Windy Ridge Wind Power Project

Environmental Assessment

Prepared for: Windy Ridge Wind (4560536 Nova Scotia Limited)

CBCL

May 29, 2024

May 24, 2024

Ms. Helen MacPhail
Nova Scotia Environment and Climate Change
Environmental Assessment Branch
#2085 – 1903 Barrington Street
PO Box 442
Halifax, Nova Scotia, B3J 2P8

Dear Ms. MacPhail,

Re: Environmental Assessment Registration Document - Windy Ridge Wind Power Project

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Please find enclosed the Environmental Assessment Registration Document for the Windy Ridge Wind Power Project.

The undersigned approve and accept the contents, as submitted to Nova Scotia Environment and Climate Change, Environmental Assessment Branch.

Sincerely,

Rose Paul
CEO, Bayside Development Corporation

Darryl McDonald
CEO, Potlotek First Nation

Trent Vichie
CEO, EverWind Fuels

Executive Summary

Windy Ridge Wind, 4560536 Nova Scotia Limited (the Proponent), an equity partnership between EverWind Fuels (EWF) and the corporate entities of two Mi'kmaq communities—Paqtnkek (Bayside Development Corporation) and Potlotek (Potlotek Development Corporation)—is proposing to construct and operate the Windy Ridge Wind Power Project (the Project). The Project is situated on the ancestral and unceded territory of the Mi'kmaq people, in the Cobequid Hills region of Nova Scotia, approximately 6 km northwest of Debert.

The Project is a proposed onshore wind farm with a total of 49 wind turbines that will include associated infrastructure such as a substation, an operation and maintenance building, a transmission line to the Nova Scotia Power Incorporated (NSPI) interconnection point, power collection systems, access roads, and temporary laydown areas. The Project turbines will have a nominal nameplate capacity 340 megawatts (MW). The development of this Project will provide renewable energy required to produce certified green hydrogen and ammonia in the region, supporting the clean renewable energy initiative.

The Project is a Class I undertaking per Schedule A of the Nova Scotia EA Regulations under the provisions of the *Environment Act*, requiring registration with the Nova Scotia Department of Environment and Climate Change (NSECC). This Environmental Assessment (EA) registration document has been prepared by CBCL Limited (CBCL) according to guidance outlined in the province's document, *A Proponent's Guide to Environmental Assessment*, as well as the *Guide to Preparing an EA Registration Document for Wind Power Projects in Nova Scotia*.

The Proponent and consultants conducted consultation and engagement as part of the Project planning process. Key rightsholders and stakeholders involved in these discussions included the Mi'kmaq of Nova Scotia, various regulatory agencies, municipal leadership, and the public. These interactions were aimed at providing information, gathering input, addressing concerns, and adhering to regulatory requirements. In response to comments raised during the consultation and engagement, the Proponent has made the following key revisions to the design and layout of the Project:

- Revised layout to decrease the number of turbines on Crown Lands and, limit the number of roads.

- Modified the road and turbine layout to avoid or reduce potential for adverse effects on Mainland Moose.
- Turbines have been removed from old growth forest and tracts of mature intact forest. Tree clearing will be minimized by using existing roads and previously disturbed areas to the extent practicable.
- The Proponent removed all turbines located in the French River Watershed by removing three turbines in entirety and micro-siting two other turbines out of the watershed.
- The turbines closest to Folly Lake were removed to reduce visual impacts.

The Project will require approximately 150 km of access roads, 77 percent of which are existing and may intersect approximately 410 watercourses, with about 15 to 20 percent possibly requiring new crossing structures.

The Project is situated primarily within private lands that have experienced historical and ongoing disturbance from forestry, recreation, and quarrying activities. The detailed design of the Project and precise placement (micrositing) of turbines will aim to locate Project infrastructure in previously disturbed areas whenever possible.

The Project's potential impact on the following Valuable Environmental Components (VECs) has been assessed:

- Air Quality
- Ambient Light
- Acoustic Environment
- Topography and Landform
- Bedrock and Soils
- Groundwater
- Aquatic Environment
- Flora
- Wetlands
- Terrestrial Wildlife
- Bats
- Birds
- Land Use and Value
- Visual Landscape
- Communication and Radar Systems
- Transportation
- Recreation and Tourism
- Health and Safety
- Indigenous Cultural Resources
- Archaeological Resources

The Proponent will incorporate environmental management approaches and strategies into Project planning and execution so that the Project complies with regulatory requirements and reduces or avoids potential adverse environmental effects. A Project-specific Environmental Protection Plan (EPP) will be developed before commencement of construction, incorporating the Province's Conditions of Approval. The EPP will include information on the following:

- Erosion and Sediment Control
- Blasting Management
- Fire Prevention and Control
- Surface Water Management
- Waste Management
- Dust Control
- Wildlife Management
- Vegetation Management
- Soil and Stockpile Management
- Hazardous Substances Management and Spill Prevention
- Decommissioning and Site Reclamation
- Environmental Emergency Response and Contingencies

In addition to providing clean energy to produce carbon-free fuel, the Project will provide the following benefits:

- Mi'kmaq Benefits Agreement
- Job creation and training opportunities
- Contributions to community groups
- Stimulus to local businesses
- Tax revenues

The Proponent has also proposed the concept of a "moose corridor" to describe a collaborative, large-scale, land conservation effort in the region in which it is prepared to play a coordinating role. A moose corridor would provide ecological connectivity between protected areas and foster improvements in land use practices, such as reduction in forest harvesting.

It is anticipated that by adhering to effective mitigation and monitoring, the Project will not result in significant adverse residual effects to the environment. The Project will have a positive residual effect associated with minimizing the regional carbon footprint and contributing economic benefits for the Municipality of the County of Colchester.

Contents

Appendices

A Figures

B AC CDC Data Report

C Greenhouse Gas Emission Calculations

D Consultation and Engagement Tables

E Windy Ridge Noise Assessment

F Domestic Water Well Records

G Aquatic Tables

H Flora Species Tables

I Wetland Photo Log, WESP-AC Functional Scores and Summary Tables

J Bird Tables and Windy Ridge 2023 Radar and Acoustic Monitoring Baseline Report

K Visual Simulations

L Windy Ridge Shadow Flicker Report

List of Acronyms

Acronym	Defined
°C	degrees Celsius
AC CDC	Atlantic Canada Conservation Data Centre
ACSR	Aluminum conductor steel reinforced
ADLS	Aircraft detection lighting system
AQMS	Air Quality Management System
ARD	Acid rock drainage
ARIA	Archaeological resource impact assessment
ARU	Autonomous recording unit
ATV	All-terrain vehicle
BoP	Balance of Plant
CAAQS	Canadian Ambient Air Quality Standards
CanREA	Canadian Renewable Energy Association
CanWEA	Canadian Wind Energy Association
CBCL	CBCL Limited
CCME	Canadian Council of Ministers of the Environment
CCWF	Colchester-Cumberland Wind Field Incorporated
CEDIF	Community Economic and Development Investment Fund
cm	Centimetre
CN	Canadian National Railway Company
CO_2	Carbon dioxide
CO2e	Carbon dioxide equivalent
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CWS	Canadian Wildlife Service
dBA	A-weighted decibel
dBC	C-weighted decibel
DFO	Fisheries and Oceans Canada
DND	Department of National Defence
EA	Environmental Assessment
ECCC	Environment and Climate Change Canada
EMF	Electromagnetic field
EMI	Electromagnetic interference
EPP	Environmental protection plan
EQS	Environmental Quality Standards
ESC	Erosion and sediment control
EWF	EverWind Fuels
GHG	Greenhouse gas
GIS	Geographic information system
GW	Gigawatts

