harlequin Duck - Eastern population	*Histrionicus histrionicus pop. 1*	Special Concern	Endangered	Special Concern	S2S3N,SUM
Horned Grebe	*Podiceps auritus*	Special Concern	Not Listed	Special Concern	S3N,SUM
Horned Lark	*Eremophila alpestris*	Not Listed	Not Listed	Not Listed	SHB,S4S5N,S5M
Hudsonian Godwit	*Limosa haemastica*	Not Listed	Not Listed	Threatened	S2S3M
Indigo Bunting	*Passerina cyanea*	Not Listed	Not Listed	Not Listed	S1?B,SUM
Ipswich Sparrow	*Passerculus sandwichensis princeps*	Special Concern	Not Listed	Special Concern	S1B
Killdeer	*Charadrius vociferus*	Not Listed	Not Listed	Not Listed	S3B
Lapland Longspur	*Calcarius lapponicus*	Not Listed	Not Listed	Not Listed	S3?N,SUM
Laughing Gull	*Leucophaeus atricilla*	Not Listed	Not Listed	Not Listed	SHB
Leach's Storm-Petrel	*Hydrobates leucorhous*	Not Listed	Not Listed	Threatened	S3B
Least Bittern	*Ixobrychus exilis*	Threatened	Not Listed	Threatened	SUB
Least Sandpiper	*Calidris minutilla*	Not Listed	Not Listed	Not Listed	S1B,S4M
Lesser Yellowlegs	*Tringa flavipes*	Not Listed	Not Listed	Threatened	S3M
Long-eared Owl	*Asio otus*	Not Listed	Not Listed	Not Listed	S2S3
Marsh Wren	*Cistothorus palustris*	Not Listed	Not Listed	Not Listed	S1B
Nelson's Sparrow	*Ammospiza nelsoni*	Not Listed	Not Listed	Not At Risk	S3S4B

Common Name	Scientific Name	*SARA* Status[1]	NS *ESA* Status[2]	COSEWIC[3]	NS S-Rank[4]
Northern Gannet	*Morus bassanus*	Not Listed	Not Listed	Not Listed	SHB
Northern Goshawk	*Accipiter gentilis*	Not Listed	Not Listed	Not At Risk	S3S4
Northern Mockingbird	*Mimus polyglottos*	Not Listed	Not Listed	Not Listed	S1B
Northern Pintail	*Anas acuta*	Not Listed	Not Listed	Not Listed	S1B,SUM
Northern Shoveler	*Spatula clypeata*	Not Listed	Not Listed	Not Listed	S2B,SUM
Northern Shrike	*Lanius borealis*	Not Listed	Not Listed	Not Listed	S3S4N
Olive-sided Flycatcher	*Contopus cooperi*	Threatened	Threatened	Special Concern	S3B
Pectoral Sandpiper	*Calidris melanotos*	Not Listed	Not Listed	Not Listed	S3M
Peregrine Falcon - anatum/tundrius	*Falco peregrinus pop. 1*	Special Concern	Vulnerable	Not At Risk	S1B,SUM
Philadelphia Vireo	*Vireo philadelphicus*	Not Listed	Not Listed	Not Listed	S2?B,SUM
Pine Grosbeak	*Pinicola enucleator*	Not Listed	Not Listed	Not Listed	S3B,S5N,S5M
Pine Siskin	*Spinus pinus*	Not Listed	Not Listed	Not Listed	S3
Pine Warbler	*Setophaga pinus*	Not Listed	Not Listed	Not Listed	S2S3B,S4S5M
Piping Plover melodus subspecies	*Charadrius melodus melodus*	Endangered	Endangered	Endangered	S1B
Purple Martin	*Progne subis*	Not Listed	Not Listed	Not Listed	SHB
Purple Sandpiper	*Calidris maritima*	Not Listed	Not Listed	Not Listed	S3S4N
Razorbill	*Alca torda*	Not Listed	Not Listed	Not Listed	S2B
Red Crossbill	*Loxia curvirostra*	Not Listed	Not Listed	Not Listed	S3S4
Red Knot rufa subspecies - Tierra del Fuego / Patagonia wintering population	*Calidris canutus rufa*	Endangered	Endangered	Endangered, Special Concern	S2M
Red Phalarope	*Phalaropus fulicarius*	Not Listed	Not Listed	Not Listed	S2S3M
Red-breasted Merganser	*Mergus serrator*	Not Listed	Not Listed	Not Listed	S3S4B,S5M,S5N
Redhead	*Aythya americana*	Not Listed	Not Listed	Not Listed	SHB
Red-necked Phalarope	*Phalaropus lobatus*	Special Concern	Not Listed	Special Concern	S2S3M
Roseate Tern	*Sterna dougallii*	Endangered	Endangered	Endangered	S1B

Common Name	Scientific Name	*SARA* Status[1]	NS *ESA* Status[2]	COSEWIC[3]	NS S-Rank[4]
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	Not Listed	Not Listed	Not Listed	S3B
Rough-legged Hawk	*Buteo lagopus*	Not Listed	Not Listed	Not At Risk	S3N
Ruddy Duck	*Oxyura jamaicensis*	Not Listed	Not Listed	Not Listed	S1B
Ruddy Turnstone	*Arenaria interpres*	Not Listed	Not Listed	Not Listed	S3M
Rusty Blackbird	*Euphagus carolinus*	Special Concern	Endangered	Special Concern	S2B
Sanderling	*Calidris alba*	Not Listed	Not Listed	Not Listed	S2N,S3M
Scarlet Tanager	*Piranga olivacea*	Not Listed	Not Listed	Not Listed	S2B,SUM
Semipalmated Plover	*Charadrius semipalmatus*	Not Listed	Not Listed	Not Listed	S1B,S4M
Semipalmated Sandpiper	*Calidris pusilla*	Not Listed	Not Listed	Not Listed	S3M
Short-billed Dowitcher	*Limnodromus griseus*	Not Listed	Not Listed	Not Listed	S3M
Short-eared Owl	*Asio flammeus*	Special Concern	Not Listed	Threatened	S1B
Spotted Sandpiper	*Actitis macularius*	Not Listed	Not Listed	Not Listed	S3S4B,S5M
Tennessee Warbler	*Leiothlypis peregrina*	Not Listed	Not Listed	Not Listed	S3S4B,S5M
Turkey Vulture	*Cathartes aura*	Not Listed	Not Listed	Not Listed	S2S3B,S4S5M
Vesper Sparrow	*Pooecetes gramineus*	Not Listed	Not Listed	Not Listed	S1S2B,SUM
Virginia Rail	*Rallus limicola*	Not Listed	Not Listed	Not Listed	S2S3B
Warbling Vireo	*Vireo gilvus*	Not Listed	Not Listed	Not Listed	S1B,SUM
Whimbrel	*Numenius phaeopus hudsonicus*	Not Listed	Not Listed	Not Listed	S2S3M
Willet	*Tringa semipalmata*	Not Listed	Not Listed	Not Listed	S3B
Willow Flycatcher	*Empidonax traillii*	Not Listed	Not Listed	Not Listed	S2B
Wilson's Snipe	*Gallinago delicata*	Not Listed	Not Listed	Not Listed	S3B,S5M
Wilson's Warbler	*Cardellina pusilla*	Not Listed	Not Listed	Not Listed	S3B,S5M
Wood Thrush	*Hylocichla mustelina*	Threatened	Not Listed	Threatened	SUB

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

7.4.5.3 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 species that are present in the Study Area through all seasons. Surveys were completed in 10-minute intervals at predetermined locations to inventory species within view or that were 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 was 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. Target species of point counts were primarily passerines, identified audibly.

Nightjar and Owl Surveys
Nightjar and owl surveys were based on the Canadian Nightjar Survey Protocol (Knight et al., 2019). Surveys were conducted in 6-minute intervals at predetermined locations where nightjar and owl habitat is present within the Study Area. All nightjars (nighthawks, etc.) and owls heard or observed were recorded with information on direction, behaviour (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 inventory the movement of species throughout the Study Area during the day, as well as how different species or flocks behave around specific habitat features, such as Lake Panuke and the airspace above it. These surveys were conducted 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. Target species include any migratory flocks, as well as diurnal raptors and soaring birds.

Winter Bird Surveys (2021)
Winter bird surveys were conducted to establish the species 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 species that are migrating through or over the Study Area. The spring migratory period included point count and diurnal watch surveys.

Breeding Bird Surveys (2022)
Breeding bird surveys were conducted to inventory the avian species that were using the Study Area during the breeding season. In Nova Scotia, the core breeding season for migratory species runs from early-June to late July. Breeding bird surveys 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. Point count surveys were conducted in early and late June 2022. Nightjar and owl surveys were also included as a component of breeding bird surveys, with two surveys being conducted in early and mid-July 2022.

Fall Migration Season Bird Surveys (2022)
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 lasts from late August through late October for most species. These surveys included point counts and diurnal watches.

7.4.5.4 Habitat Modelling Methodology
Habitat modelling for SAR observed during the 2022 breeding bird surveys (i.e., priority species that may be breeding within the Study Area) was completed. Breeding habitat preferences for these species were incorporated into a GIS model, which was used to estimate the quality and quantity of breeding habitat for each species. The model criterion for each species is summarized below.

Canada Warbler (Wilsonia canadensis)
The land cover classification was queried based on bogs, wetlands, or brush to account for the species' preferred habitat of treed conifer swamps, extensive mid-story growth (e.g., holly, alders). Forest data was queried to include the FORNON code of 39 which is an area where in part alders compose 75% or more of the crown closure. The leading species (SP1) attribute of BF (balsam fir), and BS (black spruce) were used. Furthermore, to account for smaller scale wetland features, the NSNRR wetland data was filtered to include those classified as bog, bog or fen, fen, and swamp.

Chimney Swift (Chaetura pelagica)
Chimney Swift prefer mainly urban areas that have access to chimneys, grain towers, or other form of cavity. Rural forested areas are atypical; however, cavities found in dead trees/forest and windthrow areas can be habitable by Chimney Swifts. There are 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 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 Lake Panuke.

Common Nighthawk (Chordeiles minor)
Forestry inventory data was filtered to identify areas with bare ground, including clear cuts, ditched areas (confirmed by DEM), roadsides, laydown areas, and other corridors where vegetation has been removed or is kept cut. This habitat is primarily suitable for nesting, not breeding nor foraging.

Eastern Wood-Pewee (Contopus virens)
Forest inventory data was filtered based on 10-45% crown closure of the treed stands in both the first story and the second story to identify 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.

Olive-sided Flycatcher (Contopus cooperi)
Forest inventory 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).

7.4.5.5 Remote Sensing Methodology

Avian Radar Assessment
Avian radar assessments were undertaken during the spring 2022 and fall 2022 migratory bird periods to assess migratory bird activity in the airspace above the Study Area. Avian radar systems (ARS) were deployed from April 22 to June 20, 2022 for the spring 2022 monitoring campaign, and from July 19 to November 2, 2022 for the fall 2022 monitoring campaign. During both monitoring campaigns, the ARS consisted of one Simrad Halo 6 pulse compression marine surveillance radar at 40° above horizontal to scan airspace and gather information on target range and height. This orientation allows for a 180° scan of the airspace around the radar, though with the angled orientation, 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 radar was mounted off the ground (approximately 4 m) to minimize ground noise interference and lessen the impacts of local microtopography on data collection and clarity.

Avian radar assessment results were processed using the radR platform (Taylor et al, 2010)) – an open-source platform designed for the processing of radar data for biological applications – and outputs were analyzed using Microsoft Excel. Standard settings for the identification of biological targets (BT), such as birds, and bats were used. Targets reflected by the radar generate blips in the image of the radar scan. radR helps filter sequential images of radar scans to identify blips that occur in the same area over at-least four out of five scans. Should these constraints be met, a target is generated. BTs are most likely generated by birds, but could also be bats and insects, or even drones and planes. 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 Kentville Weather Station) indicates a minimum hourly rainfall of 0.5 mm are excluded from this analysis.

Avian Acoustic Assessment

A Wildlife Acoustics SM4 Acoustic monitors was deployed within the Study Area in tandem with the radar system during the 2022 spring migration monitoring campaign (April 22 to June 20, 2022), the summer of 2022 (July 19 to August 03, 2022), and the fall of 2022 (August 27 to October 27, 2022). The monitor was programmed to record during the night during the monitoring periods with the intention of recording the acoustic activity of migratory songbirds for analysis. During both the spring (May 6 to June 13) and fall (September 17 to 26) monitoring periods, the acoustic monitor was non-functional due to technical issues that prevented data collection.

The acoustic data was initially processed using Wildlife Acoustics' Kaleidoscope's cluster analysis capabilities. The dataset was restricted to only assess data between 9 pm and 4 am 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*
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*

Common Name	Scientific Name
Fox Sparrow	*Passerella iliaca*
Gadwall	*Mareca strepera*
Great Cormorant	*Phalacrocorax carbo*
Great Crested Flycatcher	*Myiarchus crinitus*
Greater Yellowlegs	*Tringa melanoleuca*
Harlequin Duck	*Histrionicus histrionicus*
Indigo Bunting	*Passerina cyanea*
Killdeer	*Charadrius vociferus*
Lapland Longspur	*Calcarius lapponicus*
Leach's Storm-Petrel	*Hydrobates leucorhous*
Least Sandpiper	*Calidris minutilla*
Lesser Yellowlegs	*Tringa flavipes*
Long-eared Owl	*Asio otus*
Manx Shearwater	*Puffinus puffinus*
Marsh Wren	*Cistothorus palustris*
Nelson's Sparrow	*Ammospiza nelson*
Northern Goshawk	*Accipiter gentilis*
Northern Mockingbird	*Mimus polyglottos*
Northern Pintail	*Anas acuta*
Northern Shoveler	*Spatula clypeata*
Olive-sided Flycatcher	*Contopus cooperi*
Peregrine Falcon	*Falco peregrinus*
Philadelphia Vireo	*Vireo philadelphicus*
Pine Grosbeak	*Pinicola enucleator*
Pine Siskin	*Spinus pinus*
Pine Warbler	*Setophaga pinus*
Piping Plover	*Charadrius melodus*
Purple Finch	*Haemorhous purpureus*
Razorbill	*Alca torda*
Red-breasted Merganser	*Mergus serrator*
Red Crossbill	*Loxia curvirostra*
Roseate Tern	*Sterna dougallii*
Rose-breasted Grosbeak	*Pheucticus ludovicianus*
Rough-legged Hawk	*Buteo lagopus*
Ruddy Duck	*Oxyura jamaicensis*
Rusty Blackbird	*Euphagus carolinus*
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*

Common Name	Scientific Name
Turkey Vulture	*Cathartes aura*
Vesper Sparrow	*Pooecetes gramineus*
Virginia Rail	*Rallus limicola*
Warbling Vireo	*Vireo gilvus*
Willet	*Tringa semipalmata*
Willow Flycatcher	*Empidonax traillii*
Wilson's Snipe	*Gallinago delicata*
Wilson's Warbler	*Cardellina pusilla*

The signal parameters used for this analysis included:

- 250 – 22000 Hz frequency range
- 0.1 – 7.5 s length of detection
- 0.35 s maximum inter-syllable gap

The cluster analysis parameters for this analysis included:

- 2.0 maximum distance from cluster 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 avian acoustics. 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.

7.4.5.6 Field Survey Results

2021 Winter Surveys
Winter surveys were conducted on January 11, 12, 13, and March 4, 2021. The surveys included 59 10-minute point counts across 40 locations (Drawing 7.23). A total of 18 species, comprising 154 individual birds, were observed during the winter surveys (Table 7.56; Tables 1/2, Appendix L). Black-capped Chickadee (*Poecile atricapilla*), Common Redpoll (*Acanthis flammea*), and Golden-crowned Kinglet (*Regulus satrapa*) were the most abundant and commonly observed species.

Table 7.56: Total Observations by Bird Group – 2021 Winter Bird Surveys

Bird Group	# Individuals	# Species
Waterfowl	0	0
Shorebirds	0	0
Other Waterbirds	0	0
Diurnal Raptors	1	1
Nocturnal Raptors	0	0
Passerines	128	15
Other Landbirds	27*	4*
Total	**156**	**20**

*10 unidentified woodpecker specimens were observed

The seven SOCI observed during the 2021 winter surveys included Boreal Chickadee (*Poecile hudsonica*), Downy Woodpecker (*Picoides pubescens*), Evening Grosbeak (*Coccothraustes vespertinus*), Hairy Woodpecker (*Picoides* villosus), Northern Shrike (*Lanius borealis*), Pine Grosbeak (*Pinicola enucleator*), and Red Crossbill (*Loxia curvirostra*).

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

2022 Spring Migration Surveys
Spring surveys included 78 10-minute point counts, and six 120-minute diurnal watches (Drawing 7.24).

A total of 65 species, comprising 1107 individual birds were recorded in the Study Area during spring migration point count surveys (Table 7.57; Tables 3/4, Appendix L) conducted on April 20, and 24, and May 6, 9, 22, 25, 2021. White-throated Sparrow (*Zonotrichia albicollis*), Palm Warbler (*Dendroica palmarum*) and Hermit Thrush (*Catharus guttatus*) were the most frequently and abundantly observed species.

Table 7.57: Total Observations by Bird Group – 2022 Spring Migration Point Count Surveys

Bird Group	# Individuals	# Species
Waterfowl	7	2
Shorebirds	10	3
Other Waterbirds	3	2
Diurnal Raptors	6	3
Nocturnal Raptors	0	0
Passerines	917	48
Other Landbirds	164*	7*
Total	**1107**	**65**

*Seven unidentified woodpeckers were observed

The 14 SOCI observed during the spring migration point count surveys included American Kestrel (*Falco sparverius*), American Robin (*Turdus migratorius*), Baltimore Oriole (*Icterus galbula*), Canada Goose (*Branta canadensis*), Canada Warbler (*Wilsonia canadensis*), Chimney Swift (*Chaetura pelagica*), Double-crested Cormorant (*Phalacrocorax auritus*), Downy Woodpecker (*Picoides pubescens*), Gray Jay (*Perisoreus canadensis*), Hairy Woodpecker (*Picoides villosus*), Nashville Warbler (*Vermivora ruficapilla*), Northern Parula (*Parula americana*), Northern Waterthrush (*Seirus noveboracensis*), and Red Crossbill (*Loxia curvirostra*).

Ten species comprising 45 individual birds were recorded in the Study Area during spring migration diurnal watch surveys (Table 7.58; Tables 5/6, Appendix L) conducted on April 20 and 24; and May 6, 9 and 25, 2022. Bald Eagle (*Haliaeetus leucocephalus*) was the most frequently and abundantly observed species. Several soaring species were observed, including five diurnal raptor species, though no large flocks of migrating waterfowl were observed.