Acronym	Defined
ha	Hectare
HIAA	Halifax International Airport Authority
Hz	Hertz
IAAC	Impact Assessment Agency of Canada
IBA	Important Bird Area
IBoF	Inner Bay of Fundy
ICIA	Initial Constraints Identification Area
IPCC	Intergovernmental Panel on Climate Change
kg	Kilogram
km	Kilometre
km^2	Square kilometre
km/h	Kilometres per hour
KMK	Kwilmu'kw Maw-klusuaqn
kV	Kilovolt
kWh	Kilowatt-hour
L	Litres
LAA	Local assessment area
LiDAR	Light Detection and Ranging
m	Metre
m^2	Square metre
m^3	Cubic metre
m/s	Metres per second
MAC	Maximum acceptable concentration
masl	Metres above sea level
MBBA	Maritimes Breeding Bird Atlas
mbgs	Metres below ground surface
MEKS	Mi'kmaq Ecological Knowledge Study
MET Tower	Meteorological tower
mg/L	Milligrams per litre
MGS	Membertou Geomatic Solutions
mm	Millimetres
MN	Earthquake strength of magnitude
MOU	Memorandum of Understanding
MW	Megawatt
na	Not applicable
NO_2	Nitrogen dioxide
NRCan	Natural Resources Canada
NSCCTH	Nova Scotia Department of Communities, Culture, Tourism and Heritage
NSDLF	Nova Scotia Department of Lands and Forestry
NSDNRR	Nova Scotia Department of Natural Resources and Renewables

Acronym	Defined
NSDPW	Nova Scotia Department of Public Works
NSECC	Nova Scotia Department of Environment and Climate Change
NSESA	Nova Scotia *Endangered Species Act*
NSPI	Nova Scotia Power Incorporated
NWA	National Wildlife Area
OLA	Office of L'Nu Affairs
PDA	Potential development area
PGI	Pellet group inventory
PID	Property identification number
$PM_{2.5}$	Particulate matter having a size of 2.5 micrometres or less
PM_{10}	Particulate matter having a size of 10 micrometres or less
POL	Petroleum, oils, and lubricants
ppb	Parts per billion
PPE	Personal protective equipment
ppt	Parts per thousand
RAA	Regional assessment area
RABC	Radio Advisory Board of Canada
RCMP	Royal Canadian Mounted Police
RES	Renewable Energy Systems Canada
RoW	Right-of-way
RSZ	Rotor-swept zone
SDS	Safety Data Sheet
SANS	Snowmobilers Association of Nova Scotia
SAR	Species at risk
SARA	*Species at Risk Act*
SNA	Status rank not applicable
SO_2	Sulphur dioxide
SoCC	Species of conservation concern
StatCan	Statistics Canada
T	Tonne
t/ha/yr	Tonnes per hectare per year
TDS	Total dissolved solids
US	United States
USACE	United States Army Corp of Engineers
USDA	United States Department of Agriculture
UTM	Universal Transverse Mercator
VEC	Valued environmental component
VES	Visual Encounter Surveys
WESP-AC	Wetland Ecosystem Services Protocol for Atlantic Canada
WHMIS	Workplace Hazardous Materials Information System

Acronym	Defined
WNS	White-nose syndrome
WSS	Wetlands of special significance
3D	Three-dimensional
$\mu g/m^3$	Micrograms per cubic metre

1 Introduction

Windy Ridge Wind, 4560536 Nova Scotia Limited (the Proponent), an equity partnership between EverWind Fuels (EWF) and the corporate entities of two Mi'kmaq communities—Paqtnkek (Bayside Development Corporation) and Potlotek (Potlotek Development Corporation)—is proposing to develop a 340 megawatt (MW) wind power project to be located on privately-owned and Crown land predominantly in the Municipality of the County of Colchester (Municipality of Colchester), Nova Scotia. The Windy Ridge Wind Power Project (the Project) will comprise 49 turbines, access roads, above- and below-ground medium-voltage electrical cabling, a substation, an operation and maintenance building, and a permanent meteorological mast, as well as a transmission line and switching station to connect to the provincial power grid.

The Project is considered a Class I undertaking per Schedule A of the Nova Scotia Environmental Assessment (EA) Regulations under the provisions of the provincial *Environment Act*. On behalf of the Proponent, CBCL Limited (CBCL) has prepared this document, with contributions from other firms and consultants that carried out specialized studies, to serve as the EA Registration Document for submission to the Nova Scotia Department of Environment and Climate Change (NSECC).

1.1 Project Title and Proponent

Project Name:	Windy Ridge Wind Power Project
Project Location:	Municipality of Colchester, Nova Scotia
Proponent:	4560536 Nova Scotia Limited
Principal Proponent Contacts:	Matthew Tinari Chief Financial Officer and Chief Strategy Officer EWF 2101-1969 Upper Water Street Halifax, Nova Scotia B3J 3R7 Phone: (902) 292-7010 Email: Windyridgewind@everwindfuels.com Rose Paul, MBA Chief Executive Officer, Bayside Development Corporation

	7 Dillon Street Afton Station, Nova Scotia B0H 1A0 Phone: (902) 386-2380 Email: rose.paul@paqtnkek.ca Darryl McDonald, MBA Chief Executive Officer, Potlotek First Nation 12004 Highway 4 Chapel Island, Nova Scotia B0E 3B0 Phone: (902) 535-3317 Email: dmcdonald@potlotek.ca
Proponent Website	https://everwindfuels.com https://windyridgewind.com
Principal Consultant Contact:	CBCL Limited 1505 Barrington Street, Suite 901 Halifax, NS B3J 2R7 Phone: (902) 421-7241

The Proponent, 4560536 Nova Scotia Limited, is an equity partnership between EWF and the corporate entities of two Mi'kmaq communities: Paqtnkek (Bayside Development Corporation) and Potlotek (Potlotek Development Corporation).

EWF is North America's leading independent green hydrogen developer, receiving the first EA approval in North America for a large-scale green hydrogen project for the Point Tupper Green Hydrogen/Ammonia project – Phase 1. The company owns and operates the deepest ice-free berth on the east coast of North America, with world class access to rail, roads, and pipelines. The company is experienced in fostering meaningful engagement with Project stakeholders and the advancement of social and economic reconciliation.

Bayside Development Corporation, the business arm of Paqtnkek Mi'kmaw Nation, has a vision to maximize future employment and business creation for Paqtnkek community members and beyond. Rose Paul revived a 1962 agreement with the provincial government, leading to the landmark tripartite agreement with provincial and federal authorities. This accord awarded the community a multi-million-dollar highway interchange at Exit 38B, reconnecting them with lands separated since 1960, with Phase One culminating in the Bayside Travel Centre: a new business centre aimed at flourishing business growth, empowerment, and combating colonial impacts. Strategic partnerships underpin Paqtnkek's community economic vision. Collaborations with EWF in the Green Hydrogen and Ammonia sector exemplify this, pushing Paqtnkek towards energy sovereignty and a net-zero contribution to combating global warming.

Potlotek First Nation has a total population of more than 860 registered members and approximately 650 live in the community. There are two strands of community and economic initiatives that align in the community. The community development activities are aligned closely with community needs to build social enterprises that surround employment and work experience for the younger generation. These include the working relationship with the St. Peter's Canal on the Canal Landing project to attract tourists and to serve as a portal to transport tourists from the canal to Potlotek First Nation. Other community development projects integrate employment and training on social enterprise projects like the community greenhouse project that enables youth for gainful experience and employment. The newly created Potlotek Development Corporation will be focusing on the green renewable energy sector and the many potential opportunities that may be had once the green hydrogen-ammonia projects take place. Other partnerships and potential investments are being sought as part of the community's strategic approach.

1.2 Purpose of the Project

The Proponent is proposing to harness wind energy at Windy Ridge to be transmitted via the province's electrical grid to Point Tupper for the purposes of powering a green hydrogen and ammonia production facility. By using wind energy, the Point Tupper Green Hydrogen/Ammonia project will comply with the European Renewable Energy Directive II Renewable Fuels of Non-Biological Origin Standards—internationally the most stringent set of requirements. The facility will generate electrolytic hydrogen production. Hydrogen will be blended with atmospheric nitrogen to synthesize ammonia, producing substantially lower greenhouse gas (GHG) emissions than those of conventional ammonia production methods. Reduction of emissions on a global scale will be supported through international exportation of green ammonia that may be used as a component in fertilizers and fuels.

Regionally, the Project will contribute to the province's goal to reduce GHG emissions by 2030 as per the *Environmental Goals and Climate Change Reduction Act* and concurrent revisions to the Renewable Electricity Regulations under the Nova Scotia *Electricity Act* in 2021 (NSECC, 2022). To conform with the Acts, Nova Scotia Power Incorporated (NSPI) is to procure 80 percent of its energy supply from renewable sources and acquire a minimum of 1,100 GW-hours from independent power producers by 2030—the strictest target of those set by Canadian provinces. An agreement is expected to be established with NSPI for the use of green energy from the Project beyond that consumed by the Point Tupper Green Hydrogen/Ammonia project.

The Project will also support the Municipality of Colchester in achieving its target for net-zero GHG emissions by 2050 as outlined in their *Community Energy and Emissions Plan* (Municipality of the County of Colchester, 2021). Initiatives include the addition of at least 2 MW per year from wind generation, toward which the Project can contribute. The Project will also provide local economic and social benefits such as municipal tax revenues, local jobs, and a stimulus to local businesses, as outlined in Chapter 3 (Consultation and Engagement) and Chapter 13 (Socio-Economic Environment) in this EA.

1.3 Wind Energy Developer

The Proponent has retained Renewable Energy Systems (RES), the world's largest independent renewable energy company, to develop, construct, and initially operate the Project. RES has 43 years of experience in clean energy and has been active in the North American renewable energy market since 1997. RES has delivered more than 24 gigawatts (GW) through more than 360 renewable energy projects globally and supports an operational asset portfolio exceeding 12 GW worldwide. RES has experience with onshore and offshore wind projects, utility scale solar farms, energy storage solutions, transmission, and green hydrogen projects. RES has been engaged as the developer for the Project under a cooperation agreement. RES's construction branch, RES Canada Construction LP, is expected to oversee the construction of the Project and the RES services branch is expected to provide the Project with Balance of Plant (BoP) operation, maintenance, and asset management services.

1.4 Project Location and Setting

The Project takes place on Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq people. The nearest Mi'kmaq communities to the Project are Millbrook First Nation, located approximately 15 kilometres (km) southeast (directly south of Truro); Pictou Landing First Nation, approximately 50 km northeast (near Trenton); and Sipekne'katik First Nation, approximately 50 km south (near Shubenacadie).

The Project is located approximately 6 km northwest of Debert, Nova Scotia, predominantly within a rural area of the Municipality of Colchester (Appendix A, Figure 1.1) having a central coordinate of 45.5337665 N, 63.4428053 W. A portion of the Project, an access road off Route 246, lies within the Municipality of Cumberland. The Project location was selected as RES has an agreement in place with the landowner for use of the private lands, and the area provides a robust wind regime as well as viable NSPI grid interconnection and capacity. An initial constraints analysis was completed prior to development of the Project layout (see Section 2.1 for details on the Project Development Area or PDA); the outer perimeter that bounds the collective properties defines the Initial Constraints Identification Area (ICIA) is shown on Figure 1.2. The Project is laid out in an area for which the Proponent has agreements in place for seven properties, both Crown and privately-owned lands (Table 1.1).

Table 1.1 Property Ownership of Proposed Project Turbine Locations

Property Identification (PID) Number	Ownership
20434692	Northern Timber Nova Scotia Corporation
20434288	Northern Timber Nova Scotia Corporation
20109641	Northern Timber Nova Scotia Corporation
20328340	Northern Timber Nova Scotia Corporation

Property Identification (PID) Number	Ownership
20099123	Nova Scotia Crown
20097234	Nova Scotia Crown
20102059	Nova Scotia Crown

The Project lies within the Nova Scotia Uplands Ecoregion, central to the Cobequid Hills Ecodistrict 340 (Nova Scotia Department of Natural Resources and Renewables (NSDNRR), 2021). The Cobequid Hills Ecodistrict is an elongate upland area stretching from Parrsboro in the west to Pictou in the east. The area is bordered by the steep slopes of the Cobequid Slope Ecodistrict 350 in the south and Cumberland Hills Ecodistrict 540 in the north. According to 2019 Light Detection and Ranging (LiDAR) data available from the province, elevations within the ICIA range from 178.5 to 355.3 metres above sea level (masl). This high elevation exerts a strong influence on the climate of the uplands with harsher winters, higher rainfall, and shorter growing seasons compared to the nearby lowlands (NSDNRR, 2021). The higher elevation in the region is associated with greater wind speeds, which makes it a good candidate area for wind power generation. According to the Canadian Wind Atlas (Environment and Climate Change Canada (ECCC), 2018), the mean annual wind speed within the ICIA is approximately 7.96 metres per second (m/s) at a height of 80 metres (m). A meteorological (MET) tower installed by RES in the northwestern portion of the ICIA (coordinates of 45.580378 N, 63.481302 W) has recorded a mean wind speed of 7.85 m/s, predominantly southwest. Wind data has been collected by the MET tower between September 2011 to March 2013, and from August 2023 to present.

Deposits of resistant pre-Carboniferous metamorphic sediments, volcanic deposits, and granites occur within the Nova Scotia Uplands Ecoregion (NSDNRR, 2021). Lakes are relatively scarce within the Ecoregion, but numerous fast-flowing rivers with headwaters on the plateaus carve out steep-sided ravines. The Wentworth Valley Wilderness Area borders the western side of the ICIA. Wetlands, watercourses, and woodlands in the ICIA provide a habitat for a variety of flora and fauna. Acadian forests dominated by shade-tolerant hardwood species like Sugar Maple (*Acer saccharum*), Yellow Birch (*Betula alleghaniensis*), and American Beech (*Fagus grandifolia*) are present on hill crests and slopes with medium to rich soils. In contrast, shade-tolerant mixedwood forests are more dominant in the steep-sided ravines, while softwood stands occur at higher elevations with moist soils in level terrain.

The ICIA is interspersed with trails used for off-roading activities and municipal roads leading to residences or camps mostly outside the ICIA. The ICIA itself is sparsely populated. The properties are characterized by mostly fragmented forests containing harvested areas and existing roads, trails, and small mineral rock excavations. Global Forest Watch, an online platform that collects data and provides tools for monitoring forests all over the world, provides Tree Cover Loss data for the ICIA (Global Forest Watch, 2024). The data shows that substantial changes in forest cover have occurred between 2001 and 2022, as illustrated in Figure 1.3.

The NSDNRR Significant Species and Habitat Database shows an important deer wintering area on the southern slopes of the Cobequid Slopes Ecodistrict, which overlaps with southern portions of the ICIA and Other Habitat northwest of the ICIA (Figure 1.4). Several conserved and protected areas occur outside but within 5 km of the ICIA (see Atlantic Canada Conservation Data Centre (AC CDC) Data Report (2023) in Appendix B):

- Wentworth Valley Wilderness Area (400 m west of the PDA)
- Cook Conservation Lands (1.9 km north of the PDA)
- Wentworth Conservation Lands (2.8 km northwest of the PDA)
- French River Watershed Protected Water Area (immediately adjacent to the PDA)
- Douglas Meadow Brook Wilderness Area (2.3 km north of the PDA)

Staples Brook Nature Reserve (2.0 km southeast of the PDA) is pending formal designation as a Nature Reserve. In addition, two ecologically significant areas northwest of Folly Lake are within 5 km of the ICIA (Folly Lake SES and Smith Brook SES) and a Parks Canada designated national historic site, the Debert Palaeo-Indian Site National Historic Site of Canada, occurs approximately 4 km south of the ICIA. These ecologically and culturally significant areas are shown on Figure 1.5.