Table 7.58: Total Observations by Bird Group – 2022 Spring Migration Diurnal Watch Surveys

Bird Group	# Individuals	# Species
Waterfowl	0	0
Shorebirds	1	1
Other Waterbirds	0	0
Diurnal Raptors	38	5
Nocturnal Raptors	0	0
Passerines	8*	4*
Other Landbirds	0	0
Total	**53****	**10****

*2 unidentified passerine specimens were observed
**6 raptor specimens were observed

The four SOCI observed during the spring migration diurnal watch surveys include American Kestrel (*Falco sparverius*), American Robin (*Turdus migratorius*), Chimney Swift (*Chaetura pelagica*), and Northern Goshawk (*Accipiter gentilis*).

2022 Breeding Bird Surveys

Two breeding bird surveys were conducted within the Study Area in 2022. The first survey was conducted on June 4 and 6, while the second survey was conducted on June 22 and 23. In total, 56 10-minute point counts were conducted across the Study Area covering a wide range of habitat types and spatial distribution (Drawing 7.24). A total of 1103 individual birds, representing 56 species, were observed during these point counts (Table 7.59; Tables 7/8, Appendix L). The most abundant and frequently observed species were the White-throated Sparrow (*Zonotrichia albicollis*), Common Yellowthroat (*Geothlypis trichas*), and Ovenbird

(*Seiurus noveboracensis*). Migrant passerines accounted for 82% of the species and 91.9% of the individual birds observed.

Table 7.59: Total Observations by Bird Group – 2022 Breeding Bird Point Count Surveys

Bird Group	# Individuals	# Species
Waterfowl	0	0
Shorebirds	11	3
Other Waterbirds	2	1
Diurnal Raptors	1	1
Nocturnal Raptors	0	0
Passerines	1020	48
Other Landbirds	76	6
Total	**1110**	**59**

SOCI observed within the Study Area during the 2022 breeding surveys include American Kestrel (*Falco sparverius*), Boreal Chickadee (*Poecile hudsonicus*), Canada Warbler (*Wilsonia canadensis*), Chimney Swift (*Chaetura pelagica*), Eastern Wood-Pewee (*Contopus virens*), Gray Jay (*Perisoreus canadensis*), Hairy Woodpecker (*Picoides villosus*), Killdeer (*Charadrius vociferus*), Nashville Warbler (*Vermivora ruficapilla*), Northern Parula (*Parula americana*), Northern Waterthrush (*Seiurus noveboracensis*), Olive-sided Flycatcher (*Contopus cooperi*), Red-breasted Merganser (*Mergus serrator*), Red Crossbill (*Loxia curvirostra*), and Winter wren (*Troglodytes troglodytes*).

Two nightjar and owl surveys were conducted on July 3 and July 14, 2022. A total of 17 10-minute point count surveys were conducted throughout the Study Area (Drawing 7.25), with 59 individual birds, representing six species observed (Table 7.60; Tables 9/10, Appendix L). Common Nighthawk (*Chordeiles minor*) was the most abundant and frequently observed species, accounting for 89.8% of individual birds observed.

Table 7.60: Total Observations by Bird Group – 2022 Nightjar and Owl Surveys

Bird Group	# Individuals	# Species
Waterfowl	0	0
Shorebirds	3	1
Other Waterbirds	1	1
Diurnal Raptors	0	0
Nocturnal Raptors	2	1
Passerines	53	3
Other Landbirds	0	0
Total	**59**	**6**

Common Nighthawk and Chimney Swift (*Chaetura pelagica*) were the only SOCI observed during 2022 nightjar and owl surveys.

2022 Fall Migration Surveys
Fall migration surveys were conducted on September 18 and 27 and October 3, 10, 16, and 21, 2022. The surveys included 78 10-minute point counts and three 240-minute hawk watches throughout the Study Area (Drawing 7.24 and 7.25).

A total of 49 species, comprising 848 individual birds, were observed (Table 7.61; Tables 11/12, Appendix L). Black-capped Chickadee (*Poecile atricapilla*), Dark-eyed Junco (*Junco hyemalis*), and Blue Jay (*Cyanocitta cristata*), were the most abundant and frequently observed species.

Table 7.61: Total Observations by Bird Group – 2022 Fall Migration Point Count Surveys

Bird Group	# Individuals	# Species
Waterfowl	4	1
Shorebirds	0	0
Other Waterbirds	0	0
Diurnal Raptors	3	2
Nocturnal Raptors	0	0
Passerines	795*	40
Other Landbirds	46	6
Total	**848**	**49**

*13 unidentified warbler and blackbird specimens were observed

SOCI observed during the 2022 fall migratory point count surveys included Boreal Chickadee (*Poecile hudsonica*), Downy Woodpecker (*Picoides pubescens*), Gray Jay (*Perisoreus canadensis*), Hairy Woodpecker (*Picoides villosus*), Nashville Warbler (*Vermivora ruficapilla*), Northern Parula (*Parula americana*), and Red Crossbill (*Loxia curvirostra*).

A total of 17 species, comprising 96 individual birds, were observed during fall migration diurnal watch surveys (Table 7.62; Tables 13/14, Appendix L) conducted on October 3, 10 and 21. Bald Eagle (*Haliaeetus leucocephalus*) and Common Raven (*Corvus corax*) were the most abundantly observed species. No large migratory flocks were observed through field surveys, though some smaller flocks of passerines were observed.

Table 7.62: Total Observations by Bird Group – 2022 Fall Migration Diurnal Watch Surveys

Bird Group	# Individuals	# Species
Waterfowl	0	0
Shorebirds	0	0
Other Waterbirds	0	0
Diurnal Raptors	37*	6

Bird Group	# Individuals	# Species
Nocturnal Raptors	0	0
Passerines	59*	11
Other Landbirds	0	0
Total	**96**	**17**

*11 unidentified passerine and 4 unidentified raptor specimens were observed

SOCI observed during fall migration diurnal watch surveys included American Kestrel (*Falco sparverius*), Boreal Chickadee (*Poecile hudsonica*), Gray Jay (*Perisoreus canadensis*), Peregrine Falcon (*Falco* peregrinus), and Red Crossbill (*Loxia curvirostra*).

Throughout the 2022 fall migration surveys, relatively few large flocks of migratory species were observed. Despite many species being migratory, most observations were passerines, not migratory shorebirds or waterfowl flying at high altitudes or in larger flocks.

All SAR observed throughout field studies, including incidental observations outside of targeted avian surveys are provided on Drawing 7.26 (Table 15, Appendix L).

Habitat Modelling Results
Following a review of desktop resources and the completion of field assessments, a habitat model for SAR encountered during breeding season field surveys was constructed based on their respective breeding habitat requirements, as described above.

- Canada Warbler (*Wilsonia canadensis*)
- Chimney Swift (*Chaetura pelagica*)
- Common Nighthawk (*Chordeiles minor*)
- Eastern Wood-Pewee (*Contopus virens*)
- Olive-sided Flycatcher (*Contopus cooperi*)

The results of the modelling are shown in Drawings 7.27A to 7.28E.

Avian Radar Assessment
Data collected by the ARS for spring and fall 2022 monitoring periods (Drawing 7.28) were analyzed to provide the number of BT by date, and by height bin (for the vertical radar modes) or range bin (for the horizontal radar modes) (Tables 16/17, Appendix L). The daily total of BTs detected by date are shown in Figures 7.5 and 7.6.

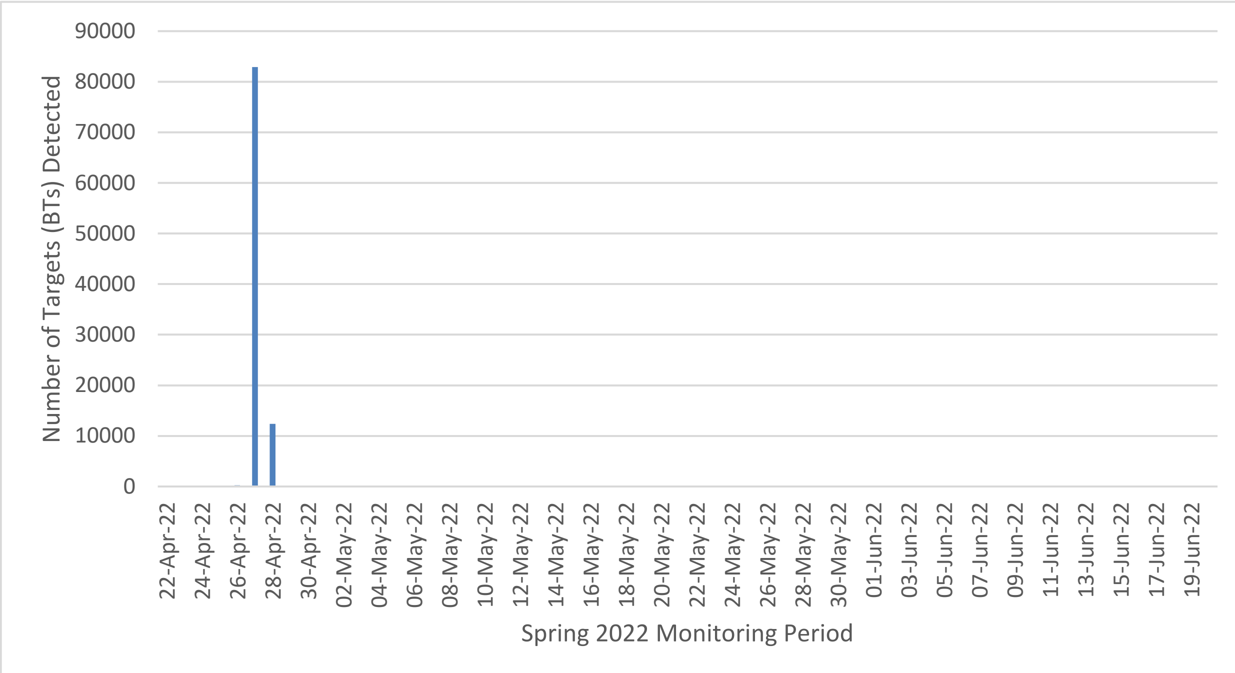

Figure 7.5: Number of BTs Detected by Date – Spring 2022 Monitoring Period.

The ARS detected 95,554 BTs during the spring 2022 monitoring period, most of which were detected on April 27 and 28 (n=45,504 and 12,357 respectively), with smaller numbers of detections (i.e., less than10 BT detections per day) until the middle of May.

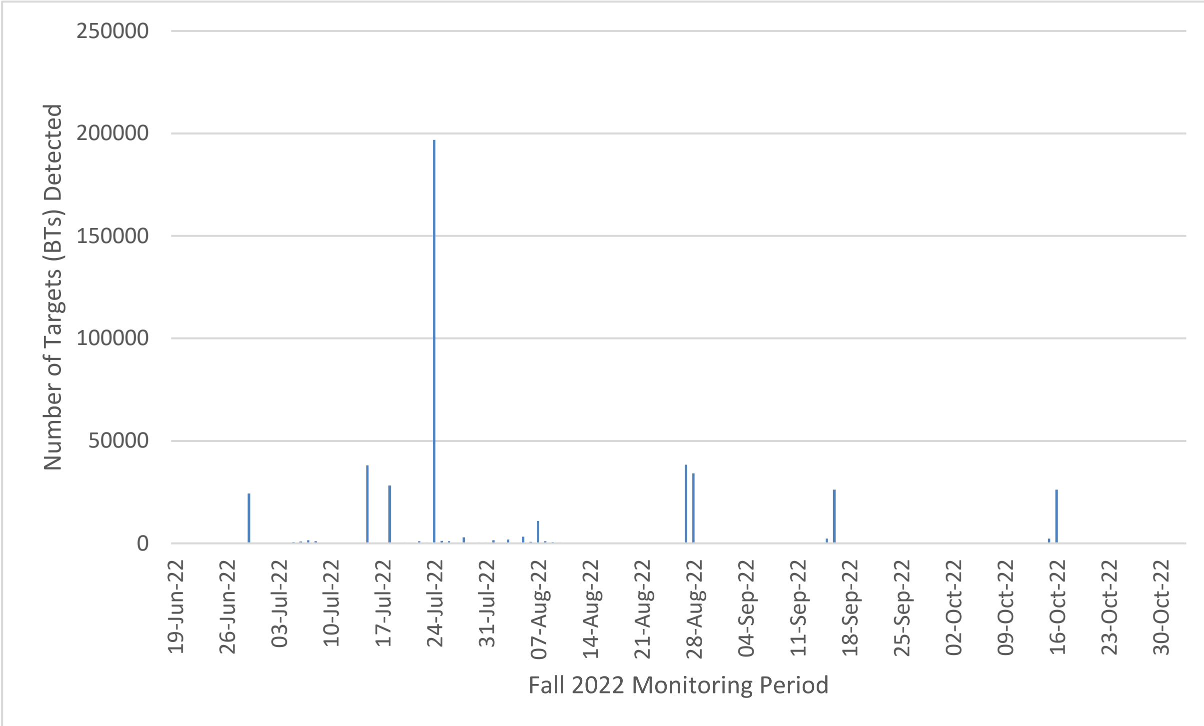

Figure 7.6: Number of BTs Detected by Date – Fall 2022 Monitoring Period

During the fall 2022 monitoring period, 453,123 BTs were detected by the ARS. BTs were detected throughout the fall monitoring period but were the most numerous during the month of July, with 61% (n = 277,144) of the BT detections having occurred during that month. The number of BT detections dropped throughout the remainder of the monitoring period, with 21% of the BT detections occurring in August and approximately 6% of the BT count in September and October.

The large proportion of BT detections in July may be due to the ARS detecting the movement of sandpipers (Family *Scolopacidae*) that are known to accumulate near the 'Guzzle' in Grand-Pre, Kings County, NS, approximately 31 km north of the Study Area. The Guzzle is a known congregation point for sandpipers from July to October due to the rich feeding opportunities in the area's mudflats, which are exposed at low tide. It is understood that these birds migrate from the Guzzle over Mainland Nova Scotia, to the Atlantic coast in Lunenburg County. This route would take them over the Study Area, where they would have been detected by the ARS. The data indicates that these movements occur steadily with occasionally large movements over the Study Area between late June to mid-August.

Overall, the daily total of BTs detected were 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).

Effect of Weather on Bird Migration

The stochastic nature of migratory bird activity is likely attributable in large part, to weather, as it is well understood that weather and atmospheric conditions influence bird migration activity (Richardson, 1990), especially wind speed and direction (Liechti & Bruderer, 1998). Conditions when tailwinds assist the migration objective are often exploited by migrating birds to travel farther with less energy (Liechti, and Bruderer 1998).

Most birds in the region migrate south in the fall from breeding grounds in northern North America, to wintering grounds in Central and South America. Likewise, in spring, most species make the reverse journey, moving northward. The Nova Scotia peninsula extends along a southwest to northeast axis, and birds in the province often migrate along this axis, following the Atlantic coast. As such, birds migrating in Nova Scotia during the spring likely also proceed in an easterly direction in addition to north. Likewise in the fall, migrating birds may move to the west and south as they head to southerly wintering grounds.

Figure 7.7 shows that the majority (87%) of BTs were detected when wind was blowing from the southeast during the spring season, which would support tailwind assisted flight amongst birds with a northerly migration goal. This indicates that wind direction is a factor in the timing of migration in the spring.

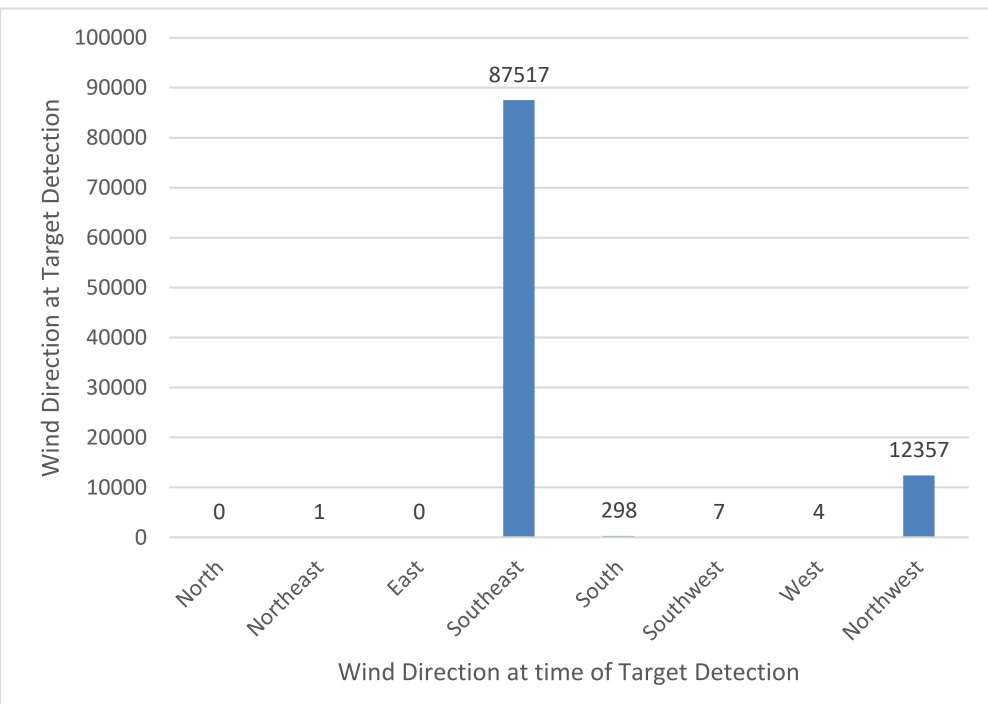

Figure 7.7: Wind Direction by Proportion of BTs Detected, Spring 2022.

In the fall season, nearly half (48%) of migration activity occurred in winds were from an easterly direction (Figure 7.8). This would support a westerly migration goal, which is common among fall migrants that pass over Nova Scotia in the fall. Movements were also prevalent in winds from the south and southwest, which would impede a southerly or westerly migration goal. This indicates other factors likely also affect bird migration timing in the region, in addition to wind direction.

The findings of other studies that examined the effects of weather and atmospheric conditions on bird migration indicate a relationship between wind speed and direction and migratory movement (Richardson 1990, Liechti and Bruderer 1998).