1.5 Regulatory Framework

Wind projects that produce 2 MW or more are considered Class I undertakings per Schedule A of the Nova Scotia EA Regulations under the provisions of the *Environment Act*, requiring Registration with NSECC to initiate the EA process. This EA Registration Document was prepared by CBCL in accordance with the *Guide to Preparing an EA Registration Document for Wind Power Projects in Nova Scotia* (the Guide; NSECC, 2021). Under the Guide, the Project is considered a Category 4 wind project, which the Guide defines as having the highest level of potential risk to wildlife and their habitats due to its use of turbines exceeding 150 m in height. Based on the Guide and the number of wind turbines, the Project size is considered “Large” (containing between 41 and 100 turbines).

The Project does not require a federal impact assessment, as it will not be located on federal lands and is not classified as a designated project per the Physical Activities Regulations under the *Impact Assessment Act*.

Presented in Table 1.2 is a summary of the federal, provincial, and municipal regulatory permits, approvals, or notifications that may be applicable to the Project, along with the status of requirements (as of the date of this report).

Table 1.2 Summary of Regulatory Permits, Approvals and Notifications

Permit/Approval/ Notification	Regulatory Authority	Application/Permit Status
Federal		
Fisheries Act Authorization	Fisheries and Oceans Canada (DFO)	A Request for Review will be submitted to DFO after the detailed design phase, and before construction within watercourses or where activities have the potential to impact fish and fish habitat.
Species at Risk Act (SARA) Permit	ECCC, DFO	A SARA Permit was procured from DFO to conduct fish sampling in watersheds that contain Inner Bay of Fundy Atlantic Salmon as part of the field surveys.
Canadian Navigable Waters Act Notification of a Work	Transport Canada	Required for minor works in a non-scheduled waterway, such as watercourse crossings. Will be submitted prior to construction, if required.
Operations Interference Clearance	Department of National Defence (DND)	Required for confirmation that turbines will not cause electromagnetic interference (EMI) in communications used by DND. DND has confirmed no objections to the Project.
Weather Radar Interference Approval	ECCC Meteorological Service of Canada	Required for confirmation that turbines will not cause EMI in communications used by weather stations. To be confirmed prior to construction.
Aeronautical Assessment Obstacle Evaluation	Transport Canada	Required for marking and lighting of obstacles (e.g., turbines). To be completed prior to construction.
Land Use Approval	NAV CANADA	Required for confirmation that turbines will not cause EMI on communications. Land use #23-3299 was provided by NAV CANADA.
Notification of Project	Royal Canadian Mounted Police (RCMP)	RCMP has confirmed that the turbines are not anticipated to interfere with their operations, but to follow-up with Bell Mobility Inc. Bell Mobility Inc. has confirmed that no interference is anticipated.
Provincial		
Crown Lands Application	NSDNRR	Application for Project components that overlap Crown lands to be submitted following EA Approval.
Water Approval for Watercourse Alteration	NSECC	Application for watercourse alteration to be submitted following EA Approval.

Permit/Approval/ Notification	Regulatory Authority	Application/Permit Status
Wetland Alteration Approval	NSECC	Application for wetland alteration to be submitted following EA Approval.
Water Approval	NSECC	Required if there is a need to draw surface water or groundwater for use during construction and/or operation that exceeds 23,000 litres per day.
Heritage Research Permit	Nova Scotia Department of Communities, Culture, Tourism and Heritage (NSCCTH)	Permits received for Archaeological Research Impact Assessment.
Special Move Permit	Nova Scotia Department of Public Works (NSDPW)	Application to be submitted prior to mobilization of oversize vehicles on public roads.
Work within Highway Right of Way Permit	NSDPW	Application to be submitted in advance of planned work within a highway right-of-way (RoW).
Endangered Species Permit	NSDNRR	Will be required if species at risk (SAR) listed under the Nova Scotia *Endangered Species Act* (NSESA) will be directly impacted. To be determined through consultation with NSDNRR.
Municipal		
Licence for a Wind Power Project – Chapter 56	Municipality of Colchester	Licence application will be submitted following EA Approval.
Development Permit, Land Use By-law	Municipality of Cumberland	Permit application for the portion of the access road construction/upgrades that lies within Cumberland County (off Route 246) will be submitted following EA approval.

1.6 Funding

The Proponent is arranging debt project financing. The Canadian Imperial Bank of Commerce and Citibank, two leading investment banks, are engaged to lead the financing of the Project. Commercial banks, along with additional funding sources, have been approached to participate in the Project as a lender, and various financing support letters have been received for the funding. Equity funding for the Project has been secured.

2 Project Description

The Project will comprise 49 turbines, a network of upgraded and new access roads, above-ground and below-ground medium-voltage electrical collector lines, an electrical substation, an operation and maintenance building, and a transmission line for interconnection to the NSPI grid. Temporary laydown areas will be required during construction. Figure 2.1 illustrates a Project layout of 52 turbines—three, however, are alternate locations that are included in the EA to allow flexibility during detailed design. The Project is intended to provide electricity to the proposed Point Tupper Green Hydrogen/Ammonia project – Phase 1.

2.1 Potential Development Area and Footprint

The Potential Development Area (PDA), covering approximately 1,468 hectares (ha), includes the access road network, turbine pads, power infrastructure (transmission line, collector lines, substation and operations and maintenance building) and laydown areas. The access roads connecting to the main collector highways or public access roads are also considered part of the PDA. The Project Footprint is the permanent space occupied by the Project, including the access roads, turbine pads, and infrastructure (excluding laydown areas) and falls entirely within the PDA.

The estimated extent of disturbance in the PDA is an exaggerated estimate that will ultimately be much smaller after detailed design is complete. The final extent of the PDA is expected to be approximately half the area described in this EA to assess the potential impacts of the Project; the following rationale has been used for this estimate:

- Estimates for the total span of the Project Footprint, as well as the PDA and its components, are based on the areal extent of 52 turbines shown on the EA figures herein. A total of 49 of the 52 turbine locations will be constructed. The Project design includes three alternative locations as a contingency measure, in case one of the intended turbine locations is deemed to be unsuitable for environmental or structural reasons.
- Estimates of clearing and disturbance for road construction are based on the entire road network in the PDA as shown on the EA figures herein, which includes both existing roads and new roads. The PDA includes approximately 116 km of existing

roads and approximately 34 km of new roads to be constructed. Some of the road segments shown in the PDA are not likely to be required; the extent of new road construction and existing road upgrades is expected to be less than stated herein.
- The PDA shown on the EA figures herein overestimates the area required for clearing, site preparation, and construction. For example, an area of approximately 1.5 ha (i.e., 70 m radius) is expected to be cleared around each turbine; however, the PDA shows a larger area of approximately 7 ha (i.e., 150 m radius).
- While four temporary laydown areas are being proposed, it is likely only up to two will be required during construction.
- Estimates of clearing and disturbance for Project construction are based on the entire PDA being cleared; however, a substantial portion of the PDA has been previously disturbed or cleared and will not require clearing.

2.2 Siting Considerations

The Project is situated primarily within private lands that have experienced historical and ongoing disturbance from forestry, recreation, and quarrying activities. An initial environmental constraints analysis was undertaken prior to configuring the layout of the PDA. Boundaries of sensitive receptors, environmental features, and local and regional infrastructure were mapped as part of the analysis. Where applicable, setback distances determined from relevant legislation, best management practices, and through consultation with government regulators were then applied to the boundaries. The preliminary version of the PDA layout was designed to first avoid and second minimize adverse environmental effects, based on the results of the constraints analysis, while also considering the following factors:

- Maximizing areas with the highest wind potential
- Maximizing use of existing disturbed areas and road networks
- Minimizing noise and visual disturbance
- Minimizing interference with radar, aviation, and communications equipment as much as possible
- Adhering to regulated setbacks (Table 2.1)

Further modifications to the PDA layout occurred following the results of the field studies, modelling studies, and information received during engagement with the Mi’kmaq of Nova Scotia and the public. Efforts have been and will continue to be made to avoid siting turbines on or directly adjacent to wetlands, watercourses, and old growth forests to the greatest possible extent. Adjustments were made to the PDA layout following the outcomes of public and regulator engagement. These changes are illustrated on Figure 2.2 and generally included the following:

- Adjustment of turbine model to reduce the number of turbines required to achieve desired electricity output
- Removal of turbines from the French River Watershed
- Removal of turbines from Crown land to avoid disturbance to mature forest

- Removal and realignment of access roads in Crown land and near Frog Lake
- Removal of turbines from Frog Lake area, including two on crown land, to reduce impact to local recreation
- Removal of turbines closest to Folly Lake to reduce visual impact

A summary of the turbine setback distances applied to the PDA layout and relevant references are provided in Table 2.1.