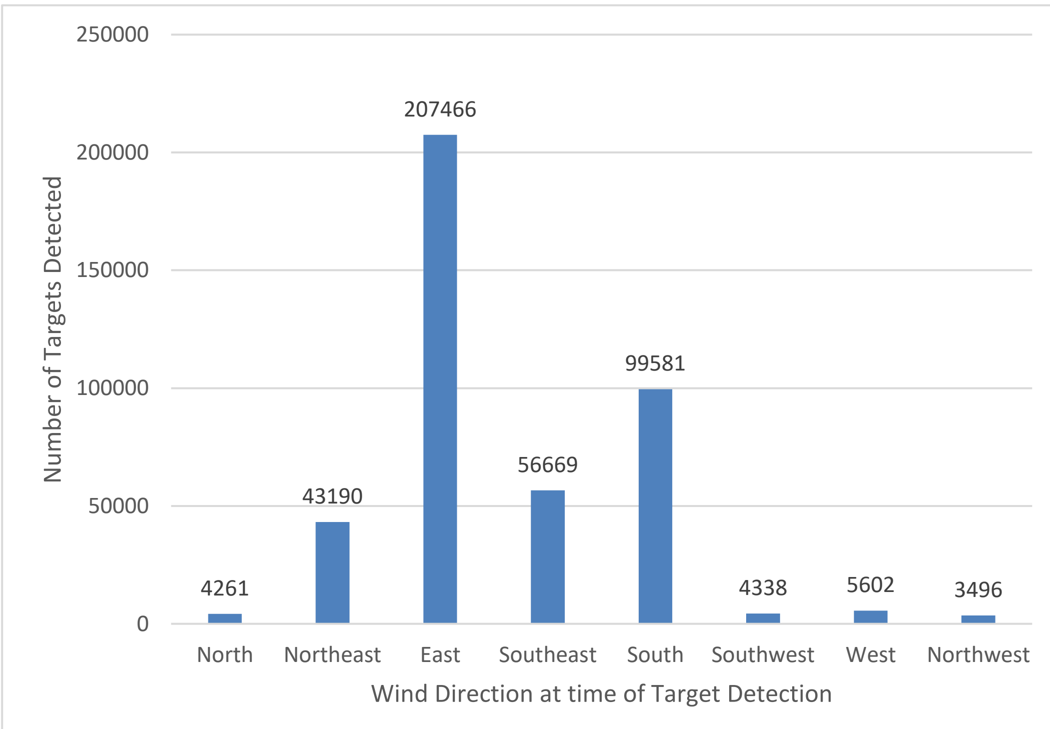

Figure 7.8: Wind Direction by Proportion of BTs Detected, Fall 2022.

The weather records for the area during the monitoring campaigns are appended (Tables 18/19, Appendix L).

Determining Migratory Bird Density

The Halo 6 radar (used by the ARS) emits a beam that is angled 12.5° upward and downward from the radar's antenna. As the radar beam extends outwards, the volume of airspace that the radar scans increases with range. Therefore, the number of BTs detected by the ARS generally increases with range, until such a point that the radar becomes limited by range and the number of BTs detected drops (this is true for both the horizontal and vertical radar modes).

To correct for the distortions in BT detection counts at different ranges, 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, the volume of airspace scanned in each of the range and height bins for the horizontal and vertical radar modes was determined using CAD software. These volumes are shown for each height bin in Table 7.63 along with the number of BTs detected in each height bin, and the target density (i.e., the number of targets detected per cubic kilometer of airspace) for the spring and fall 2022 datasets. Birds per km^3 has been used as a metric of bird migration in avifauna for in other studies (Farnsworth 2013). Target density is representative of, and likely proportional to, the migratory bird activity in the airspace above the Study Area.

Table 7.63: Vertical Target Density – Spring 2022

Height Bin (m)	Airspace Scanned (km^3)	Number of Targets (BTs) Detected	Target Density (BT/km^3)
0-25	0.1015	20	197.04433
25-50	0.1016	4	39.370079
50-100	0.2036	7	34.381139
100-150	0.2043	21	102.79001
150-200	0.2052	48	233.91813
200-250	0.2063	55	266.60204
250-500	1.052	735	698.6692
500-1000	2.226	7341	3297.8437
1000-1500	2.337	17795	7614.463
1500-2000	2.426	22174	9140.1484
2000-3000	3.774	47354	12547.43
Total	**95554**	**12.8375**	**7443.3496**

The number of BTs detected by the ARS was generally higher at higher ranges, where the radar scans a greater volume of airspace, before dropping to ranges where radar signal decay becomes limiting. However, when the BT counts for each high bin are corrected for the volume of airspace that the ARS scanned, the value (i.e., target density) portrays a more accurate representation of migratory bird activity across the variouse height bins.

During the spring 2022 monitoring period, both the number of BTs detected and target density increase with height, especially over 500 m (Figure 7.9). The height bin with the highest number of BT detections, and target density, was the 2000 m to 3000 m height bin.

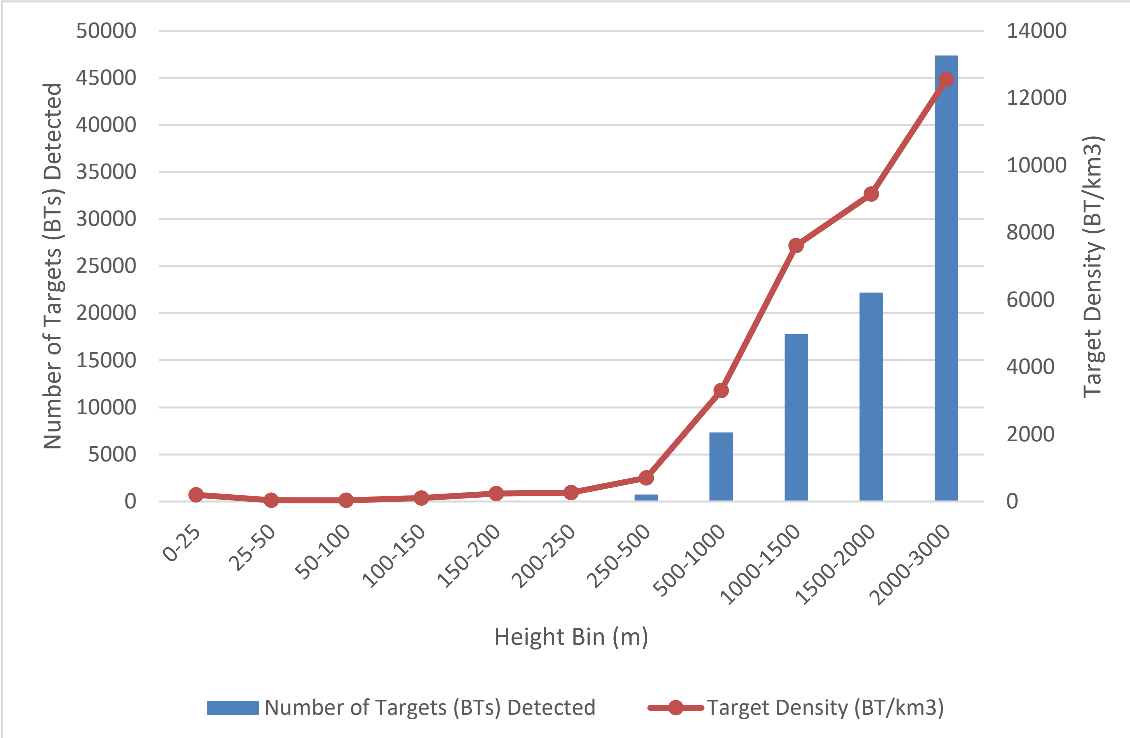

Figure 7.9: Targets Detected and Target Density – Spring 2022

The data from the fall 2022 monitoring period was used to determine the vertical target density, as shown in Table 7.64. BT detections and target density increase with height, especially above 500 m (similar to the spring 2022 monitoring period), but the number of detections decreases (proportionately) in the 1500 m to 2000 m height bin, and no detections were made in the 2000 m to 3000 m height bin (in contrast to the spring 2022 data).

The target density shown on Figure 7.10 shows less variability than the BT counts, indicating a more-even vertical distribution of targets than the BT counts alone would suggest.

Table 7.64: Vertical Target Density – Fall 2022

Height Bin (m)	Airspace Scanned (km^3)	Number of Targets (BTs) Detected	Target Density (BT/km3)
0-25	0.1015	361	3557
25-50	0.1016	345	3396
50-100	0.2036	489	2402
100-150	0.2043	1248	6109
150-200	0.2052	1730	8431
200-250	0.2063	3880	18808
250-500	1.052	40872	38852

Height Bin (m)	Airspace Scanned (km^3)	Number of Targets (BTs) Detected	Target Density (BT/km3)
500-1000	2.226	142335	63942
1000-1500	2.337	219819	94060
1500-2000	2.426	42044	17331
2000-3000	3.774	0	0
Total	**12.8375**	**453123**	**35297**

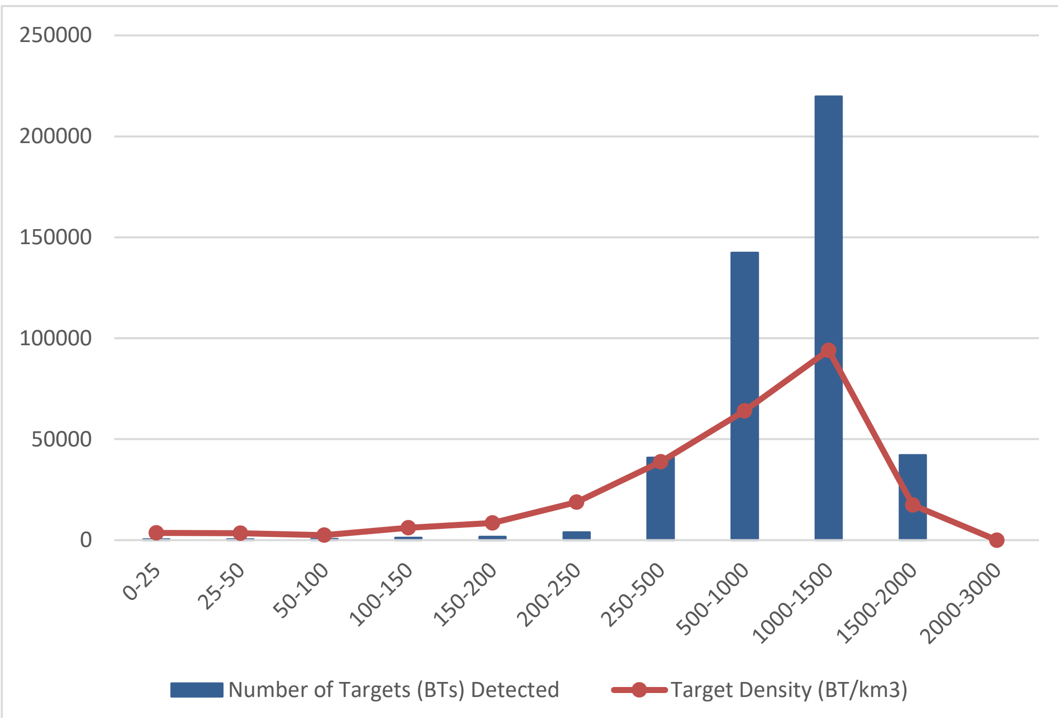

Figure 7.10: Targets Detected and Target Density – Fall 2022

For both the spring and fall monitoring periods, target density was generally higher in the height bins over 250 m (from the ground), which would indicate that the majority of migratory bird activity occurs above the height of the wind turbines.

Avian interaction model

The level of interaction between migratory birds and the Project turbines can be estimated using data collected from the ARS during the spring and fall of 2022. Interactions may include sensory disturbance to birds passing near the turbines, a requirement for birds to maneuver around the turbines (thus forcing migratory birds to expend energy), bird collisions with the turbine components, or blade strikes (for operating turbines).

The Migratory Bird Interaction Index MBII (M) is an estimate of the level of risk that aerial infrastructure for a Project poses to migratory birds. This index is calculated using the following expression.

Equation 1:

$$M = D \div I$$

Where D is the migratory bird density, and I is the volume of airspace that the infrastructure being assessed would occupy.

To represent the volume of airspace occupied by the infrastructure (I), the volume of airspace where avifauna would interact with the turbines was estimated using CAD software that is based on morphology of the proposed turbines. An over-estimate of the volume of the turbine's physical components was used to represent the larger volume of airspace where the turbines would influence avifauna. Table 7.65 shows the turbine dimensions for this Project and the parameters used to calculate the interaction airspace volume for the turbine model.

Table 7.65: Turbine – Avifauna Interaction Volume Calculation Information

Turbine Model Information		
Component	**Description**	
Turbine Model	Nordex N163	
Number of Turbines	12	
Hub Height	125 m	
Total Height	206.5 m	
Rotor Diameter	163 m	
Blade Length	81.5 m	
Rotor Sweep Area	20,867 m^2	
Turbine – Avifauna Interaction Volume Calculations		
Interaction Airspace Model Component	**Dimensions**	**Airspace Interaction Volume**
Tower	15m diameter cylinder, 125m tall	22,089 m^3
Nacelle	7.5*7.5*24M cuboid	1, 350 m^3
Rotor (Operational)	180m diameter cylinder, 7.5m thick	156,504 m^3
Rotor (Curtailed)	three 7.5*7.5*90m cuboids (triangular)	13,753 m^3
Total airspace volume (Operational Turbine)		179,943 m^3

The spring 2022 ARS dataset was used to determine target density for each day of the monitoring program (calculated from values in Tables 20 to 23, Appendix L) and the interaction airspace volume (determined in Table 7.64) was used to calculate and project the MBII (Figure 7.11) over the spring 2022 monitoring period.

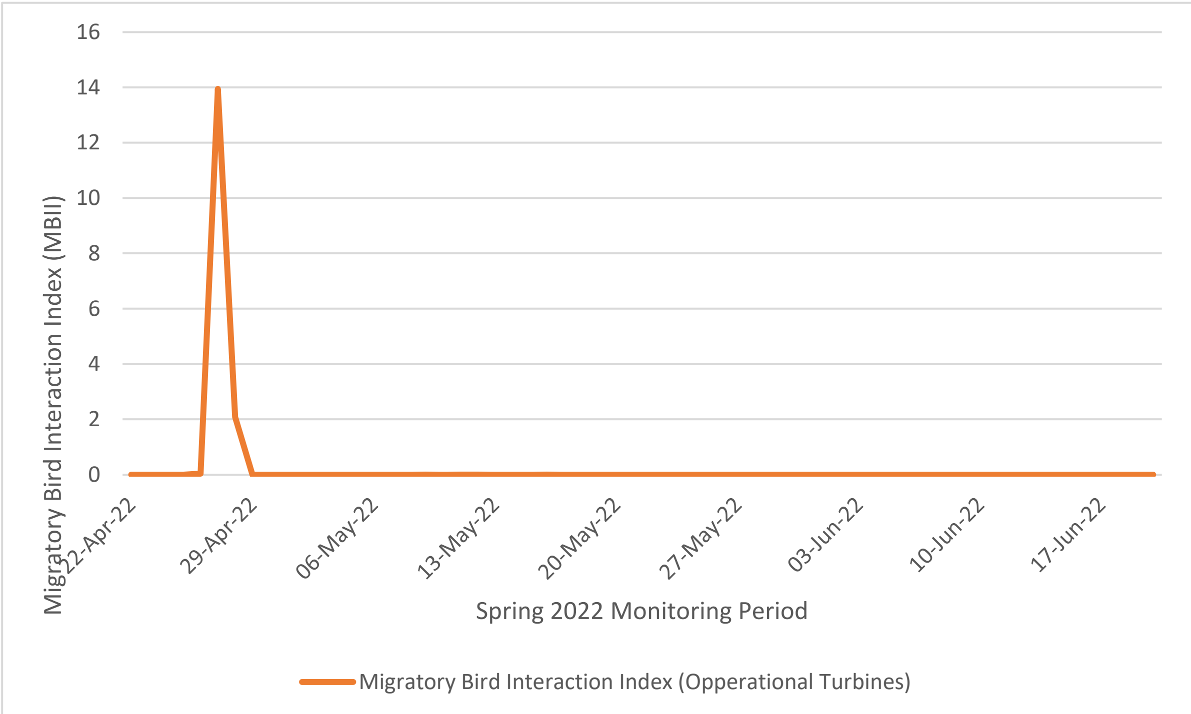

Figure 7.11: Migratory Bird Interaction Index – Projected Daily for the Spring 2022 Monitoring Period

Figure 7.11 shows the MBII value were elevated for April 27, 2022, corresponding to the large migratory movement on that date and the following day. The MBII model represents a basic estimate of the level of interaction between migratory birds and the wind turbines infrastructure.

The MBII was projected over the fall 2022 period using the fall 2022 ARS dataset (Figure 7.12)

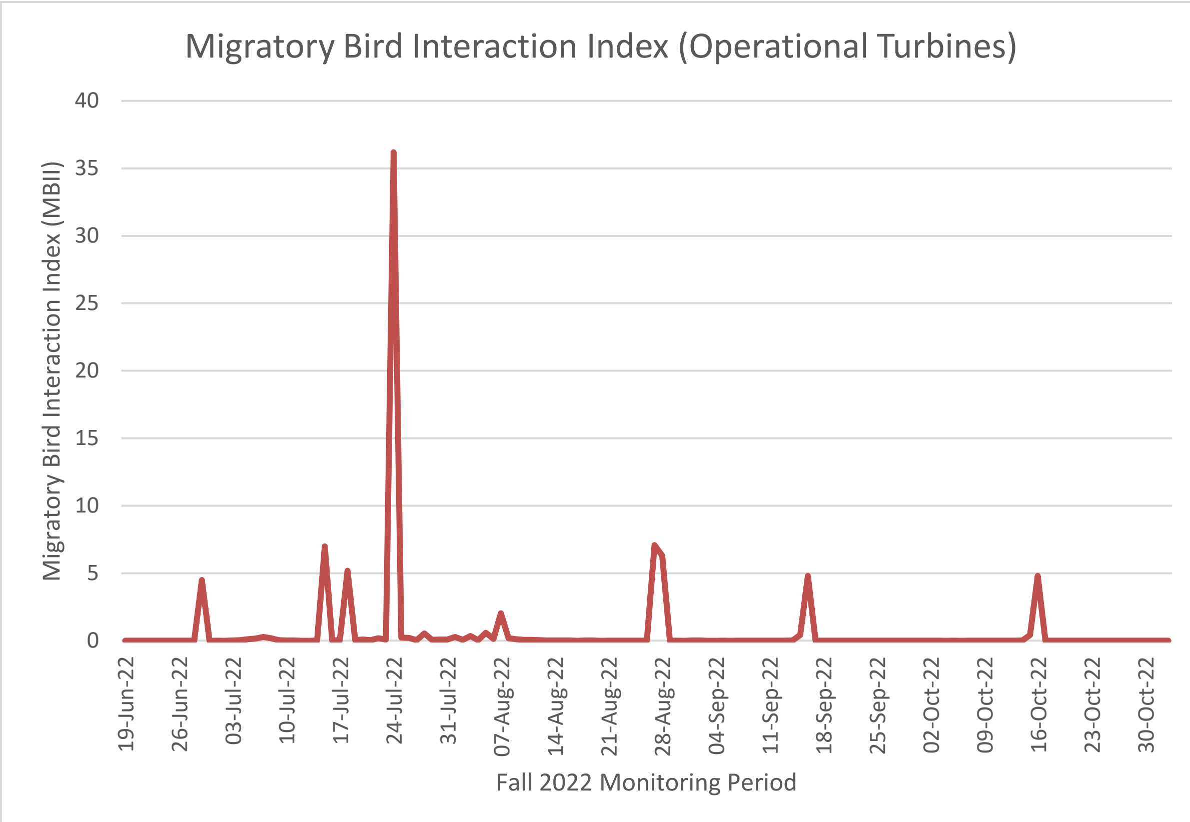

Figure 7.12: Migratory Bird Interaction Index – Projected Daily for the Fall 2022 Monitoring Period

Figure 7.12 shows the MBII value had several small and modest peaks throughout July, including the largest value on July 24, 2022 (MBII = 36.12) that corresponds to a large migratory movement that occurred on that date. These peaks may well be associated with *Scolopacidae* movements, as discussed above. Additional modest peaks occurred from late August until late October, indicating more sporadic and stochastic movements, which are likely associated with mixed species migratory bird flocks, although *Scolopacidae* species may still be present and account for some of the migratory bird movements detected in the latter half of the fall 2022 monitoring period.