Table 2.1 Turbine Setback Distances

Feature	Setback Distance	Reference
Protected Areas, Provincial Parks, and Park Reserves	> 500 m from Wentworth Valley Wilderness Area and Wentworth Provincial Park	The Guide
Wetlands of Special Significance	≥ 30 m measured from the area of disturbance (where possible)	Best Practices, NSECC
Lakes	≥ 30 m measured from the area of disturbance (where possible)	Best Practices, NSECC
Old Growth Forests	≥ 100 m on Crown land	An Old-Growth Policy for Nova Scotia
Residences (Civic Addresses)	> 2,000 m based on a total turbine height of 199.5 m	Municipality of Colchester Chapter 56 – Wind Turbine Development By-law
External Property Boundaries	≥ the wind turbine height (199.5 m)	Municipality of Colchester Chapter 56 – Wind Turbine Development By-law
Public Roads	≥ the wind turbine height (199.5 m)	Best practice
Noise	Turbine operational noise levels of < 40 dBA from the exterior of receptors[1]	The Guide
Shadow Flicker	Distance required such that no receptor will receive 30 minutes or more per day, and/or 30 hours or more per year of shadow flicker.	The Guide

[1]Per the Guide, a receptor is considered "an adjacent dwelling including a building or structure that contains one or more dwellings, educational facility, daycare/nursery, place of worship, hospital, senior's residence and could also include a vacant lot where appropriate zoning or permits to build such dwellings have been approved".

2.3 Project Schedule

The necessary clearing will be performed during late fall and winter of 2024/25. Project construction is anticipated to begin in spring of 2025 and be completed over a period of approximately 20 months as outlined in Table 2.2.

Table 2.2 Project Construction Schedule

Construction Activity	Estimated Timeline
Site Clearing	Fall 2024 to March 2025
Site Preparation and Access Roads	May to November 2025
Foundation Installation	June 2025 to September 2026
Collector System and Substation Installation	May 2025 to September 2026
Turbine Delivery and Assembly	May to October 2026
Testing and Commissioning	July to December 2026

Commissioning is planned for late 2026. The Project will operate from the commercial operation date through to decommissioning, with an anticipated lifespan of at least 35 years.

2.4 Project Components

2.4.1 Access Roads

The Project will require approximately 150 km of access roads, 116 km (77 percent) of which are existing gravel or paved roads. Most existing roads will require upgrades. New gravel road sections will be required where turbines branch from the existing roads, and alternate access routes are proposed, resulting in approximately 34 km (23 percent) of new road construction. The proposed entrances to the PDA will use existing access roads. One proposed access route is via the Axe Handle Factory Road from Route 246. There are also four proposed points of access on Trunk 4, including the Lafarge public road and, furthest south, Plains Road. Multiple access points are being evaluated based on technical feasibility and social impact but will not all be used. The Proponent is planning multiple points of access in order to minimize traffic impacts at any one location.

The design of the access roads will adhere to established standards, requirements for turbine transport specifications, and best practices. The access roads will serve as routes for mobilizing equipment and personnel to and from the PDA during all phases of the Project. The roads, therefore, must provide adequate bearing capacity and turning radii to accommodate the transport of heavy trucks, turbine components, and construction equipment—including cranes. Upgrades will be required in areas that do not currently meet these specifications.

Specific requirements for ditching, culverts, and bridge installation/repairs will be determined during detailed Project design to meet industry standards.

2.4.2 Turbines

The Project will consist of 49 Nordex N163 wind turbines. The turbine model under consideration has an individual generating capacity of 7 MW and stands at 118 m in hub height—a total height of 199.5 m including an 81.5 m blade length. Each turbine will consist of a tower secured to a concrete foundation at the base, nacelle generator, and three blades. The rotors will have a maximum diameter of 163 m (a maximum rotor-swept zone of 20,867 square metres (m^2)). The blade to ground clearance is approximately 36.5 m. Each turbine has three independent pitch control systems with emergency power supply, rotor brake, and a rotor lock controlled remotely. The footprint for each turbine foundation will cover an area of 0.12 ha. There will be a crane pad at the base of each turbine and surrounding the base of each turbine will be a gravel ring.

The Proponent expects to use a lighting mitigation system on the turbines to be controlled by an automated aircraft detection lighting system (ADLS) that meets NAV CANADA and Transport Canada requirements for aviation.

2.4.3 Power Lines and Substation

2.4.3.1 Collector System

A 34.5 kilovolt (kV) underground turbine collector circuit (medium voltage electrical cabling) will relay power generated from each turbine to the base of wood or steel monopoles that will support the overhead collector lines. Underground collector lines will extend approximately 100 m from the turbine to the overhead collector lines. The overhead collector line system will run parallel to the access road RoW and will converge at the substation. Routing is expected to be optimized as part of detailed design.

2.4.3.2 Substation and Transmission Line

The substation, situated central to the PDA, is required to convert voltage received from the turbine collector system before the power connects to the NSPI grid system as per the NSPI Interconnection Procedure and Transmission System Interconnection Requirements. The substation will have a maximum footprint of 1 ha and the operation and maintenance building, located adjacent to the substation, will have a footprint of up to 0.4 ha (Figure 2.1).

A new aboveground transmission line approximately 10 km in length will be routed from the substation to the NSPI 345 kV power line in the corridor running perpendicular to Trunk Highway 4, in the far southwest corner of the PDA (Figure 2.1). The transmission line design will be determined during detailed design but will likely consist of steel lattice towers or wood-pole H-frame structures. A System Impact Study is currently being undertaken by NSPI and should any grid upgrades be required, these will be paid for by the Proponent.

2.4.3.3 Fencing

For public safety, perimeter chain link fence (approximately 2 m in height) will be installed around the substation and operation and maintenance building to restrict access by unauthorized people. No other restrictive fencing is anticipated on other Project infrastructure.

2.4.4 Temporary Laydown Areas

At the base of each turbine will be a designated temporary working/laydown area of approximately 1.5 ha, where the turbine components (the hub, nacelle, generator, and blades) will be stored just prior to assembly (Figure 2.3).

There are four additional rectangular temporary laydown areas, covering a combined area of approximately 29 ha, proposed within the PDA to store other onsite equipment and components of infrastructure during construction (Figure 2.1):

- One in the northern portion of the PDA, adjacent to the existing road between T4 and T5
- One in the southern portion of the PDA, between T40 and T41
- One in the eastern portion of the PDA, adjacent to the collector road near T72
- One in the central portion of the PDA, near T52

While four laydown areas are being proposed, it is likely only up to two will ultimately be required during construction. Final laydown area size and locations will be determined during detailed design.

2.5 Construction

It is anticipated that the construction phase of the Project will take place over two years, from late fall 2024 to late fall 2026. Construction will involve site preparation, access road construction and modifications, materials and equipment delivery and storage, installation of infrastructure, and restoration of the temporary areas needed to facilitate construction within the PDA. Testing and commissioning of the Project will mark the end of the construction phase.

Approximately 200 to 300 workers will be necessary during the construction phase. Accommodations for traveling workers will be facilitated through established commercial lodging facilities in the region, specifically in Truro and Halifax, Nova Scotia. Construction is to occur predominantly within daytime hours, seven days per week.

The Proponent is in negotiations with the Municipality of Colchester to sign a binding community benefits agreement that includes a commitment to use local contractors whenever possible.

2.5.1 Site Preparation

Site preparation activities will consist of clearing, grubbing, excavating, grading and compaction, and ditching, which will require installation of erosion and sediment control (ESC) measures. Clearing within 30 m of watercourses will be manually performed.

Grubbing will be conducted using a root rake or similar equipment capable of removing roots from cleared vegetation while preserving the topsoil for salvage. Excavators will remove both topsoil and overburden, which will then be stockpiled for potential reuse or disposal. Topsoil will be stored separately, and away from aquatic features, for restoration of temporary laydown and construction areas. Grading and leveling in the PDA will be accomplished using heavy equipment such as graders, dozers, and scrapers.

Site preparation activities will be limited to the extent possible to minimize adverse effects to the environment, while providing sufficient space for development to occur. ESC and other suitable mitigation measures will be put in place, and soil conservation principles will be applied in accordance with construction regulations, standards, and best practices.

Turbine pads may require a cleared area of up to 3 ha per structure, but many are placed in previously disturbed areas to minimize clearing. Wood cleared on Crown land will be chipped on site; Northern Timber will handle roundwood produced on their privately-owned land. Excavated material during construction will be stockpiled on site and either reserved for reuse or disposed of following regulations and adhering to best practices.

Geotechnical investigation, including targeted clearing where required and borehole drilling in areas designated for the turbine pads, is in progress. Earthworks will be required for the development of the access roads, including ditches/drainage and the turbine pads.

The approximate area designated for clearing as shown in the PDA is estimated to be in the order of approximately 917 ha, including the transmission line RoW, turbine pads, new access roads, existing access road ditches, substation, operation and maintenance building, and temporary laydown areas. As described in Section 2.1, after detailed design, the area to be cleared is expected to be approximately half this amount or less.

2.5.2 Access Road Construction and Modification

Road surfaces, both new and upgraded, will use clean fill gravel. The clean fill will be sourced from local quarries and borrow pits and stored temporarily until required for application. Excess clean fill and materials that are excavated during road construction will be stored for reuse or disposed of in adherence to applicable regulations and road construction standards and best practices. The anticipated RoW of the access roads, including ditches, existing roads, and turbine access connection spurs, will be a maximum width of 11 m. The maximum gradient of each road will be approximately 8 percent, which may require cut and fill to achieve the required gradient in some sections. Blasting may be required in some areas to remove rock. The final footprint will have a road width of 5 m. Ditches will be established with ESC measures appropriate for the drainage and erosion potential. Culverts and/or bridges will be installed at watercourse crossings where new roads are constructed. For the existing roads within the PDA, the decision to replace culverts at watercourse crossings will depend on their current condition. The specific number of culverts to be replaced will be determined during the detailed design phase.

2.5.3 Material and Equipment Delivery and Storage

Construction equipment will be mobilized to the PDA from local contractors and will consist of graders, crushers, bulldozers, rollers, excavators, cranes, and light to heavy-duty trucks. It is estimated that there may be up to 200 trucks needed per day during the peak construction period.

2.5.3.1 Transportation

Turbine components will be transported to the province via ship to an existing port, which is expected to be Liverpool or Sheet Harbour, and be transported approximately 280 km to the PDA via existing highways. Turbine components will then be mobilized to the temporary staging area within each designated turbine pad prior to assembly.

Traffic management will be required on local and provincial roads as well as recreational trails within the PDA. This will include communication protocols such as sharing proposed transportation schedules and routes within the community as well as the recreational off-road users via their organizations. The Proponent also intends to coordinate traffic with the proposed Higgins Mountain project which is adjacent to the Project and will be under construction at the same time. A Special Move Permit will be procured from NSDPW to mobilize vehicles beyond the legal weight or dimensions on a public road in the province.

2.5.3.2 Temporary Lay-down Areas

A radius of approximately 70 m around each turbine coordinate will be considered a working area to accommodate the equipment and turbine components during assembly. An area of approximately 1.5 ha is anticipated to be cleared for a laydown area at the base of each turbine. A cone shaped tagline area for crane lifts has been designed to extend beyond the centre of each turbine in parallel with the access road by approximately 105 m (Figure 2.3). The cone-shaped tagline is a designated area free of obstructions adjacent to the turbine foundation where ground crew guide and control the ascent of the tower and its components during the installation process. It serves as a safety and operational feature to allow adequate space and freedom of movement during lifting, reducing the risk of entanglements or disruptions.

The total combined area of the four rectangular laydown areas in the northern and southern portions of the Project is approximately 29 ha. While four laydown areas have been proposed, only up to two will ultimately be required. Within each laydown area will be segregated zones designated for storage of fuel, aggregate, and other materials. This material will be stored a minimum of 30 m from watercourses and wetlands. Appropriate ESC measures will be employed for aggregate storage. Each laydown area configuration will prioritize space utilization and safety with demarcations, signage, and controlled pathways while implementing measures for erosion control and compliance with environmental regulations and best practices.

2.5.4 Infrastructure Installation

This section addresses the construction activities related to the installation of Project infrastructure, including the turbines, power lines, electrical substation and operation and maintenance building, lighting, and security fencing.

2.5.4.1 Turbines

The turbine components described in Section 2.4.2 will be installed sequentially.

Foundations

To provide stability and proper drainage for the wind turbine pads, clean-fill gravel or crushed stone will be used as the foundational material. The turbine foundation design will be finalised once the geotechnical investigation has been completed but it is expected that turbines will be stabilized via a reinforced concrete gravity base foundation with a diameter of 30 m. The area for the foundation will be excavated to a depth of approximately 3 to 7 m; the height of each foundation being approximately 3.2 to 4 m. Concrete may be sourced from Quality Concrete at the Truro Industrial Park with the possibility of an onsite batch plant or from another local provider.

Excavation may occur via drilling, or localized blasting if bedrock is present and determined not to be a suitable base. If required, blasting activities will be completed by a qualified blasting contractor and will follow the Nova Scotia Blasting Safety Regulations under the *Occupational Health and Safety Act*. Following excavation, the reinforcement bar supports will be laid and the concrete poured. After the concrete has finished curing, the foundation excavation, apart from the concrete pedestal, will be backfilled to ground level.

Assembly

The turbine assembly will consist of installing the tower sections, nacelle, hub, and three-blade rotors in sequence. A crane will be mobilized to each working area and stabilized on a 30.5 m by 20 m pad during construction. The turbines will be erected in pieces, starting with towers being hoisted vertically from the designated laydown areas by the crane and secured within the turbine foundation. Once secured, the nacelle, hub, and turbine blades will be independently lifted and installed via crane.

2.5.4.2 Power Lines and Substation

Collector Lines

A 34.5 kV turbine collector circuit (medium voltage electrical cabling) will be installed below ground surface to relay power from each turbine to the collector power line. The collector line will be strung overhead on wood or steel monopoles leading to the electrical substation. The power poles will be installed as per standard procedures. The spacing of the poles will be determined during detailed design.

Transmission Line and Substation

Collector lines will converge at the Project's substation (Figure 2.1), where the voltage will be converted to 345 kV for interconnection to the NSPI power grid. The substation will be constructed as a permanent structure likely on piles. An operation and maintenance building will be situated within the substation site to provide a base of operations for personnel responsible to maintain and oversee the equipment.

2.5.4.3 Security

The installation of the perimeter chain link fence around the substation and operation and maintenance building will begin by digging post holes at regular intervals and setting steel posts 2 m in height, backfilled by concrete. Top rails and tension bands will be subsequently secured at the top of the fence connecting to the terminal posts. The chain link fabric will be connected to the line posts, adding gates, and then tensioning and trimming excess fabric.

2.5.5 Restoration of Temporary Areas

Where possible, topsoil preservation will be prioritized during grubbing activities, with the intent of replacing it after temporary laydown areas are no longer in use. Additionally, decompaction and scarification of temporary construction areas will be undertaken to restore their natural state. Areas of exposed soil will be revegetated progressively during Project construction, using only non-invasive (native) plant species for restoration.