Avian Acoustic Assessment

The results of the spring acoustic analysis are shown in Figure 7.13. Parameters used to isolate acoustic activity show low levels of activity throughout much of the early spring 2022 monitoring period. There is a notable increase in acoustic activity in the latter portion of the monitoring period, after June 15, 2022. 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 June, when the migration season ends.

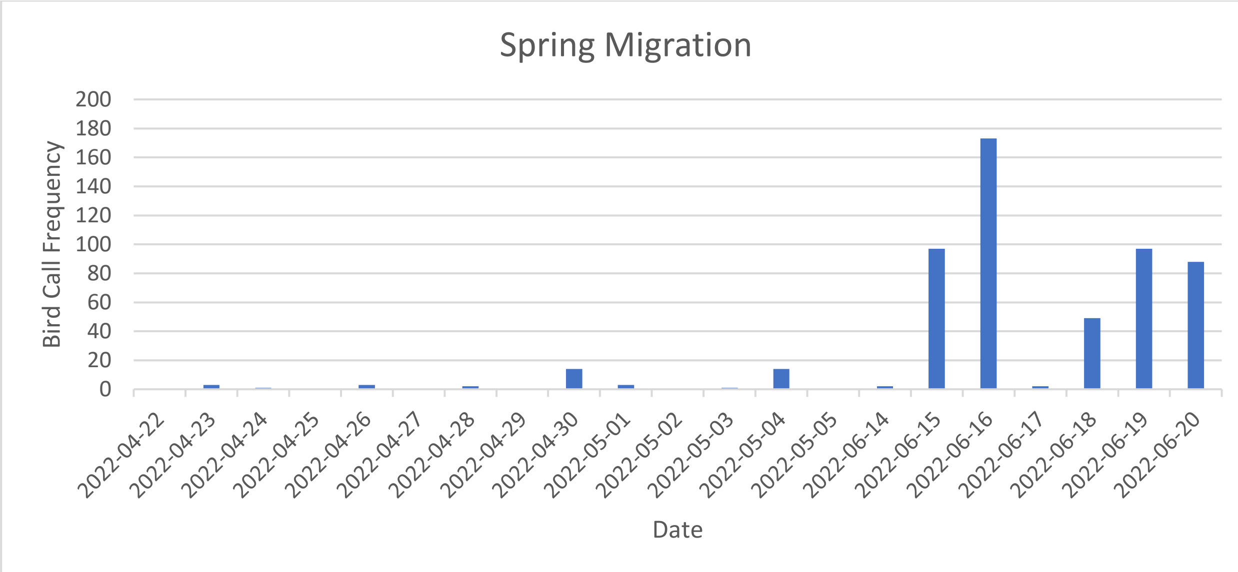

Figure 7.13: Avian Activity by Date During the 2022 Spring Migration Season, Compiling NFCs, Calls, and Songs

Avian acoustics are higher in July when nesting is still underway and taper off towards August (Figure 7.14). This is likely attributable to birds leaving the region as nesting activities conclude. Most of the acoustics identified in the summer were songs and calls, rather than NFCs. This establishes the summer acoustic trend where birds are more acoustically active while foraging and breeding within the Study Area, which appears to be most prominent in July.

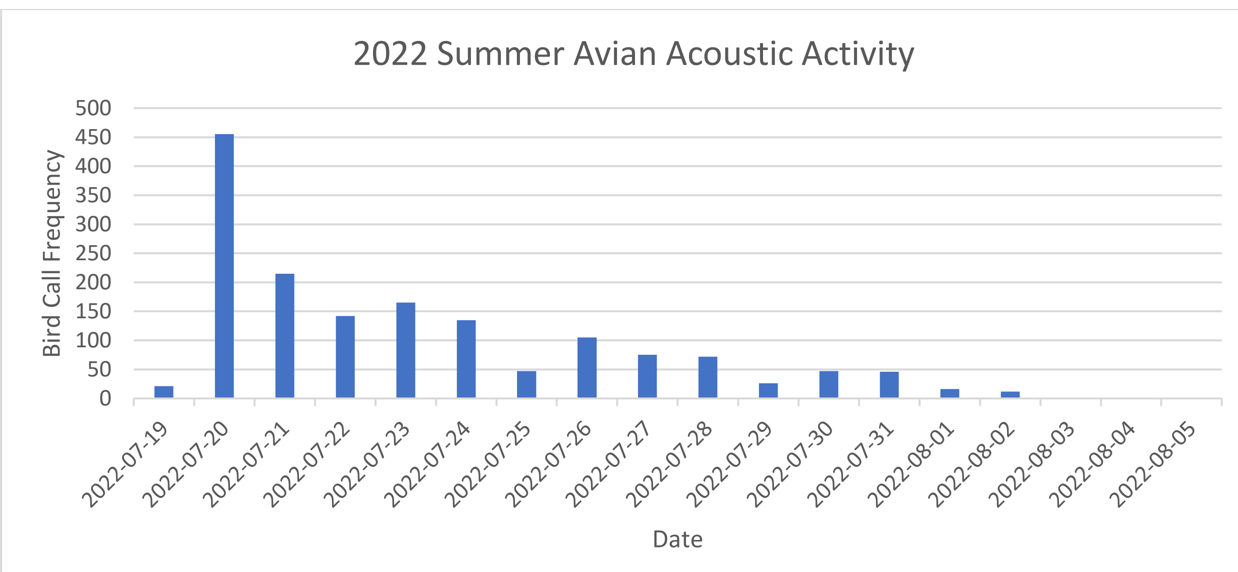

Figure 7.14: Avian Activity by Date During the 2022 Summer Season, Compiling NFCs, Calls, and Songs

Fall migration for many avian species begins in August and can continue until October. The acoustic monitoring identified many NFCs at the end of September (Figure 7.15), indicating a migratory event. This migratory event is corroborated with radar data showing an increase in detections around these dates. Data clarity at the beginning of the fall migration period is poor and is likely due to several factors including the presence of crickets and katydids including *Gryllus pennsylvanicus* and *Scudderia pistillata* which create loud noises that interfere with acoustic monitoring.

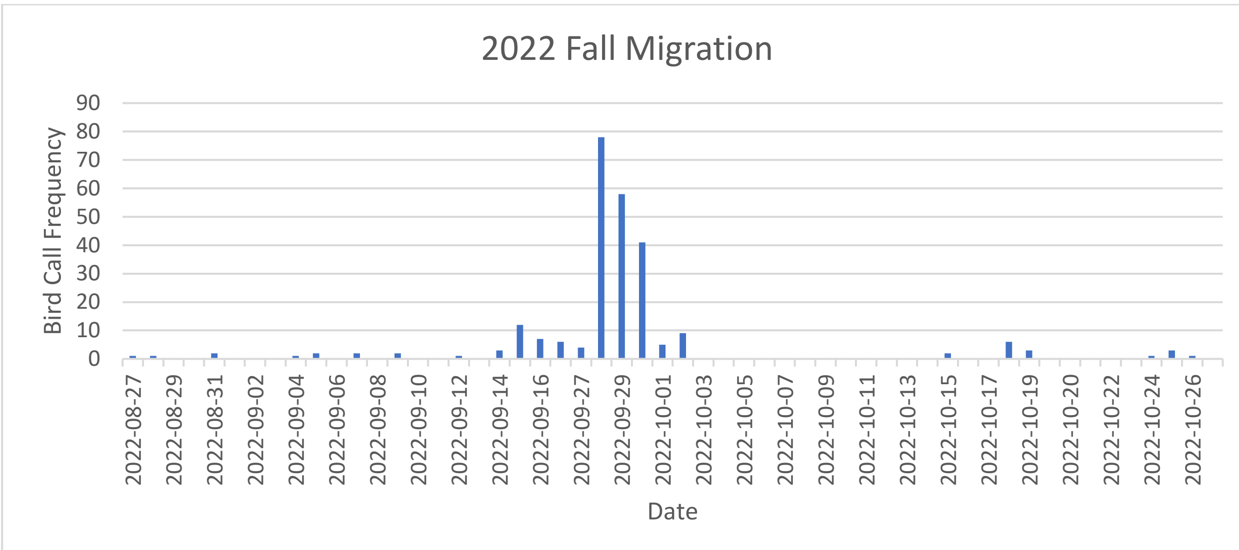

Figure 7.15: Avian Activity by Date During the 2022 Fall Migration Season, Compiling NFCs, Calls, and Songs.

A frequent call identified with the acoustic monitor was the Common Nighthawk (*Chordeiles minor)* (Figure 7.16). This species is considered threatened, and as such is listed as a SOCI.

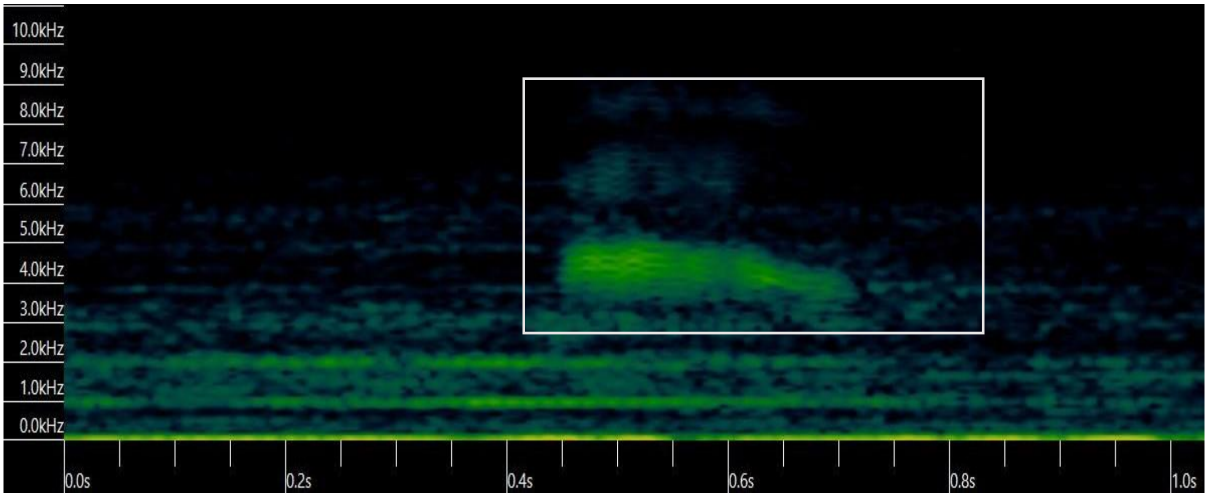

Figure 7.16: Spectrogram Showing a Common Nighthawk Identified Using Kaleidoscope (2022). Highlighted in the boxed area.

The passive nature of the acoustic monitor allows for the capture of avian wildlife that may be missed in other types of surveys. The Great Horned Owl (*Bubo virginianus*) is not included in the ACCDC table for bird species found within 100 km of the Project (Table 7.53) but was identified via acoustic analysis (Figure 7.17).

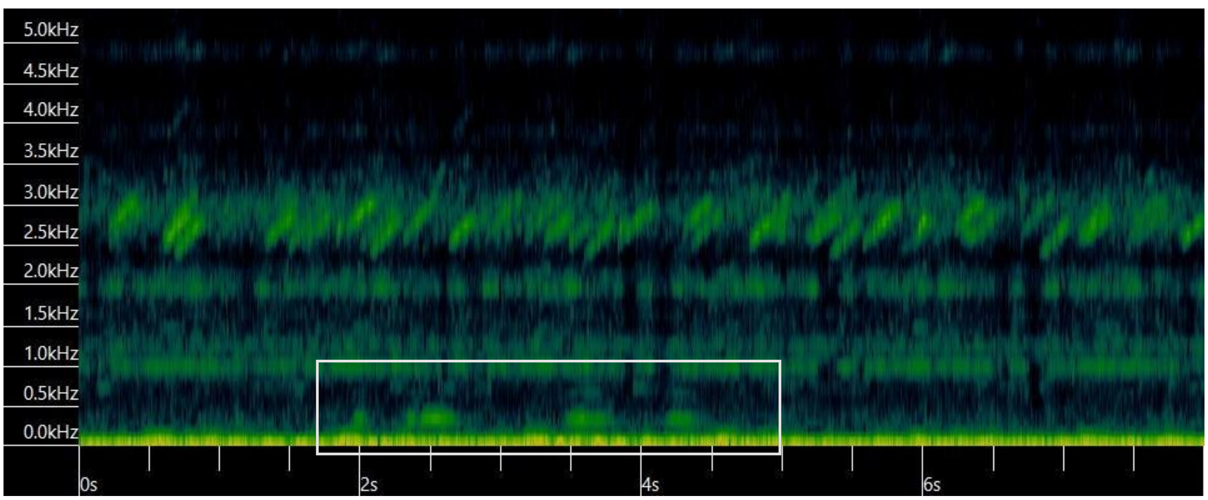

Figure 7.17: Spectrogram Showing a Great Horned Owl Identified Using Kaleidoscope (2022). Highlighted in the boxed area

This analysis gives very limited aid to the radar assessment in quantifying the movement and composition of migratory avian species throughout the Study Area, especially given the detection range of the acoustic monitor compared to that of the radar system. In addition, the presence of Spring Peepers (*Pseudacris crucifer*) during the spring migration season and crickets and katydids during the fall migration season made the results difficult to parse given that these species are loud and occupy a similar frequency to many avian NFCs.

7.4.5.7 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. Other Project related activities, including during construction and operation, may impact avifauna behaviours, 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		X

Assessment Boundaries
For the purposes of this assessment, the LAA for avifauna includes the Assessment Area as well as the airspace that is directly surrounding the turbines, as described above in the MBII. The RAA for avifauna includes the surrounding landscape, including Lake Panuke, and the airspace above it, up to approximately 3000 m (Drawing 7.29).

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

- Negligible – no loss of important avifauna habitat (e.g., breeding bird habitat) and no impacts to migratory avifauna are expected.
- Low – small loss of important habitat supporting avifauna and/or impacts to migratory avifauna are expected to be low.
- Moderate – moderate loss of important avifauna habitat and/or moderate impacts to migratory avifauna.

- High – high loss of important avifauna habitat and/or high impact to migratory that would be sufficient to impact species on a population scale.

Effects

Habitat Loss and Fragmentation
Across Canada, forest harvesting, and silviculture are leading causes of habitat loss for forest-dependent avian species, with mining and energy exploration also contributing to habitat loss, as well as to the disruption of individuals and their migratory and breeding behaviours (ECCC, 2016 a, b).

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 approximately 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. In addition, 11 of the 12 turbines are sited in areas that have been previously disturbed through forestry activities or otherwise, minimizing impacts to breeding habitats for birds. The Project design also prioritized the avoidance of old growth forests and has minimized loss of wetland habitat. Habitat loss and fragmentation effects to avifauna are therefore expected to be low.

Additional evaluation of habitat loss and availability was completed for SAR observed within the Study Area during breeding season field surveys as detailed below.

Canada Warblers were observed at several locations throughout the Study Area, with four of the five individuals observed outside the Assessment Area. Canada Warbler breeding requirements include wetland types where a closed canopy and complex shrub layer are present (ECCC, 2016a). The Project design has prioritized the use of existing roads and minimized alterations to wetlands, with no wetland alterations being anticipated for the construction of turbine pads. A lone male Canada Warbler was observed within the Assessment Area at a roadside wetland (WL 10, see Section 7.3.3) but did not display observable breeding behaviour. Mitigation and minimization of impacts to WL10 will be assessed during the detailed design and permitting stage of the Project. Furthermore, Canada Warbler habitat modelling results indicates that the Study Area contains ample suitable breeding habitat for this species (Drawing 7.27A) and impacts to breeding habitat are expected to be low.

Chimney Swifts were observed during both nocturnal and breeding point count surveys, though no confirmed breeding behavior was observed during those surveys. An incidental observation of Chimney Swifts was recorded during field surveys, as they were observed emerging from a large cavity in a yellow birch tree in October 2022 (Drawing 7.27B). The preferred breeding habitat for this species includes large/mature tree cavities and more urban areas where chimneys and other tall infrastructure are present (ECCC, 2022c), indicating that the host tree is likely a roost. As such, this area was avoided in the Project design to avoid impacting this species. Habitat modelling results indicate limited availability of suitable breeding habitat within the Study Area, likely due to the removal of most mature hardwood trees by past forestry activities. Therefore, the Project's impact on breeding habitat availability for this species is expected to be low.

Common Nighthawks were observed during nocturnal field surveys, primarily foraging and passing overhead. While these observations are consistent with potential breeding behaviours, no confirmed breeding evidence was observed. Modelled habitat suggests there is ample breeding habitat available for these birds, including along roads (both active and unused) throughout the Study Area (Drawing 7.27C). In addition, the construction of turbine pads and new spur road may create additional suitable habitat for Common Nighthawks. Eastern-wood-Pewees prefer intermediate to mature deciduous or mixed wood forests, of which there are few within the Study Area (Section 7.4.1) (NSNRR, 2022e). Given the apparent limitations of breeding habitat availability as shown in Drawing 7.27D, the lone Eastern Wood-Pewee observed during breeding season field surveys is expected to have been passing through the site in search of adequate breeding partners. No confirmation of breeding evidence was observed and impacts to breeding habitats are expected to be low.