2.5.6 Testing and Commissioning

The final activity of the construction phase is to test the facility’s operative conditions and make physical adjustments as needed to Project components. Power transmission to the provincial grid will adhere to the NSPI *Transmission System Interconnection Requirements* (NSPI, 2021). Operation will commence when the required approvals and authorizations are in place to supply electricity to the provincial power grid via the existing 345 kV transmission line.

2.6 Operation and Maintenance

It is anticipated that the Project will be commissioned in late 2026 and that operation and maintenance will occur for a minimum of 35 years, during which the facility will be contributing power to the NSPI electrical grid. The facility will require oversight and repairs as needed for the turbines, roads, power lines, and substation as well as the management of vegetation and the safety and security of the site. The RES services branch is expected to provide the Project with BoP operation and maintenance and asset management services.

2.6.1 Turbine Operation and Maintenance

The wind turbines will operate automatically. A computerized system, or programmable logic control, will continuously monitor the operating parameters. When there is no wind, the wind turbines will remain idle until the cut-in speed is reached. At the cut-in speed, or minimum required wind speed of 3 m/s, the blades will begin rotating and electrical energy will be produced. When the wind turbines reach a cut-out speed of 20 m/s, which is the maximum wind speed the turbine is designed to handle, safety measures are initiated. The turbine's control system automatically shuts the turbine down, ceasing the rotation of rotor blades to prevent damage from high winds. Periodic shutdowns will occur during maintenance or during extreme weather or icy conditions when the risk of ice throw is high.

Turbine lighting will meet NAV CANADA and Transport Canada requirements for aviation, which may be under control of an ADLS. The Proponent expects to use this system, which automizes lighting of the turbine array to minimize light pollution using aircraft radar transponders to detect oncoming air traffic. The automated system would allow the turbine lighting to be turned off most of the time during operation, activated by incoming air traffic within 5.5 km (3 nautical miles) of a transponder situated on the hub of each turbine.

Required maintenance will be completed in accordance with the manufacturer’s specifications, industry best practices, and internal procedures and standards. Regular preventative and predictive maintenance activities involve servicing of components to avoid failures and enable proper function. Maintenance activities include the following:

- Inspecting and assessing mechanical and electrical components
- Applying lubricants and coolants to moving parts
- Examining and tightening bolts
- Repairing or replacing damaged or faulty components
- Fixing electrical systems
- Cleaning and maintaining blades to remove debris
- Updating or upgrading software systems and control mechanisms
- Performing health and safety inspections
- Running diagnostics on monitoring systems

There will be 12 to 20 personnel performing operation and maintenance employed on both a part-time and full-time basis when required. Key roles of onsite personnel include a site manager, high voltage and wind turbine technicians, road maintenance workers, vegetation management service providers, snow removal providers, administrative support, and inventory/materials management.

2.6.2 Road Maintenance

Onsite staff will notify the facility management when maintenance is required. Onsite roads will require typical repairs to ditches, culverts, shoulders, and signage. Occasional clearing of brush may be necessary to maintain clearance and onsite litter will be collected for disposal. Washout and pothole repairs will be necessary during the lifetime of the Project. Gravel roads may need occasional resurfacing and grading as well as vegetation clearance at the shoulders (e.g., brush cutting). The Proponent is working with local snowmobile clubs to determine a strategy for winter snow management on site roads that overlap with the club trail systems. Possible winter maintenance strategies include the use of tracked vehicles to reduce snow removal, positioning of roads adjacent to trails to facilitate pushing snow from the road onto the trails, and snow removal where required. The application of salt may be used as a last resort in areas where de-icing is required and alternative strategies are not possible.

2.6.3 Power Line and Substation and Operation and Maintenance Building

Maintenance of power lines, substation, and the operation and maintenance building may include repair and/or replacement of components such as utility poles, transformers, cables, connections and splices, switchgears, and circuit breakers, computer systems, and office equipment. The housing infrastructure of the substation enclosure and operation and maintenance building may also need repairs, such as roofing replacement, over the course of the Project operation.

2.6.4 Vegetation Management

Onsite vegetation management within the Project footprint will involve the systematic maintenance and control of plant growth in the areas directly surrounding the turbines, substation, and transmission lines. Vegetation control will be necessary to maintain the safety and environmental features of the facility grounds and will include trimming and removal of vegetation to prevent contact that could damage or disrupt equipment. The *Nova Scotia Industrial Vegetation Management Manual* outlines procedures for industrial vegetation managers (Nova Scotia Department of Environment and Labour, 1999). Management practices will be further developed as described in Section 2.9 of the manual.

2.6.5 Safety and Security

The selected turbines are equipped with advanced safety features and technology to maintain operation while safeguarding both people and systems. Safety-related parameters within the system control are continuously monitored. Data from the safety sensors are transmitted to the safety controller for evaluation. If specific parameters are exceeded, the system is stopped using actuators and placed in a secure state.

Different brake programs are activated based on the specific cause for cut-out (i.e., enabling of automatic shut down of the wind turbine). In instances of external factors like high wind speeds or temperatures below the operational range, the wind turbine is softly slowed through adjustments to the rotor blades. Additional safety protocols are employed to safely halt operations for maintenance purposes.

During maintenance activities that pose safety risks to the public, clear signage will be erected to notify the public about the maintenance activities and potential hazards. A Traffic Management Plan will be developed to avoid potential risks to public safety on access roads and neighbouring areas.

Onsite personnel will regularly monitor the condition of the fence. Fencing will require routine maintenance to preserve the security of the substation.

2.7 Waste and Emissions

This section summarizes the waste and emission sources and sinks pertinent to the Project, emphasizing the assessment and measurement of GHG emissions for the Project's duration. Aside from GHGs, the Project will emit noise, light, and fugitive dust/particulates and generate waste, primarily during construction. This section focuses on the characterization and quantification of GHG emissions during all Project phases (construction, operation and maintenance, and decommissioning).

The generic Environmental Protection Plan (EPP) used by NSDPW will be referenced for monitoring emissions and air quality at the Project site (NSDPW, 2007). The contractor is responsible for monitoring the equipment used during construction to maintain good operating condition. Non-idling and reduced speed policies may be considered during all Project phases to minimize adverse effects on local air quality, soil and water quality, and GHG emissions. The NSDPW EPP also provides guidelines for waste management as well as the handling and storage of petroleum, oils, and lubricants (POL).

2.7.1 Waste Management

Hazardous waste generated during the Project—including used POL, oil filters, solvents, and batteries—will be segregated, stored, transported, and handled in accordance with regulatory requirements and disposed of at an approved hazardous recycling or disposal facility. Non-hazardous waste will be handled in a similar manner but stored and disposed of at an approved non-hazardous recycling or disposal facility. Construction debris, such as concrete and metal scraps, will be stored, handled, and disposed of or recycled in abidance with municipal by-laws and provincial regulations. Excess soil and excavated materials that are unsuitable for reuse, cleared vegetation, and unused aggregates will be stockpiled in laydown areas for offsite disposal, in accordance with applicable regulations, after the completion of construction activities.

2.7.2 Non-GHG Emissions

During the construction and decommissioning phases, relevant sources of noise emissions include heavy machinery such as excavators, bulldozers, cranes, blasting equipment, and trucks for transporting materials. All construction activities contribute some form of noise to the baseline environment, while only certain types of decommissioning activities create noise (e.g., noise during revegetation will be limited). Dust can be generated from site preparation activities and vehicular movement. Dry weather conditions exacerbate dust emissions. While construction and decommissioning will predominantly occur during daytime hours, there may be times where these activities extend into the night. Artificial lighting used during nighttime construction activities, including site lighting, vehicle lights, and temporary construction lighting, contributes to light emissions. During construction, activities like grading, excavation, and earthmoving can disturb soil and potentially lead to increased runoff and sediment transport. Proper stormwater management, ESC measures, and spill response and prevention will be required. Other applicable mitigation measures will be implemented to minimize the quantity of noise, dust, light emissions, and stormwater within and outside the PDA.