Olive-sided Flycatchers prefer breeding habitats in open coniferous and mixed wood forests, while feeding on insects in open areas, often near swamps (ECCC, 2016b. Breeding habitats appear to be somewhat limited within the Study Area (Drawing 7.27E), though this species is known to inhabit a variety of habitats where preferred habitat is less available. Neither of the Olive-sided Flycatchers observed during breeding season field surveys were within the Assessment Area. The Project has prioritized the use of existing roads and previously disturbed areas in developing the Project Area, which minimizes impacts to preferred habitats for both breeding and foraging.

Road Traffic

Many species of avifauna are known to use the roadways within the Study Area, as evidenced by field survey results (Tables 1 to 23, Appendix L). 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.

Bird Strikes

Bird strikes are a primary concern when considering the interactions of avifauna with the Project, as turbine blades spin at high speeds through the airspace frequented by a variety of species at all different altitudes within the rotor swept area. Bird strikes include instances when birds are struck by the rotating turbine blades, or birds collide with the turbine tower or nacelle structures, which can cause injury or mortality to birds.

The ARS data from the spring and fall 2022 monitoring campaign indicates that the majority of migratory bird activity occurs above the height of the proposed turbines (i.e., above 250 m). However, most nights when activity was detected, activity was observed in the lower height bins that coincide with the height of the proposed turbines (i.e., below 250 m), which indicates that there would be some level of interaction between migratory avifauna and the Project during operation.

Observed migration events were stochastic throughout the migration seasons, and are likely heavily influenced by weather, particularly wind direction. This is consistent with the findings of a large-scale avian radar study conducted in the continental United States, which determined that most migratory bird movements occur on just 10% of a migration season's nights (Horton et al., 2021). Interactions with the turbine infrastructure would vary over time, with variations in migratory bird density. Bird strikes and avian mortalities are likely to be proportional to migratory bird activity. MBII values (Figures 7.11 and 7.12) cannot be used as a predictor of avian mortality rates, as not every interaction would result in mortality.

Other studies that examined interactions between wind turbines and avifauna have determined the level of avian mortality caused by wind turbines to be low (Zimmerling et al., 2013).

Post-construction avian mortality monitoring conducted by Strum at the adjacent Ellershouse Wind Farm between 2016 and 2018 showed that the existing turbines resulted in low bird mortality levels, and notably no *Scolopacidae* species were recovered. Over the three years of mortality surveys, scavenging rates were observed to be between 0 and 23%, with 10 carcasses found, none of which were SOCI. Searcher efficiency rates were observed to be between 43 and 71%. Overall, mortality levels were deemed to be insignificant through each season. This indicates that the proposed Project would likely result in low levels of migratory bird mortalities, and is not expected to impact *Scolopacidae* species, which may mostly fly above the operating turbines.

Migration Disruption

The Project has the potential to impact bird migration directly (e.g., turbine strike), or indirectly (e.g., sensory disturbance or requiring excess calorie expenditure that would compromise a bird's ability to migrate).

The MBII model shows that interactions between birds and the turbines would be low, with infrequent peaks during migration events. Turbine lighting could cause sensory disturbances that disrupt migration activity, as migratory birds are attracted to sources of light at night, especially in low visibility conditions. Operating turbines can also cause sensory disturbances, causing birds to divert course, and possibly spend excess caloric energy, thus compromising migration success.

Lighting associated with the Project will be minimal, and the turbines will be un-lit at night except for the aeronautical obstruction lighting required by Transport Canada. As such, lighting is not expected to impact bird migration. Other research that addresses the impacts of operating wind turbines on migratory bird movements has determined that the machines do not significantly alter migratory bird movements (d'Entremont et al., 2017) suggesting that impacts to migration would be minimal.

Mitigation Measures
Adaptive management of potential effects will be addressed through the development and implementation of an EPP which will include mitigation and monitoring for avian species. The primary mitigation for avifauna is avoidance in the siting of infrastructure, including:

- Avoidance of topographic funnels, such as within lake or river valleys, for turbine placement to reduce the likelihood of interactions with concentrated bird movements.
- Avoidance, to the extent possible, of important bird habitats, such as wetlands, waterbodies, old growth forest, etc. to reduce the impact of habitat changes. This includes siting Project infrastructure within areas with existing disturbances, such as existing roads and cutover areas of forest.

Mitigations to reduce effects on avifauna include:

- Adhere to ECCC guidelines on clearing windows for nesting migratory birds, where possible. Best efforts will be made to conduct vegetation clearing activities outside of the nesting period that is generally from late March/April to September each year (ECCC, 2018). Timing of clearing activities are generally dependent on seasonal conditions and will be completed in consultation with NSECC and ECCC, as appropriate.
- Assess additional mitigation and minimization of impacts to WL10 during the detailed design and permitting stage of the Project.
- 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 prevention and response procedures related to spills, emergencies, and fire within the EPP.
- Revegetate disturbed areas, as appropriate.
- Install avian deflectors on powerlines in areas identified as requiring mitigation based on monitoring results.
- Minimize lighting, to the extent possible.

- Develop a site reclamation plan in accordance with engineering standards and in consultation with NSECC and NSNRR.

Monitoring
A site-specific post-construction Wildlife Management Plan will be developed in consultation with NSECC, NSNRR, and all other relevant parties. The management plan will inform monitoring activities that will take place to ensure continued protection of known SOCI in the LAA and RAA.

In addition, post-construction avian mortality monitoring will be conducted to assess mortality levels caused by turbine operations and the second year of avian radar monitoring will be completed in accordance with CWS requirements.

Conclusion
While effects to avifauna species differ, the effects considered to be of greatest concern include habitat loss, migratory disruption, and bird strikes. Based on this assessment and through the implementation of proposed mitigation and monitoring activities, effects to avifauna are expected to be of low magnitude, within the LAA, of medium duration, intermittent, reversible, and not significant.

8.0 SOCIO-ECONOMIC ENVIRONMENT

8.1 Economy

8.1.1 Existing Environment
The Project is located near the community of Ellershouse, within the West Hants Regional Municipality. The largest communities in the Municipality include Windsor (pop. 5,514), Falmouth (pop. 1,553), and Hantsport (pop. 1,542) (Statistics Canada 2022). The nearest communities to the Project are Hartville (6.3 km), Ellershouse (6.9 km), St. Croix (7.7 km), and Newport Station (10 km).

Population statistics for West Hants Regional Municipality from the 2016 and 2021 census are summarized in Table 8.1.

Table 8.1: Population in West Hants Regional Municipality

Population Statistics	West Hants Regional Municipality
Population in 2021	19509
Population in 2016	19016
Population change from 2016-2021 (%)	+2.6
Total private dwellings in 2021	9136
Land area (km^2)	1250.5
Population density (per km^2)	15.6

Source: Statistics Canada 2022

The age distribution for the West Hants Regional Municipality reveals a median age of 48.8 years, which is higher than the provincial median age (45.6) and the Halifax Regional Municipality (40.4). An overview of age distribution for 2022 is outlined in Table 8.2.

Table 8.2: Age Distribution in West Hants Regional Municipality

Age Statistics	West Hants Regional Municipality
0 - 14 years	2835 (14.5%)
15 - 64 years	11870 (60.8%)
65+ years	4810 (24.7%)
Total Population	**19510 (100%)**

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

Average housing costs and average individual incomes for West Hants Regional Municipality are compared to the provincial and federal averages, as shown in Table 8.3.

Most residents in West Hants Regional Municipality (99%+ each) speak English (Statistics Canada, 2022). All public outreach and communication for the Project has been and will continue to be in English. There is some knowledge of other languages in the RAA, though no communication has been requested in other languages.

Table 8.3: Housing Costs and Average Individual Income

Jurisdictions	Average Dwelling Value in 2020	Average Total Income in 2020
West Hants Regional Municipality	$257,600	$43,640
Province of Nova Scotia	**$295,600**	**$47,480**
Canada	$618,500	$54,450

Source: Statistics Canada 2022

The Brooklyn Volunteer Fire Department is located approximately 12 km north of the Project on Highway 215. The Windsor Fire Department is also located nearby, approximately 12 km northwest of the Project, on King Street.

Health services in the region are provided by the West Hants/Uniacke Community Health Authority, which offers a wide range of services throughout the Municipality of West Hants, including Hants Community Hospital, located in Windsor. Health and emergency services exist in the area and are accessible to Project workers if the need should arise.

Statistics for West Hants Regional Municipality indicate that the unemployment rate in 2016 was 10.3%, which is below the provincial rate of 12.7% (Statistics Canada 2022). The employment rate was 50.1%, which is lower than the provincial rate of 51.9% (Statistics Canada 2022).

A breakdown of the labour force is provided in Table 8.4. The highest proportions of workers in the West Hants Regional Municipality falls into the "Health Care and Social Assistance" category (14.8%). Other significant industries include retail trade, manufacturing, educational services, and construction (Statistics Canada 2022).

Table 8.4: Top Industries for the Employed Labour Force, West Hants Regional Municipality

Industry	West Hants Regional Municipality (%)
Total employed labour force 15 years +	9100
Construction	1195 (13.1%)
Retail trade	1090 (12.0%)
Health Care and Social Assistance	1350 (14.8%)
Manufacturing	770 (8.5%)
Educational Services	670 (7.4%)

Source: Statistics Canada 2022

Windsor is located approximately 11 km northwest of the Project and offers a range of business services. A review of businesses located within 10 km of the Project is provided in Table 8.5.

Table 8.5: Local Businesses and Proximity to Study Area

Business	Distance and Direction to the Study Area*
Weiner Brown Alignment Centre	7.0 km
Ellershouse General Store	6.8 km
Rapprich Flooring Ltd	8.0 km
Cornwallis Veteranarians	8.0 km
Nova International Ltd.	8.2 km
Oulton Fuels	9.3 km
Irving Oil	9.5 km
Downeast Motel	9.4 km
Gold House Chinese Restaurant	9.4 km
D&W Swinimers Convenience	9.5 km
Appearances Hair Studio	9.6 km
Payzant's Home Hardware Building Centre - Windsor	9.8 km
Dale Young's Auto Repair	8.8 km
Exit 5ive Restaurant & Pub	9.6 km
Hants Equipment Ltd.	8.8 km
Tara's Discovery Toys	7.3 km
The Station Food Hub	7.5 km
USC Horses at Work	8.6 km
Brown's Garage	8 km
R.K. Machining	7.1 km

Business	Distance and Direction to the Study Area*
Scotian Bee Honey & Gifts	7.6 km
Windsor Corn Maze	7.6 km
Ski Martock	9.9 km
O'Leary's Enviro Depot	9.4 km
T. Swinamer's Towing	9.2 km
Magic Hand Car Wash	9.3 km
G.E. Johnson Quarry	9.8 km
Hood Hardware & Automotive	9.8 km

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

A number of local artists and photographers are based out of the community of Ellershouse, including Woodland Wool, Signature Glass, David Howell's Paintings, Steve Sharpe Scenic & Landscape Photography, and Transformed Life Photography.

8.1.2 Effects Assessment

Project-Economy Interactions
Project activities have the potential to interact with the economy during all phases of the Project (Table 8.6).

Table 8.6: Potential Project-Economy Interactions

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

Assessment Boundaries
The LAA for economy is the West Hants Regional Municipality. The RAA for 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
The Project anticipates between 100-150 direct and indirect job opportunities during the development and construction phases. The Project will target a minimum of 40% participation of local labour and Indigenous peoples through these phases. The Project Team will continue working with AVFN and the existing CLC to help identify Project-related opportunities and benefits for the local community and the Mi'kmaq of Nova Scotia.

Ellershouse 3 Wind LP 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 could be involved in providing services in a variety of areas, including: civil and electrical engineering, legal, environmental and biological surveys, archaeological, land and community relations, and many others. It is expected that 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 require approximately 100–150 jobs 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. For this Project, Ellershouse 3 Wind LP is considering 3-5 full time technicians on site to maintain regular operations and maintenance service. 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 Project 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 West Hants Regional Municipality 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 $429,000 annually to the Municipality.

A renewable energy project near a community allows residents to gain a better understanding of wind technology and how wind power can help reduce reliance on fossil fuels. Energy literacy is an increasingly important skill in today's economy, and the Project Team is committed to providing energy literacy to the surrounding communities and is available to answer questions and provide a better understanding of local and provincial energy issues.

Mitigation Measures
The economic impact to the LAA and RAA is positive; therefore, no mitigation is proposed.

Monitoring
A specific monitoring program for the economy is not recommended.

Conclusion
The impact 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 property on which the Project will be built is "Commercial Forest" land owned by Atlantic Star Forestry Ltd. Land use around the Project is varied. This includes the existing Ellershouse Wind Farm to the north, provincial Crown lands to the south-southwest, "Resource Forest" lands to the north-northwest, and a mix of "Resource Forest", residential, and farm lands to the northeast along Highway 101. The St. Croix First Nation Reserve (IR 34), which forms part of AVFN, is located within the exterior boundary of the Study Area, though the land is not within the Study Area or Assessment Area (Service NS 2013). The St. Croix Reserve was established in 1851 (Davis MacIntyre and Associates Ltd. 2013) but is not currently inhabited by any of the AVFN community. No observations of use of reserve lands were observed during field surveys; however, AVFN members utilize the area on occasion for hunting, hiking, and fishing access.

There are several protected lands and parks in the area (Drawing 7.17), including the Eagles Nest Nature Reserve, and Panuke Lake Nature Reserve, with the South Panuke Wilderness

Area further away at the South End of Panuke Lake. There are also several points of interest, including the Dawson Brook Waterfall and the Panuke Lake Boat Launch.

No mineral leases are known to be held within the Study Area, aside from the pre-existing quarries to the north, including the Hartville Quarry.

8.2.2 Effects Assessment

Project-Land Use and Value Interactions
Project activities have the potential to interact with land use and value during all phases of the Project (Table 8.7).

Table 8.7: Potential Project-Land Use and Value Interactions

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

Assessment Boundaries
The LAA for land use and value is the West Hants Regional Municipality. 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 quarries near the Study Area will not be disrupted by Project operations, nor will the forestry activities that are ongoing in the area. As existing land users are primarily industrial in nature, upgraded roads and infrastructure stand to improve access, limit weather disruptions, and lessen impacts of poor roads on industrial equipment. Nearby industrial operations, including the Hartville Quarry, could see positive effects due to Project construction.

None of the points of interest noted above are expected to be impacted by the Project. A recent study mentions that given the traditional energy industry's impacts on conservation in both direct and indirect ways, wind energy can be seen as a complementary land use to conservation and protected areas in a broad way, as wind energy is not a carbon emitter (Wind Europe, 2017). Given the context of Nova Scotia where the traditional energy source has primarily been coal, 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, peer-reviewed, and statistically defensible studies have concluded that wind energy developments have had no significant effect on surrounding property values as outlined in the paragraphs below.

Prior to 2013, the most comprehensive study on the impact of wind farms on property values had been completed by Hoen *et al.* (2009). This research analyzed data on nearly 7,500 sales of single-family homes situated within 10 miles (16 km) of 24 existing wind farms in the United States. Eight different hedonic pricing models failed to generate statistically significant evidence that property values for houses located within 10 miles (16 km) of wind farms are influenced by the developments. Subsequent research by the same laboratory but employing further analyses confirmed these results (Hoen *et al*. 2011).

Carter (2011) analyzed home transactions in a rural landscape surrounding small (1-4 turbines) wind energy developments, while employing a hedonic model to statistically control for variables affecting all real estate transactions such as square footage, age of home, and school zone. This study concluded that proximity to the wind farms did not impact average selling price of homes; in fact, in one case, homes closer to a wind farm sold for significantly higher than those elsewhere (Carter 2011).

A study by Hinman (2010) tracked property transactions in communities located close to a 240-turbine wind farm for an eight-year period that spanned pre-development and operation stages. Hinman (2010) found that before project approval, property values in the area decreased. This was attributed to a fear of the unknown effects that the development would have; an effect known as anticipation stigma. However, once the development became operational, property values recovered. This recovery was attributed to a greater understanding of the operational effects of the development. Anticipation stigma, however, was not detected in a similar study in Colorado (Laposa and Mueller 2010), in which it was concluded that the announcement of a large wind energy development did not significantly reduce the selling prices of homes surrounding the proposed development.

Until recently, the primary limitation of previous research on the effects of wind energy facilities on surrounding home values has been that research has been based on relatively small sample sizes (data sets) of relevant home-sale data. The inability to account for the complexity of the various factors which affect property values has also been cited as a limitation to previous studies. In particular, data had been limited for homes located within about a half mile (800 m) of turbines, where impacts would be expected to be the largest: Hinman (2010) (sample size of 11); Carter (2011) (sample size of 41). This is in part because setback requirements generally result in wind facilities being sited in areas with relatively few dwellings, limiting the number of sales transactions available to be analyzed (Hoen *et al.* 2013). Although these smaller data sets are adequate to examine large impacts (*e.g.*, over 10%), they are less likely to reveal small effects with any reasonable degree of statistical significance.

A study published in August 2013 by Berkeley National Laboratory was conducted to address these gaps in data and included the largest home-sale data set to date. Researchers collected data from 51,276 home sales spanning 27 counties in nine states, related to 67 different wind facilities (Hoen *et al*. 2013). These homes were within 10 miles (16 km) of 67 different wind facilities, and 1,198 of the sales analyzed were within 1 mile (1.6 km) of a turbine, giving a much larger data set than previous studies have collected. The data span the periods well before announcement of the wind facilities to well after their construction (Hoen *et al.* 2013).

Two types of models were employed during the study to estimate property-value impacts: 1) an ordinary least squares model, which is standard for this type of study, and 2) a spatial-process model, which accounts for spatial variability. These models allow the researchers to control for home values before the announcement of a wind facility (as well as the post-announcement, pre-construction period), the spatial dependence of unobserved factors effecting home values, and value changes over time. A series of robust models was also employed to add an additional level of confidence to the study results (Hoen *et al.* 2013).

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

A recent review based on housing and property values within specific radii of wind farms and other energy infrastructure by Brinkley and Leach (2019) finds that while most energy infrastructure has an impact on nearby land values, renewable energy projects (including wind farms) do not have statistically significant impacts compared to those impacts of other energy projects. 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 and 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 within proximity to other energy infrastructure (e.g., transmission lines, substations) or those sited away from energy facilities entirely.

Mitigation Measures
The Project has been designed to minimize potential effects to land use and value through siting considerations and observations of current land uses. 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

The center of the Project is located approximately 6 km southwest of Ellershouse Road and 2 km east of the Panuke Lake Boat Launch, though it is on the opposite shore of the lake. The only road that runs directly through the Study Area is unnamed, though it passes through the existing Ellershouse Wind Farm, as well as past the Hartville Quarry at its northern extent. This road is the primary point of access for the Study Area, though a series of trails and forestry roads connect this access point in Ellershouse to the Bowater Mersey Road at the Head of St. Margaret’s Bay, as well as other access points near Hubbards.

Throughout the Study Area the roads are accessible by truck/sport utility vehicle as well as other vehicles designed for rough dirt roads and tracks. During the summer months, there are few vehicles visiting the area aside from the rare drive-through or ATV user. Due to the relatively remote location and lack of inhabitants, as well as the poor quality of the roads, there is very little through traffic in the summer outside of recreational ATV use and forestry-related activities.

During the fall and winter months, the Study Area is far more frequently visited, both for active forestry harvest, and other recreation activities, including hunting, snowmobiling, and Off Highway Vehicle use. Smaller roads that cover the Study Area, many of which are dead ends, are primarily used for ATVs year-round, though most see little traffic. The Hubbards and Area ATV Club, Long Lake Loggers ATV Club, and Safety Minded ATV Association likely comprise a percentage of trail users in the area and charge membership fees that are related to the ATV Association of Nova Scotia. The access point from the north end of the Study Area is maintained year-round for access to the Hartville Quarry, as well as the existing Ellershouse Wind Farm.

The transportation of turbine components to the Project Area is subject to the comprehensive transportation study by the turbine manufacturer. Turbine components are expected to arrive in Sheet Harbour and come to the Project Area via the 100-Series Highways, before taking Highway 1 and the Hartville and Ellershouse Roads to reach the primary access road leading into the Assessment Area. The transportation of components is expected to require infrastructure upgrades and the temporary removal of some signage, all of which will be undertaken within specifications as set out by the proper governing body.

Air Navigation, communications, and navigation aids are addressed in Section 10.2 (EMI letters, NAV CANADA 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.
  - Provincial road weight restrictions will also need to be considered, especially Spring Weight Restrictions, for heavier equipment and materials that will be transported to the Project Area.
- Access points will be designed with proper height and width to accommodate large trucks and will adhere to commercial stopping sight distances.

8.3.3 Effects Assessment

Project-Transportation Interactions

As on-site traffic is minimal, Project activities primarily have the potential to interact with transportation during construction (Table 8.8).

Table 8.8: Potential Project-Transportation Interactions

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

Assessment Boundaries
The LAA for transportation is the West Hants Regional Municipality. The RAA will extend to the Port of Sheet Harbour.

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 temporary removal of signage and guardrails, and possible widening of turns or improvement of bridges. During the Project's construction phase, trucks and other vehicles will be frequently visiting the area resulting in increased vehicular sound and air emissions (Section 7.1.1 and 10.5). 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, unless a major repair is required.

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 travelling public safety.

- Complete upgrades to roads and overhead wires, branches, and signs where necessary.
- 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 reduce impacts to road-way flow and impacts on air quality due to exhaust.
- Restrict vehicles and work on-site to 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

Windsor and the surrounding area offers a range of entertainment and recreational services, including amusement parks, exhibition grounds, museums, theatre, and dining. The Windsor region is well-known throughout the province for many activities coinciding with the fall harvest including apple picking, farmers markets, and pumpkin festivals.

Existing outdoor recreation in the vicinity of the Project includes snowmobiling, ATV use, hunting, fishing, boating, golfing, camping, and hiking. Coyote Hill Golf Course and Driving Range, a par 35, 9-hole course, is located 11 km north of the Study Area. Smiley's Provincial Park is located approximately 14 km to the northeast, which includes a campground, picnic area, playground, and walking trails. Panuke Lake Nature Reserve brings a variety of recreational opportunities including hunting, fishing, wildlife viewing, birdwatching, and boating. Fishing is a popular activity in the area, with nearby Panuke Lake hosting an annual Smallmouth Bass Tournament. The existing roads and trails within the Study Area are frequently used by local hunters and ATV and snowmobile associations including the Hants SnoDusters Snowmobile Club.

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, along with blinds and tree stands that appear to have been used for hunting. Other mammalian hunting or trapping may occur within the Study Area, though no signs were observed during field surveys.

Most recreation within the Study Area is concentrated on the already developed roads and trails. ATV use in the warmer months and snowmobile use in the winter account for most of the recreational use; however, other uses exist.

8.4.2 Effects Assessment

Project-Recreation and Tourism Interactions
Project activities have the potential to interact with recreation and tourism during all phases if access is temporarily limited to facilitate work (Table 8.9).

Table 8.9: Potential Project-Recreation and Tourism Interactions

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

Assessment Boundaries
The LAA for recreation and tourism is the West Hants Regional Municipality. 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 2019 Nova Scotia Visitor Exit survey, administered by Tourism Nova Scotia in 2015 and 2017 combined with results published in 2019, shows little information about attractions that could be related to the region surrounding the Project. No spatial data is available regarding the places visited within the province, limiting the understanding of the impact that tourism has on the communities that surround the Project. Given that the main attractions discussed in the exit survey report are coastal scenery, the world's highest tides, lobster consumption, and the attractions in the Halifax Regional Municipality, the communities surrounding the Project do not appear to be significant tourist destinations. The Project lies in a region that is "passed through" to access many of the attractions associated with the Annapolis Valley, and possibly the world's highest tides in Digby; therefore, wind turbines may be seen by a number of visitors.

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 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).

Ellershouse and the West Hants Regional Municipality is a largely rural area, with numerous points of interest for those who enjoy spending their time outdoors and in the woods. The immediate vicinity of the Project, including the area of the existing Ellershouse Wind Farm, has a number of existing industrial impacts to the landscape, including forestry activities and the Hartville Quarry. Given the existing presence of wind turbines in the viewscape, additional turbines, especially those placed further away from most dwellings and transportation corridors, are not likely to be perceived as an eyesore. Turbines are likely to be visible from Lake Panuke, both at the public boat launch, as well as from boats at various points on the lake. Visual simulations are provided in Section 10.4.

The turbines will consist of a small footprint on privately owned land. Where the landowner has confirmed public access, the Project Team is committed to working with local recreational groups to continue access to the area and associated trails, within the bounds of all safety considerations. During construction access will be limited to manage health and safety concerns for the public and construction teams. As discussed above, the presence of turbines is highly compatible with most land-based recreation activities and is not expected to limit the usability of the area.

Mitigation Measures

- Continue to work with local recreation groups to continue access to recreation sites.
- Continue to work with nearby landowners to maintain the 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

In 2017, the Ellershouse Wind Farm was expanded to its current operating capacity of 23.5 MW and 10 wind turbines. As those turbines are within 3 km of the Project, they have been included in sound and shadow flicker modelling (Sections 10.3 and 10.5), where cumulative effects and mitigations are discussed. The Martock Ridge Community Wind Project is situated approximately 6 km to the northwest and includes three turbines with an installed capacity of 6 MW. Potential cumulative effects are discussed in Section 14.

9.0 ARCHAEOLOGICAL RESOURCES

9.1.1 Overview

The purpose of the Archaeological Resource Impact Assessment (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 Sara Beanlands.

9.1.2 Regulatory Context

The *Special Places Protection Act* 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.

Two assessments were conducted in accordance with the terms of Heritage Research Permits A2022NS191 and A2023NS029, 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. On December 5, 2022, NSCCTH provided a letter indicating its acceptance of the findings and recommendations of the ARIA completed under Permit A2022NS191. Permit A2023NS029 included assessment of minor road alignments, the interconnection route, and substation location and the related ARIA has been provided to NSCCTH under separate cover.

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. 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 are also incorporated into the archaeological potential model, developed by Boreas Heritage.

The field component involved an on-site visual and non-intrusive examination of the Assessment Area. Parallel pedestrian transects were completed, at intervals of 20 to 30 m (maximum of 50 m), across the Assessment Area to visually assess archaeological potential. These transects assisted in maintaining effective coverage. Structured pedestrian transects assisted in the recognition of topographic and/or vegetative anomalies that may inform the extent and nature of previous disturbance factors in the Assessment Area (e.g., clear-cutting, ploughing, construction earthworks), or suggest an elevation in archaeological potential, including evidence of buried archaeological resources (e.g., small knolls, apple trees in the forest, overgrown depressions, or abandoned roads).

The process and results of the field component were documented in field notes and with digital photographs. Upon identification of areas of high archaeological potential, or confirmed archaeological resources, these locations and features are sufficiently documented to make informed archaeological resource management recommendations. Confirmed archaeological resources, as determined by NSCCTH, will result in the registration of the site(s) in the MARI database.

9.1.4 Assessment Results

The field component of the ARIA under A2022NS191 was carried out between November 9 and 17, 2022 and resulted in the identification of three areas considered to exhibit high potential for encountering archaeological resources.

The field component of the ARIA under A2023NS029 was carried out between April 20 and 21 and resulted in the identification of four areas considered to exhibit high potential for encountering archaeological resources.

The remaining portions of the Assessment Area are considered to exhibit low 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 (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 (Drawing 2.2). 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. Seven high potential areas were identified, all of which are associated with existing watercourse crossings. The need to upgrade the roads and associated crossings for three of these areas will be determined during the detail design phase. Four of the high potential

areas are along the interconnection route and are expected to be spanned such that there will be no disturbance to these areas.

Mitigation
The following mitigation measures are recommended:

- Conduct a systematic shovel testing program to identify potential archaeological resources in high potential areas if ground disturbance is required. No construction work will be completed in these areas unless they are cleared by NSCCTH of any further requirement for future archaeological assessment or, in the event of a positive result during the shovel testing, a mitigation plan is developed and accepted by NSCCTH.
- Develop procedures in the EPP related to the potential for an unexpected discovery of archaeological items or sites, or human remains during construction. This would include halting any work immediately upon discovery of suspected resources and contacting NSCCTH. If the resources are suspected to be of Mi'kmaq origin, the Executive Director of KMKNO would also be contacted.
- Conduct additional archaeological assessment if, during the detailed 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, 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 constructed and operated 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 (163 m rotor diameter and 125 m hub height), the maximum throwing distance associated with the Project's turbines is 432 m. Turbines for the proposed Project have been located over 600 m from the nearest potential seasonal residential receptor. The public road within closest proximity to a turbine is NS-16, which is approximately 4.5 km southwest 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 from ice throw or shedding will include:

- Continue engagement and education with local recreational users (Section 8) 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.
- Installation of ice and vibrational sensors.
- Shutdown during extreme weather or icing accumulation events.
- Restart operation of turbines only once hazards are confirmed not to be present following periods of extreme weather or ice accumulation.

With the implementation of these mitigation measures, the impacts to human health from ice throw are negligible.

10.1.3 Electrical Fires

Wind turbines contain the key elements required for fire: fuel, oxygen, and a source of ignition. These elements are housed in the turbine nacelle, which is a compact and enclosed space at a height of 125 m. Fires may be ignited by lightning, an electrical or 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 is located over 600 m from the nearest residence and 4.5 km from the nearest public road (paved). Fire prevention and response procedures will be developed 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 and 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 the Canadian Wind 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 (RABC and CanWEA 2020).

These guidelines outline a consultation-based assessment protocol that establishes areas, called “consultation zones”, around transmission systems, based on the type and function of the system.

10.2.3 Assessment Methods

An EMI Study was completed for the Project by WSP Canada Inc. (WSP) in early 2022 to identify priority consultation zones. The scope was to investigate radio frequencies within the Study Area extending 100 km from the Project’s center. Location and frequency details were obtained by the Spectrum Management System Data that is administered by Innovation, Science and Economic Development Canada (Government of Canada, 2023).

The EMI consultation process typically begins with a letter distribution to those parties affected by the development. The RABC Guidelines describe consultation zones as detailed 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 (National Television Standards Committee): **15 km** Digital TV station (Advanced Television Systems Committee): **10 km**
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 CANADA 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**
Very High Frequency (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

The EMI Study prepared by WSP identified the following priority EMI Consultation Zones, which are summarized in Table 10.2.

Table 10.2: Summary of Priority EMI Consultation Zones from WSP EMI Study

System	Comments
Microwave Links	Two line-of-sight microwave links (using the same path) pass through Project lands.
Base Stations and Land Mobile Systems	There are no fixed or base station locations that have consultation zones that intersect Project lands.
Satellite Systems	The Project lands do not intersect with the consultation zone for satellite earth stations.
Broadcasting Stations	There are 2 AM, no FM and 4 TV broadcasting stations found near the Project lands. There are AM broadcasting stations nearby the Project lands; it is recommended that owners of these stations be contacted to address any interference concerns.
Broadcast TV Reception	The Project lands are within 17 broadcasting reception zones. Receptors (homeowners) in and around the Project lands should be notified of potential interference.
RCMP	The RCMP should be contacted to address interference concerns.
Environment Canada Radar	The Project lands intersect with the consultation zones of 1 weather radar station. Environment Canada should be contacted to address any interference concerns.
Experimental	The Project lands do not intersect with consultation zones for experimental licensing.
Maritime Radio Navigation	The Project lands do not intersect with the consultation zones of maritime stations.

System	Comments
Civilian Radar and Navigation (NAV CANADA)	The Project lands intersect with 1 consultation zones of NAV CANADA systems. Consultation with NAV CANADA is required once final turbine locations are known.
Civilian Aerodromes	The Project lands do not intersect with consultation zones of any aerodromes. There still may be undisclosed airfields in the area.
Military (DND) Radar, Radiocommunications, and Aerodromes	DND should be contacted to address any interference concerns.

Consultation with relevant agencies was completed and results are provided in Table 10.3. Responses are provided in Appendix M.

Table 10.3: EMI Consultation Results

Signal Source	Operator	Consultation Results
Air defense and air control radar systems DND Radio Communications	DND	Correspondence sent May 2022. Letter of non-objection received June 2022. Updated details to be provided, as necessary.
Maritime vessel traffic system radars	CCG	Correspondence sent February 2023. Response received February 2023 indicating the Project Area is located outside of the coverage zone of their radars. Therefore, no interference issues are anticipated. Updated details to be provided, as necessary.
VHF omnidirectional range Primary air traffic control surveillance radar	NAV CANADA	Correspondence sent May 2022. Response received February 2023. Discussions are ongoing and EMI effects are expected to be low magnitude.
Weather radar	ECCC	Correspondence sent May 2022. Letter of non-objection received September 2022. Updated details to be provided, as necessary.
Radiocommunication Systems	RCMP	Correspondence sent May 2022. Response received from the RCMP in May 2022 requesting coordination with Bell, who are acting on behalf of the RCMP in the province with leased towers. Updated details to be provided, as necessary.

Signal Source	Operator	Consultation Results
Regulators	Transport Canada Service Nova Scotia and Internal Services Innovation, Science and Economic Development (ISED) Canada	Aeronautical Assessment Form sent to Transport Canada in May 2022. Response received June 2022. Correspondence sent to Service Nova Scotia and Internal Services in June 2022. Response received from Service Nova Scotia and Internal Services in July 2022 indicating the Project will not significantly impact the performance of the Nova Scotia Integrated Mobile Radio System. Correspondence sent to Innovation, Science, and Economic Development Canada in February 2023. Response received from ISED February 2023 indicating there are non-disclosed assignments (e.g., police, military) within 15 km of the proposed turbines as well as a Rogers point-to-point microwave link crossing the area. ISED Canada encouraged Ellershouse 3 Wind LP to consult all agencies listed in Table 1 of the RABC/CanWEA guidelines and also Rogers Communications. Updated details to be provided, as necessary.
Telecom	Bell Rogers Communications Seaside Communications	Correspondence sent to Bell June 2022. Response received from Bell in July 2022 indicating none of the TMR2 sites surrounding the Project Area use microwave, so there are no concerns for microwave on the TMR2 site. Correspondence sent to Rogers Communications and Seaside Communications in February 2023. Still awaiting responses from Seaside Communications and Rogers Communications. Updated details to be provided, as necessary.
Emergency Services	Brooklyn Volunteer Fire Department Hantsport Fire Department	Correspondence sent February 2023. Acknowledgement email received from Hantsport Fire Department February 2023.

Signal Source	Operator	Consultation Results
	Uniacke & District Volunteer Fire Department Windsor Fire Department	Email received from the Windsor Fire Department indicating this is Brooklyn Volunteer Fire Department's jurisdiction. Still awaiting response from Brooklyn Volunteer Fire Department and Uniacke & District Volunteer Fire Department. Updated details to be provided, as necessary.

10.2.5 Effects Assessment

Project-EMI Interactions

Project activities only interact with electromagnetic signals during operations (Table 10.4).

Table 10.4: 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 10.3, 15 notifications were submitted.

Correspondence received from DND, CCG, ECCC, RCMP, Transport Canada, Service Nova Scotia and Internal Services, ISED, Bell, Hantsport Fire Department, and Windsor Fire Department confirmed receipt and (if relevant), indicated no objections.

Discussions are ongoing with NAV CANADA and generally are not related to EMI concerns.

No response was received from Rogers Communications, Seaside Communications, Brooklyn Volunteer Fire Department, or Uniacke & District Volunteer Fire Department.

Mitigation
The following general mitigation measures regarding EMI will be implemented:

- Consult operators 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 to moderate 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 in a day at residential receptors.

10.3.3 Assessment Methodology

The shadow flicker assessment was completed through modelling to achieve the following objectives:

- To identify nearby receptors that may potentially experience shadow flicker from the Project's operation.
- To quantify and assess the duration and frequency of shadow flicker for nearby residents under worst-case and real-case scenarios.
- To determine if applicable guidelines are met.
- To mitigate and minimize shadow flicker experienced by nearby residents, if necessary.
- To consult with potentially affected residents, if necessary.

Receptors located within 2 km of the Study Area were identified using GIS data from the Nova Scotia Geomatics Centre and aerial imagery. Receptors were field verified to eliminate structures that were derelict and to assess building height and orientation and window locations. The assessment also included the 10 existing turbines from the Ellershouse Wind Farm and thus considered the potential for cumulative effects.

An analysis was conducted using the windPRO version 3.5.552 under a "theoretical" scenario, which assumes that all the criteria listed in Section 10.3.1 are always met. The "theoretical" modelling also assumes receptor structures are a 'greenhouse', having windows on all surfaces.

As the "theoretical" scenario uses highly conservative, unrealistic assumptions, resulting in modelling conditions that overpredict shadow flicker effects that are not possible to occur in practice, a real-case scenario was developed to better represent site and receptor characteristics. The real-case scenario included the following changes to the criteria listed in Section 10.3.1:

- Incorporation of average daily sunshine hours from the Kentville weather station (Table 10.5).

- Incorporation of field-verified receptor data including window placement, building height and orientation of building.
- Incorporation of topographic features (DEM).
- Incorporation of wind speed and direction from the meteorological tower within the Study Area.

Table 10.5: Sunshine Data Used for the Real-Case Scenario

Month	Average Daily Sunshine Hours*
January	2.53
February	3.50
March	4.28
April	4.96
May	6.33
June	7.24
July	7.51
August	7.27
September	5.85
October	4.44
November	2.81
December	1.86

*Source: Kentville Weather Station (windPRO Weather station)

10.3.4 Assessment Results

A total of 500 receptors were identified within 2 km of the Assessment Area (Drawings 10.1A-C). Under the "theoretical" scenario conditions (meeting criteria described in Section 10.3.1 above), 19 receptors exceed 30 hours of shadow flicker per year and/or 30 minutes of shadow flicker on the worst day (Table 10.6). Detailed results showing all receptors within 2 km of the Assessment Area are provided in Appendix N.

Table 10.6: Potential Receptors Impacted by Shadow Flicker – Theoretical Scenario

Receptor ID*	Receptor Description	Hours of Shadow Flicker per Year	Minutes of Shadow Flicker per Day (on the worst day)
B	Year-round residential; one story	14:49	30
C	Year-round residential; two stories	83:15	60
F	Seasonal residential; one story	42:37	36
G	Year-round residential; one story	49:27	43
H	Year-round residential; one story	57:15	43
I	Year-round residential; one story	61:20	47
J	Year-round residential; two stories	58:55	38
K	Year-round residential; one story	55:32	34
L	Year-round residential; one story	58:07	41

Receptor ID*	Receptor Description	Hours of Shadow Flicker per Year	Minutes of Shadow Flicker per Day (on the worst day)
M	Year-round residential; one story	55:22	50
N	Year-round residential; one story	69:09	40
P	One story	58:22	36
Q	Year-round residential; one story	22:00	31
R	Year-round residential; two stories	36:03	24
T	Year-round residential; two stories	71:16	44
U	Seasonal residential; one story	107:20	55
V	Year-round residential; one story	65:31	65
X	Year-round residential; two stories	18:45	34
Z	Year-round residential; one story	49:16	70

*Receptor ID corresponds to labelling on Drawings 10.1B-10.1C. Further, receptors A, D, E, O, S, W, and Y are not included in Table 10.6 as they were determined not to exist in the field.

The model was subsequently re-run using the sunshine data in Table 10.4, meteorological tower wind data and topographic features to provide a real-case scenario assessment. Real-case scenario results are provided in Table 10.7 and Drawing 10.1A. Detailed results are provided in Appendix N.

Table 10.7: Potential Receptors Impacted by Shadow Flicker – Real-Case Scenario

Receptor ID*	Receptor Description	Hours of Shadow Flicker per Year**
B	Year-round residential; one story	3:50
C	Year-round residential; two stories	22:46
F	Seasonal residential; one story	7:23
G	Year-round residential; one story	13:24
H	Year-round residential; one story	15:30
I	Year-round residential; one story	16:25
J	Year-round residential; two stories	15:39
K	Year-round residential; one story	14:33
L	Year-round residential; one story	15:22
M	Year-round residential; one story	14:25
N	Year-round residential; one story	16:05
P	One story	11:33
Q	Year-round residential; one story	4:33
R	Year-round residential; two stories	8:46
T	Year-round residential; two stories	19:11
U	Seasonal residential; one story	28:52
V	Year-round residential; one story	14:20
X	Year-round residential; two stories	5:00

Receptor ID*	Receptor Description	Hours of Shadow Flicker per Year**
Z	Year-round residential; one story	12:46

*Receptor ID corresponds to labelling on Drawings 10.1A.
**windPRO cannot calculate minutes per day for a real-case scenario.

10.3.5 Effects Assessment

Project-Shadow Flicker Interactions
Project activities only interact with shadow flicker during operations (Table 10.8).

Table 10.8: 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
Modelling for the real-case scenario predicts that all receptors will experience less than 30 hours of shadow flicker per year. This is still considered a conservative assessment because the real-case scenario still assumes the wind turbines are always in operation (i.e., rotors always spinning), which will not be the case, and does not account for screening by trees,

outbuildings, or other local structures which may, depending on the time of year, minimize the amount of shadow flicker at receptors.

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.)

Aeronautical safety lighting associated with wind turbines may also result in visual impacts, especially during the nighttime.

10.4.2 Regulatory Context

There are no provincial or federal guidelines related to viewscape.

Operational turbine lighting is regulated by NAV CANADA and Transport Canada.

10.4.3 Assessment Methodology

Visual simulations were undertaken to assess the wind turbines impact on the visual landscape and local aesthetics. Locations for the visual assessment were selected based on accessible locations of concern that meet the criteria listed in Section 10.4.1, where turbines were expected to be visible within the area surrounding the Project. The following locations were selected (Drawing 10.2A-G):

- West of Panuke Lake on Panuke Road (three photos taken at bearings 108°, 160° and 180°; coordinates provided in Drawing 10.2B-D).
- Roadside of Highway 102 (one photo taken at bearing 247°; coordinates provided in Drawing 10.2E).
- North of Weir Brook on Rocks Road (two photos taken at bearings 183° and 192°; coordinates provided in Drawing 10.2F-G).

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-G.

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 10.9).

Table 10.9: 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-F). The RAA is not applicable for visual effects.

Assessment Criteria
Assessment criteria provided in Section 4.6 apply for visual effects. The VC-specific definition for magnitude is applied to each observer location individually as follows:

- Negligible – Project components cannot be seen from the observer location.
- Low – Project components may be seen from the observer location, but do not stand out or are not discernible in the view (i.e., low exposure on the horizon).
- Moderate – Project components can be seen from the observer location but are not a prominent feature in the view.
- High – Project components are the prominent feature in the view from the observer location.

It is noted that the magnitude criteria for visual effects is considered a neutral 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 all observer locations. In addition, several existing and operating turbines area visible in two of the three observer locations.

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 receptor, which is over 600 m. Lighting intensity and flashes will be minimized, as allowable by Transport Canada; and the exterior turbine maintenance lights will be turned off prior to maintenance staff leaving the site where health and safety requirements allow.

Mitigation
No mitigation is recommended related to viewscapes.

The following mitigation is recommended regarding turbine lighting:

- Limit lighting on turbine hubs and towers to minimum levels while still meeting requirements of NAV CANADA and Transport Canada.
- Prohibit general lighting within the Project Area where allowed by health and safety requirements. Lighting for operations activities will only be used when technicians are working on-site.

Construction activities will be limited to daytime hours when possible. It is noted that turbines may be erected during the evening as the activity must be completed when the wind is less than 8 m/s as a safety measure. Additionally, where concrete pours are in progress, night work may be required to maintain the integrity of the pour. On-site lighting will be pointed downward to minimize light throw.

Monitoring
No monitoring programs are recommended.

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

10.5 Sound

10.5.1 Overview

The assessment of sound considered both construction and operational generated noise from the Project.

During construction, heavy equipment, machinery, and light vehicles will emit sound to the surrounding environment from activities associated with the development of wind turbine pads, roads, the transmission 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 10.10).

Table 10.10: Summary of Sound Level Regulations and Guidelines

Regulated By	Regulation/Guidance	Sound Level (dBA)	Hours / Duration
For Residential Receptors			
Nova Scotia Department of Environment and Labour (now NSECC)	Guidelines for Environmental Noise Measurement and Assessment (NSECC, 1990)*	≤ 65	0700 to 1900
		≤ 60	1900 to 2300
		≤ 55	2300 to 0700
NSECC	Guide to Preparing an EA Registration Document for Wind Power Projects in Nova Scotia (NSECC, 2021)	≤ 40	During the operation of wind turbines
Municipality of the District of West Hants	*Guidelines/by-laws for noise are not established.*	---	--
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.

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.

Operational Sound

The operational sound assessment was completed through a combination of desktop studies and modelling with the following objectives in mind:

- Identify receptors/dwellings within 2 km of the Assessment Area.
- Identify existing operational turbines within 3 km of the Project.
- Identify and assess any potential impacts on these receptors, including cumulative effects from neighbouring turbines, if present.
- Avoid and/or mitigate impacts of Project generated sound on nearby receptors.
- Confirm the modelled Project sound levels at nearby receptors will be below guidelines.

The sound assessment identified potential receptors within a 2 km radius of the Assessment Area. The assessment was completed using the windPRO version 3.5.552 software package. For the purposes of this model, potential receptors included all structures identified in GIS data from the Nova Scotia Geomatics Centre, as well as any additional identifiable structures based on aerial imagery. A field investigation was completed to confirm the receptors on Panuke Lake and identify any additional receptors that were not included in the desktop GIS data. The assessment also included the 10 existing turbines from the Ellershouse Wind Farm and thus considered the potential for cumulative effects.

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 (for the project wind turbines) or calculated by windPRO, for the existing wind turbines.
- UTM coordinates for potential receptors (all non-Project participating structures within a 2 km radius of the Assessment Area were evaluated).
- A wind speed of 8.8 m/s, the speed at which the highest sound power level output is achieved (based on test data from the manufacturer).
- Topographic data for the surrounding area.

The ISO 9613-2 calculation method assumes meteorological conditions that are ideal for noise propagation, including a ground temperature of 10°C and 70% relative atmospheric humidity. A ground factor of 0.7 was applied to the model, representing predominantly porous ground (i.e., capable of vegetative growth) interspersed with hard surfaces (e.g., rock).

Modelling results were mapped and presented as a isopleth, demonstrating the sound levels each receptor may 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 less than 1 km southwest of Highway 101, an east-west highway running from Bedford to Yarmouth. This major highway is travelled daily by vehicular traffic emitting different levels of sound, including transport trucks and motorcycles. Approximately 0.3 km northwest of the Study Area in Panuke Lake are two powerhouses associated with dams operated by Minas Basin Pulp and Power Company. A number of industrial activities currently operate within the Study Area, including forestry, quarrying, and an operational wind farm. Sounds associated with forestry activities include operation of forestry machinery and logging trucks. Hartville Quarry, located in the northern extent of the Study Area, has multiple trucks driving on and off site each day to transport quarried materials. The existing Ellershouse Wind Farm, located directly north of the Project, feature 10 operating turbines. 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 sound originating from wind 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. The Project will require blasting. A summary of sources and anticipated volumes of sound produced during the Project's construction is provided in Table 10.11.

Table 10.11: 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	
Blasting	137[1]
Backhoe	85-104[3]
Concrete Truck/Pump	103-108[3]
Dozer	89-103[2]
Dump Truck	84-88[2]
Excavator	97-106[3]
Harvesting Equipment (log truck, manual faller, etc.)	85-103[4]
Roller	95-108[3]
ATV	97[5]

Equipment	Average Noise Level Ranges (in dBA)
Road, Transmission Line, Grid Connection, and Turbine Pad Development	
Loaders	88[4]
Pickup Trucks	95[5]
Tracked Drilling Units	91-107[6]
Tracked Dump Truck/Decks	91[7]
Tracked Man Lift/Bucket Machines	85[7]
Tracked Radial Boom Derricks/Cranes	93-98[3/6]
Turbine Assembly	
Crane	78-103[2]
Handheld Air Tools	115[3]
Compressor (drilling, pneumatic tools, etc.)	85-104[8]

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]New Gold (2015)
[2]WorkSafe BC (undated)
[3]Transport Scotland (undated)
[4]WorkSafe BC (2016)
[5]Government of Oregon (undated)
[6]The Driller (2005)
[7]SCE (2016)
[8]Government of Ontario (2021)

The range of decibels anticipated for the Project's construction activities will be between 78 to 137 dBA (from a single piece of equipment within 15 m from the source).

Assuming that sound attenuates at the standard rate of 6 dBA per doubling in distance from a given point source, approximate sound levels experienced at incremental distances during construction activities for the Project are provided in Table 10.12. 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 10.12: 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
	Blasting	137	126.5	120.5	114.5	106.5	100.5	94.5

*Approximate point source sound levels, based on data collected in Table 10.12 above. Combined sound levels produced by multiple pieces of equipment operating simultaneously have not been included in the assessment.

For the median case, sound levels will meet the ≤65 dBA guideline for daytime noise levels at approximately 500 m from a given point source of noise/the Assessment Area.

Operational Sound
A total of 500 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 O. Wind turbines associated with Ellershouse Wind Farm are within 3 km of the Project; therefore, have been included in the modelling to show cumulative effects. No potential receptors exceed the recommended guideline of 40 dBA. The highest predicted sound level at a potential receptor is 38 dBA.

Information from the turbine manufacturer supplied the 1/3 octave low frequency power levels at 120 m hub height. The power levels were entered into a Finland low frequency model in windPRO software to produce the maximum dBA at each receptor. No potential receptors exceed the most critical noise demand from windPRO's Finland low frequency model of 43 dBA. The Finland low frequency model is provided in Appendix O. Therefore, low frequency sound is not expected to be a concern. A literature review related to infrasound/low frequency sound is provided in Appendix O.

10.5.5 Effects Assessment

Project-Sound Interactions
Project activities will interact with the acoustic environment during all phases of the Project. Sound related to the decommissioning phase is not specifically addressed because sound levels are expected to be comparable to construction levels (Table 10.13).

Table 10.13: 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. 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.

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 potential receptors located within close proximity to activities at some locations within the Project Area. For the median case, sound levels will meet the ≤65 dBA guideline for daytime noise levels at approximately 500 m from a given point source of noise/the Assessment Area. Within 500 m of the Assessment Area, there are 30 potential receptors which may experience sound levels exceeding daytime thresholds depending on the type and location of the activity required. All 30 receptors (within 500 m of the Assessment Area) are located near the intersection of Ellershouse Road the Project's access road (which was constructed for the development of Ellershouse Wind Farm). Therefore, most Project-related construction sound will be consistent with existing sound levels.

Given that the construction footprint is widespread, Project-related construction noise potentially exceeding NSECC guidance at individual receptors would occur intermittently and over a very short time frame. Furthermore, the median sound level from construction is similar to sound produced from an ATV or pick-up truck, which is already a common source of sound within the Study Area. Activities producing higher levels of sound such as blasting (if required) or handheld air tools will be less frequent and last for a very short duration.

Operational sound at 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, where possible.
- Limit vehicle idling.
- Conduct construction activities within the recommended daytime hours of 7:00 am to 10:00 pm to the extent possible.
- Include mitigation and monitoring for blasting in the Project's EPP. Blasting activities will follow the guidelines and requirements outlined in the Blasting Safety Regulations.

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 baseline 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 – The project is expected to have a positive effect on GHG emissions	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 required; monitoring may be required
Fish and Fish Habitat	Low – Small loss of fish habitat or impact to fish behaviour	Within the Assessment Area	Seasonal aspects applicable; short-term duration	Single event	Reversible	Not significant	Mitigation required; monitoring may be 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

VC	Magnitude of Effects	Geographic Extent of Effects	Timing and Duration of Effects	Frequency of Effects	Reversibility of Effects	Significance Level	Mitigation and/or Monitoring Required?
Terrestrial Habitat	Low – 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 behaviour 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
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 surrounding the turbines	Seasonal aspects not applicable; medium-term duration	Intermittent	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?
Economy	Positive – Project is expected to have a positive effect on the economy	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 change in traffic levels and/or moderate disruptions to traffic flow and routing	Within the area of West Hants Regional Municipality extending to the Port of Sheet Harbour.	Seasonal aspects not applicable; short-term duration	Intermittent	Reversible	Not significant	Mitigation required; no monitoring required
Recreation and Tourism	Negligible – No expected changes to recreation and tourism						Mitigation required; no monitoring required
Archaeological Resources	Moderate to low – Activities have a moderate to low potential for encountering archaeological resources during ground disturbance	Within the 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	Mitigation required; no monitoring required
Electromagnetic Interference	Moderate to low – Letters of no objection received, and organizations have requested additional consultation	Within consultation boundaries established by the RABC Guidelines	Seasonal aspects not applicable; medium-term duration	Continuous	Reversible	Not significant	Mitigation required; no monitoring required

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?
Shadow Flicker	Low – Measurable shadow flicker predicted at receptor locations, but results are below guidance	Within 2 km buffer around Study Area	Seasonal aspects applicable; medium-term duration	Intermittent	Reversible	Not significant	Mitigation may be required; no monitoring required
Visual Impacts	Low – Project components can be seen from the observer location but are not a prominent feature in the view	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	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 required for construction activities.
- Stabilize exposed soil surfaces 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.
- 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 approved alternative dust suppressant technologies to minimize airborne emissions.
- Monitor the need for dust suppression and its effectiveness.
    - Consider changes in speed limits, alternative routes, and timing of activities, where appropriate.
- 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.
- Require 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).
- Set Project site speed limits to minimize dust generation.
- Require that site equipment meets the applicable provincial and air quality regulations and emissions standards.
- Require that equipment is fueled using low-sulphur diesel (to reduce SO_x air emissions), where possible
- 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).
- Require 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.
- Require that construction equipment with an improperly functioning emission control system is not operated.
- Require that regular equipment maintenance is undertaken to maintain good operations and fuel efficiency.
- Require that 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.
- Require that 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.
- Implement an anti-idling policy to limit GHG/exhaust 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, where required, in accordance with provincial legislation and subject to terms and conditions of applicable permits.
    - Require that all blasts are conducted and monitored by certified professionals.

  - Require that 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. This will include a review for potential impacts related to uranium and associated mitigation and monitoring, as required.
  - 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.
- Require rock removal in known areas of elevated sulphide potential to 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.
- Temporarily store any soil needed for backfilling (e.g., after foundations have been poured) adjacent to the excavations until needed. Any remaining excavated material will be used on the site or removed and sent to an approved facility.
- Install temporary erosion controls immediately after a disturbance in an erosion prone area and maintain and reinstall as necessary. Inspect controls on a regular basis.
- Remove temporary erosion and sedimentation controls once the area has stabilized.

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.
- Clearly mark (delineate and flag) watercourses and wetlands and avoid impacts to the watercourse/wetland and adjacent riparian habitat to the extent possible.
  - Complete in-season wetland surveys for areas subject to minor layout modifications (refer to Section 7.3.3.5).
- Revegetate along the watercourse edge and above the ordinary high-water mark to stabilize the area.
- Avoid impacts to wetlands to the extent possible.
  - Where unavoidable, complete wetland alterations in accordance with the NS Wetland Conservation Policy and the wetland alteration process during the permitting stage, which includes a requirement to compensate for lost

    wetland habitat and functions.
    - Design wetland crossings to occur at the narrow part of the wetland or the wetland's edges, to the extent possible.
    - Design wetland crossings to avoid permanent diversion, restriction, or blockage of natural flow, such that hydrologic function of wetlands will be maintained.
- Avoid travel through wetlands. If travel through wetlands is required:
    - Use anti-rutting mitigation (e.g., mud mats), as appropriate.
    - Cross the wetland at the narrowest portion, where possible.
    - Time work to occur during frozen ground conditions, where possible.
- Train staff on the requirements for work in and around wetlands to avoid unnecessary compaction.
- Conduct any work within the bed of a watercourse or along the banks of a watercourse between June 1 and September 30, where possible, to avoid sensitive periods in the life cycles of fish, to better control water flow, and to allow for a faster revegetation period (NSECC, 2015b).
- Plan any activities within the bed of a watercourse or along the banks of a watercourse to align with low-flow periods, where possible.
- Develop a site-specific erosion and sedimentation plan during the detailed 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).
- Limit the slope and gradient of disturbed areas to minimize the velocity of surface water runoff.
- Avoid surface run-off containing suspended materials or other harmful substances.
- Direct run-off from construction activities away from wetlands.
- Leave riparian vegetation as intact as Project developments will allow.
- Integrate water management systems including diversion and collection ditches, roadside drainage channels, vegetative swales, 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 or Engineer.
- Integrate outlet protection features to dissipate flow velocities and decrease erosion at the outflow.
- Require 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, 2015) if crossing upgrades are required.
- 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, 2015).

- Utilize rock material that is clean, coarse granular, non-ore-bearing, non-watercourse-derived, and non-toxic to aquatic life (NSECC, 2015).
- Use quarried, crushed materials for road construction to reduce the introduction of invasive vascular plant species, where possible.

Terrestrial Environment

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

- Minimize overall area to be cleared, road density, habitat fragmentation, and habitat isolation by utilizing pre-existing roads (and rights-of-way) and previously altered areas (i.e., clearcuts).
    - 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 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.
- Complete in-season rare plant and lichen surveys for areas subject to minor layout modifications (further discussed in Section 7.3.3).
- 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, in consultation with the landowner, and particularly use seed mixes that do not contain clover to avoid attracting deer to the area.
    - Maintain 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), where possible.
- Schedule blasting activities within proximity of abandoned mines/caves during the summer months to avoid risk of collapse/degradation of these potential habitats when bats would be present.
- Continue to utilize habitat modelling results, field survey results, and guidance from NSNRR through the detail design phase to minimize impacts to terrestrial fauna through habitat loss.
- 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.

  - Additional surveys will be conducted to determine presence (if any) of flora SOCI in the Assessment Area which have not yet been surveyed during flowering season.
- Educate Project personnel about the potential for plant or lichen SOCI during construction and subsequent Project phases that may require removal or disturbance of vegetation.
  - Guidance will be provided to Project personnel to raise awareness of terrestrial flora SOCI that are known to exist within and nearby the Study Area to increase the number of trained eyes looking for these species.
- Consult with NSNRR if an unexpected flora SOCI is encountered during construction activities. Potential mitigation measures based upon recognized practices to transplant or collect seeds can be used as a contingency if flora SOCI are unexpectedly encountered during construction activities. A transplantation plan will be developed along with a monitoring protocol through consultation with NSNRR should this be required during construction.
- Clean and inspect equipment to prevent the introduction of non-native species into previously undisturbed areas.
  - Because non-native species are already present within the Study Area, care will be taken when travelling from developed areas to undisturbed areas so that plant material is not transferred between locations.
- 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
  - Turtles (Wood, Eastern painted, and Snapping) – May to June (nesting) and October to April (overwintering)
  - Four-toed salamander – March to April (nesting) and Fall (mating)
  - Monarch – Late summer (July) to early fall (October) (congregation of migratory groups)
  - Bats – late April to late September
  - Birds – late March to September

- Minimize loss of important habitat required by priority species for reproduction events, migration, or hibernation, including:
  - Mainland moose – wetlands and isolated islands/peninsulas
  - Fisher – large snags, large woody debris, or live, hollow standing trees in mature, intact forests
  - Wood turtle – clear, meandering streams with gravel shores, gravel roadsides
  - Eastern painted turtle – open/sloped south-facing areas with gravel, sand, or loam substrates
  - Snapping turtle – sand, gravel or soil of wooded areas
  - Four-toed salamander – sphagnum moss and peat bogs that border watercourses
  - Monarch – goldenrod and aster for food sources during migration
  - Bats – Abandoned mines, large diameter (≥25 cm) snags and hollow trees (over-day roosting habitat)
- Assess additional mitigation and minimization of impacts to WL10 during the detailed design and permitting stage of the Project.
- Maintain all equipment and machinery in good working condition to reduce noise and vibration emissions. Where practicable, utilize noise controls (e.g., mufflers) on machinery, equipment, etc. during construction of the Project.
- Restrict on-site lighting, especially at night, to limit disturbance.
- Prohibit harassment and feeding of wildlife by Project personnel.
- 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 prevention and response procedures related to spills, emergencies, and fire within the EPP.
- Install avian deflectors on powerlines in areas identified 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 the travelling public safety.
- Complete upgrades to roads and overhead wires, branches, and signs where necessary.
- 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 reduce impacts to road-way flow and impacts on air quality due to exhaust.
- Restrict vehicles and work on-site to 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 continue access to recreation sites.
- Continue to work with nearby landowners to maintain the positive relationship within the community.

Archaeological Resources

- Conduct a systematic shovel testing program to identify potential archaeological resources in high potential areas if ground disturbance is required. No construction work will be completed in these areas unless they are cleared by NSCCTH of any further requirement for future archaeological assessment or, in the event of a positive result during the shovel testing, a mitigation plan is developed and accepted by NSCCTH.
- Develop procedures in the EPP related to the potential for an unexpected discovery of archaeological items or sites, or human remains during construction. This would include halting any work immediately upon discovery of suspected resources and contacting NSCCTH. If the resources are suspected to be of Mi'kmaq origin, the Executive Director of KMKNO would also be contacted.
- Conduct additional archaeological assessment if, during the detailed 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, EMI, shadow flicker, visual impacts, and sound include the following:

- Continue engagement and education with local recreational users (Section 8) 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.
- Installation of ice and vibrational sensors.
- Shutdown during extreme weather or icing accumulation events.
- Restart operation of turbines only once hazards are confirmed not to be present following periods of extreme weather or ice accumulation.
- Implement a fire prevention and evacuation plan for Project personnel as part of the EPP, in addition to general safety protocol and training.

- Consult operators 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 or the development of a turbine-specific curtailment plan.
- Limit lighting on turbine hubs and towers to minimum levels while still meeting requirements of NAV CANADA and Transport Canada.
- Prohibit general lighting within the Project Area where allowed by health and safety requirements. Lighting will only be used when technicians are working on-site.
- Construction activities will be limited to daytime hours of 7:00 am to 10:00 pm when possible. It is noted that turbines may be erected during the evening as the activity must be completed when the wind is less than 8 m/s as a safety measure. On-site lighting will be pointed downward to minimize light throw.
- 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 turbines, including applicable operating procedures, safety protocols, and evacuation plans. To further mitigate damages that cannot be controlled by education and training alone, the Project will be equipped with safety mechanisms to limit damage resulting from extreme weather events.

12.1 Climate Change

Climate change is the persistent change in the state of the climate which lasts for decades or longer (IPCC, 2018). Climate change may impact the Project through increased occurrences of extreme weather, precipitation, and subsequent flooding. In addition, increased weather extremes due to climate change may impact turbines, powerlines, and/or roadways, causing washouts and/or damage to infrastructure.

12.1.1 Temperature

One major change associated with climate change is global warming, which is defined as an increase in global mean surface temperature averaged over a 30-year period, relative to preindustrial temperatures (IPCC, 2018). Projected rising temperatures associated with global warming may impact many phases of the Project and on-site personnel. For example, longer and more intense heat waves may increase heat-related illnesses and increase the risk of food and water-borne contamination. Hotter and drier conditions also increase the risk of droughts and wildfires during construction and operation activities (Government of Canada, 2019c). Requirements for stopping work or taking regular breaks to cool down and rehydrate will be mandated throughout the Project's lifetime to protect Project personnel. 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 Panuke Lake which is directly south of the St. Croix River, a subsidiary of the Bay of Fundy. The northern extent of the Study Area nearest to the St. Croix River is approximately 75 masl. The elevation of almost the entire Study Area is over 90 masl. The entrance to the site, and proposed collector line and substation are the lowest points in the site at 75-90 masl. The proposed turbine locations are between 140-197 masl and should therefore experience minimal to no impacts from rising sea levels based on their elevation. The integrity of the roads leading to the Project Area are of greatest concern as they have the lowest elevation; however, these roads are 2.31 km from the nearest tidal waters and are therefore unlikely to be impacted by rising water levels within the lifespan of the Project.

12.1.3 Flooding

Flooding in the Study Area may increase due to more frequent severe precipitation associated with climate change. Due to the effects of ocean warming, climate change is predicted to produce more intense precipitation, which may result in increased flood risk (US EPA, 2022d). Flooding may impact both terrestrial and aquatic habitat, damage Project infrastructure, and limit site access. The Project will mitigate the risks of flooding by concentrating the road and turbine layout in high elevation areas, maintaining regular upkeep and grading of roads to reduce formation of ruts, designing roadside ditches and water offtake infrastructure next to all roads to encourage drainage of rainwater off the roads, and revegetating roadsides to absorb excess water. A hydrology study will be conducted and stormwater management plan will be developed during detailed engineering to mitigate potential flooding risks through drainage or other project design features.

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, 2020b). 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. Project design features noted in Section 12.1.3 will also mitigate the effects of heavy rainfall and snow melt to maintain road access during severe precipitation events.

Wind and lightning, which may be associated with heavy rainfall or hurricane conditions, may increase the risk of mechanical issues or electrical fires. Restricted access to the site during severe weather events may limit the ability to shut down the system to prevent damage. To mitigate this risk, the turbines will be equipped with an automatic shut down when thresholds for wind speeds are reached and will also be designed with a built-in grounding system for lightning strikes. In addition, Ellershouse 3 Wind LP 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 Forest Fire Protection Regulations, NS Reg. 135/2019 outline restrictions for burning and operating power saws during the fire season (March 15 to October 15). Burning restrictions are determined daily, depending on the Fire Weather Index (FWI). The Nova Scotia government employs an FWI during the fire season to determine fire danger across the forested areas in Nova Scotia (NSNRR, 2021j). A higher FWI score indicates that if a fire were to start it would be of high intensity and pose greater danger than a lower FWI score. Operation of power saws and/or clearing saws in forested areas within the Project Area will only occur when and as permitted under the Forest Fire Protection Regulations. Any activities requiring burning during the Project lifetime will be timed according to local burning restrictions.

As a best practice, the FWI can be used to determine fire danger associated with activities that may result in burning. The FWI during the summer months across the Study Area ranges from low (0-5) to moderate (5-10) (NRCan, 2022b). Federal and provincial FWI data is updated daily, with the closest provincial weather stations to the Study Area being ‘Keizer Meadows and ‘Pockwock’ (NSNRR, 2021j; NRCan, 2022b). Although most days in the 2022 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, such as mechanical brushing/land clearing, using spark-producing tools, or piling of woody debris (Wildfire Regulation, BC Reg. 38/2005). Should the risk of fires increase throughout the lifetime of the Project, mitigation strategies to protect Project infrastructure and relevant VCs will be adapted accordingly.

12.3 Potential Residual Effects

Environmental effects associated with climate change and natural hazards have the potential to result in a significant effect on the Project. Project location siting and design measures will minimize many of the risks associated with these environmental hazards, and the mitigation measures described above will allow for both proactive and adaptive management of any remaining risks, thus limiting the likelihood of impacts on all phases of the Project. Therefore, the residual effects associated with climate change are considered not significant.

13.0 ACCIDENTS AND MALFUNCTIONS

Without proper mitigation, accidents and malfunctions can interact with many VCs and potentially result in adverse effects. However, implementing preventative measures limits the probability of occurrence, and having appropriate response procedures in place reduces the magnitude of residual effects.

Accidents, malfunctions, and unplanned events considered for this Project include:

- Erosion and Sediment Control Failure
- Fire
- General Hazardous Material Spill

The safety of on-site personnel is a vital Project component; however, it is not specifically considered in the EA, as workplace occupational health and safety is regulated by the policies, procedures, plans, and codes of practice set in the 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.
- Install erosion and sediment controls per the manufacturer's specifications or site-specific requirements.
- 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.
- Maintain function of erosion and sediment controls
- Provide workers with training 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 (e.g., flammable chemicals, fuels, vegetation).
- Implement mitigation related to chemical and fuel storage (Section 13.3).
- Allow smoking in designated areas only.
- Equip heavy machinery and turbines with fire suppressant equipment

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 spill prevention and response procedures as part of the Project's EPP, which will set out spill prevention and response procedures.
- Store all fuels, lubricants, and hazardous material in designated containers and areas.
- Provide secondary containment in storage areas (where possible).
- Inspect equipment for fluid leaks.
- Locate fuel storage areas, refueling, and/or equipment lubrication a minimum of 30 m from surface water (i.e., watercourse) and groundwater feature (i.e., well).
- Refuel machinery and equipment on an impervious surface, where possible. If this is not possible, require that the work is completed in a designated area, greater than 30 m from a watercourse/water body/wetland.
- Complete equipment servicing off-site, where possible. If this is not possible, require that the work is completed in a designated area, greater than 30 m from a watercourse/water body/wetland.
- Store all dangerous goods in compliance with the Workplace Hazardous Material Information System.
- Equip mobile equipment with spill kits stocked with appropriate spill containment materials for the activities taking place, such as soaker pads, oil-absorbing materials, and containment booms.
- Locate stationary spill kits or spill drums at work areas utilizing mobile equipment, hazardous fluids and/or in proximity to environmentally sensitive areas (i.e., wetlands or watercourses).
- Stock spill kits with the appropriate quantity and type of material for the anticipated product type(s) and volume(s) in use.

- Train site workers on site specific spill response requirements and equipment.

With the implementation of the above preventative measures, the likelihood of an accident or a malfunction is low. Appropriate response plans will be put in place to ensure any interactions with VCs from an accident or malfunction are limited and the effects can be quickly contained.

14.0 CUMULATIVE EFFECTS

14.1 Overview

Cumulative effects are changes to environmental, social, and economic values caused by the combined effect of past, present, and potential future human activities and natural processes (Government of British Columbia, 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 have the potential to result in an overall impact to a VC of interest.

14.2 Other Undertakings in the Area

There is an existing wind farm located within 3 km of the Study Area, known as the Ellershouse Wind Farm, which was developed from 2014 to 2017 by AREA. The project consists of 10 operational Enercon E92 turbines, with a total output of 23.15 MW (AREA, 2013; AREA, 2016).

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
Hartville Quarry	Quarrying for aggregate	Active	783 Ellershouse Road, NS	Adjacent to AA
Spence Aggregates Ltd.	Quarrying for aggregate	Active	126 Stark Road, Windsor, NS	2.2 km west
NOVA Quarry	Quarrying for aggregate	Active	700 Panuke Road	3.7 km west
St. Croix Hydro System	Operation and maintenance for a series of hydroelectric dams, power lines, and substation.	Active	Panuke Lake/St. Croix River	1.0 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	The Project is maximizing use of existing roadways, minimizing the disturbance of surface freshwater resources. Residual impacts will be mitigated, monitored, and be contained within the Project Area.
Fish & Fish Habitat	No	Utilization of existing roadways, minimizing the requirement for new crossings/disturbance of potential fish habitat. Watercourse crossings will have applied mitigation and monitoring.
Wetlands	No	The Project is maximizing use of existing roadways, minimizing the disturbance to wetlands. All impacted wetlands will be compensated.
Terrestrial Habitat	No	Project Area is located within an active forest management area, such that a large portion of tree removal would have been subject to future harvesting in the absence of the Project.
Terrestrial Flora	No	Avoidance of SOCI.
Terrestrial Fauna	No	The Project Area is maximizing use of existing roads, clearings, and infrastructure to minimize potential impacts to fauna SOCI and associated habitat. In addition, high quality habitat identified through modelling and field observations will be avoided by the Project Area. Further, in the absence of the Project, it is likely that the Project Area would still be subject to future clearing/disturbance from forestry activities.

VC	Cumulative Effects Assessed	Reasoning
Bats	Yes	Other wind developments within 3 km of the Project.
Avifauna	Yes	Other wind developments within 3 km of the Project.
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	Yes	Other wind developments are within 3 km of the Project. Assessment for cumulative effects considered in Section 10.3 (i.e., shadow flicker modelling includes the operation of the existing turbines).
Visual Aesthetics	Yes	Other wind developments are within 3 km of the Project. Assessment for cumulative effects considered in Section 10.4 (i.e., visual simulations include views that capture the existing turbines).
Sound	Yes	Other wind developments are within 3 km of the Project. Assessment for cumulative effects considered in Section 10.5 (i.e., sound modelling includes the operation of the existing turbines).

The following VCs are assessed for cumulative effects:

- Bats
- Avifauna

Bats & Avifauna
Bats and avifauna are discussed in terms of cumulative effects based on the Project's proximity to other wind developments (Ellershouse Wind Farm) along with the cumulative potential for injury/mortality of SAR. The Ellershouse Wind Farm is considered a small sized wind farm consisting of 10 wind turbines (~98 m hub height). The 10 existing wind turbines are adjacent to the Project and an existing quarry (Hartville Quarry). As part of the EA for the Ellershouse Wind Farm, pre-construction avian surveys were completed, and the EA determined that impacts to avifauna would not be significant. In addition, the proponent was

required to complete post-construction bat and bird monitoring which found no bat carcasses and insignificant levels of bird carcasses between 2016 and 2018 (Strum Consulting, 2020). These reports/results were submitted to NSECC.

Based on the small scale of the existing wind power development nearby, the EA conclusions, and results of post-construction monitoring, the anticipated cumulative effects on bats and avifauna from the operation of the combined wind developments are anticipated to be not significant.

Other infrastructure/development near the Study Area (and associated with the Project) also has the potential to cause injury/mortality to bats and avifauna as a result of collision with infrastructure such as power lines and highways/road networks. The cumulative effect on bats and avifauna from the operation of the Project in combination with surrounding infrastructure and development is also anticipated to be not significant (Zimmerling et al., 2013).

15.0 CONCLUSION

In accordance with A Proponent's Guide to Environmental Assessment (NSECC, 2017), the studies, regulatory assessments and VC evaluations described within this EA Report have been considered both singularly and cumulatively, for all phases of the Project.

The results of this assessment indicate that in consideration of the Project's mitigative and protection measures, adverse residual effects are not anticipated to be significant.

16.0 CLOSURE

This EA Report was completed by Strum Consulting, an independent, multi-disciplinary team of consultants with extensive experience with submission of EA Registration documents for undertakings within Atlantic Canada. Curriculum vitae for EA Report contributors and Project Team members are provided in Appendix P. A list of the Project Team and their associated roles is provided below.

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