During the operation and maintenance phase, the primary source of noise will be the operation of wind turbines due to the rotation of the blades, mechanical components, and the operation of the generator and gearbox. Sources of noise during maintenance will be similar to the construction phase depending on the activity, though to a lesser degree. Dust emitted during operation will be minimal; however, dust can be generated from vehicle movement and access roads during monitoring and maintenance. Lighting during operation is expected to be minimal, even more so if the turbines are equipped with an ADLS. Artificial lighting may be required during maintenance depending on the activity required. Like the construction and decommissioning phases, suitable mitigation measures will be employed to limit emissions during the operation and maintenance phase.

2.7.3 Project GHG Emissions Sources and Sinks

This section was prepared in accordance with International Standards Organization 14064-1: 2018, Greenhouse gases*, Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals*. Several assumptions were made to calculate the GHG emissions. Refer to Section 2.1 for an explanation of the assumptions and overestimates related to clearing and construction required for the Project.

2.7.3.1 Construction Phase

Access Roads and Laydown Areas

The process of developing new roads, improving existing roads, clearing new transmission corridors, and preparing laydown areas will necessitate the clearing of vegetation and overburden, leading to the generation of GHG emissions. The construction of new and upgraded roads as well as the clearing needed for each turbine site will require the removal of existing vegetation as well as some temporary or permanent removal of the organic-rich natural overburden in most of the Project Footprint. A review of forestry layers in the provincial geographic information system (GIS) database of the Project site, as well as the Global Forest Watch database (Global Forest Watch, 2024), was used to estimate the current vegetation cover. These databases do not account for more recent forest loss as a result of windfall such as during Hurricane Fiona in September 2022. Using these databases, the following estimates were derived of vegetation cover at each proposed turbine site:

- Mature mixed Acadian Forest – 32 sites
- Young mixed forest – 14 sites
- Non forested meadow/shrub – 3 sites

Across the entire PDA, the database yielded the following estimate of vegetation cover:

- Mature mixed Acadian forest – 67 percent
- Young mixed forest – 28 percent
- Non forested meadow/shrub – 5 percent

Carbon sequestration potential for each vegetation type is estimated as follows:

- Mature forest – 1.7 tonnes/hectare/year (t/ha/yr) (Giffen et al., 2022)
- Young forest – 0.2 t/ha/yr (Natural Resources Canada, 2022)
- Non forested meadow/shrub – 0.05 t/ha/yr (Natural Resources Canada, 2022)

Each turbine site is expected to require a clearing with a radius of approximately 70 m resulting in a total cleared area of approximately 1.5 ha. It is estimated that 150 km of access roads will be required within the PDA to reach the 49 turbine sites and provide access points to the provincial road network. The road network in the PDA is expected to be composed of 116 km of upgraded existing roads and 34 km of new roads. Existing roads in the PDA are estimated to have a 5 m clearing. Cleared RoWs for these roads are assumed to require 25 m widths on straight sections and 59 m on curves to allow for the turning radius of the longest single component to be transported, which would be a turbine blade. Assumptions are that roads will be 75 percent straights and 25 percent curves. The laydown areas are expected to require a total area of approximately 29 ha while the substation and operation and maintenance building site is expected to require approximately 2.5 ha. The new double transmission line corridor to connect from the substation to the existing NSPI 345 kV transmission is assumed to require a total area of approximately 77 ha. Using these numbers yield the quantities of carbon sequestration loss attributed to PDA development shown in Table 2.3.

Table 2.3 Sequestration Loss Attributed to PDA Development

Category	Current Vegetation			Total Sequestration (T per year)
	Type	Area (ha)	Sequestration Intensity (t/ha/yr)	
Turbine Site	Mature Forest	48	1.7	81.6
	Young Forest	21	0.2	4.2
	Meadow	4.5	0.05	0.2
Updated Road	Mature Forest	221.5	1.7	376.5
	Young Forest	92.6	0.2	18.5
	Meadow	16.5	0.05	0.8
New Road	Mature Forest	76.4	1.7	129.9
	Young Forest	31.9	0.2	6.4
	Meadow	5.7	0.05	0.3
Laydown Area	Mature Forest	19.6	1.7	33.3
	Young Forest	8.2	0.2	1.6
	Meadow	1.5	0.05	0.1
Substation	Mature Forest	1.7	1.7	2.7
	Young Forest	0.7	0.2	0.1
	Meadow	0.1	0.05	0
345 kV line	Mature Forest	51.8	1.7	88.1
	Young Forest	21.6	0.2	4.3
	Meadow	3.9	0.05	0.2
Total		**627.2**		**748.8**

The organic soil layer in the PDA is assumed to contain a large amount of embodied organic carbon, given the predominant type of forest cover. Excavation of this layer to allow the installation of turbine bases, laydown areas, and crane pads could allow a large portion of this embodied carbon to be released back into the atmosphere if this material is not reinstated and revegetated before it dries out. It is assumed that excavated organic soils at each turbine site will be reinstated and revegetated at a suitable site nearby to prevent soil carbon loss.

Emissions are anticipated to be temporary and short term for the construction of roads and laydown areas and therefore have not been quantified as they contribute only minimally to the Project emissions.

Concrete Foundation

A turbine base for a Nordex model N163 turbine could require as much as 2,367 cubic metres (m^3) of concrete and 425 T of steel rebar. Assuming 49 turbine bases, this will require 115,983 m^3 of concrete and 20,825 tonnes (T) of steel rebar. Quality Concrete operates a quarry at Folly Lake adjacent to the Project site. Assuming mobile batch plants are established here to produce concrete, the transportation distances to each turbine site can be reduced. Each ready-mix concrete truck can haul 7 m^3 (16.8 T) which results in a total of 16,569 truckloads. At an average round trip distance of 30 km the total haul distance will be 497,000 km. At an average diesel fuel consumption of 0.05 litres per tonne-kilometre fully loaded and 0.41 litres (L) per km unloaded, the transport of concrete will consume approximately 310,540 L of diesel fuel. Steel rebar for each base is assumed to be supplied from a location in Dartmouth, Nova Scotia, which is approximately 140 km from each turbine location. At an average load of 21.25 T, it will require 20 truckloads of steel rebar per turbine base. At an average round trip distance of 280 km the total haul distance will be 274,400 km. Fuel consumption for this portion of the Project will be approximately 202,030 L of diesel fuel. Total embodied and transportation carbon emissions associated with the turbine bases are calculated and provided in Appendix C.

Turbines

The proposed turbines are the Nordex N163 with a maximum generating capacity of 7 MW each. A breakdown of the GHG emissions associated with the manufacture and shipment of the turbines is shown in Appendix C. The turbines are expected to be manufactured in South Korea and transported by truck to dockside, then by ship to either Sheet Harbour or Liverpool, and then by truck to the Project site. Each turbine is assumed to have a weight of approximately 998 T that is composed primarily of steel (87 percent) with the remainder being mostly the fiberglass blades and electronics. The total embodied carbon associated with the manufacture of each turbine is estimated to be 1,951 T. Transport from South Korea is assumed to require one ship per turbine, while land transport will require 19 truckloads per turbine at an average load of 50 to 60 T. The total carbon emissions associated with the transport of each turbine from the manufacturer to the Project site is estimated to be 305 T.

Electrical Infrastructure

The Project is expected to require a considerable amount of electrical infrastructure to permit interconnection with the NSPI grid. Each of the 49 turbines is expected to generate electricity that will be transformed to 34.5 kV at each site. Collector lines are assumed to be composed of three aluminum conductor steel reinforced (ACSR) overhead cables that will connect each turbine location to the Project substation. It is estimated that up to 10 circuits will be required with each circuit connected to five to seven turbines. The 350 megavolt-ampere capacity substation is expected to include two 190 megavolt-ampere utility transformers to increase the voltage to 345 kV. The substation will also include additional high and low voltage equipment as well as an operation and maintenance building and perimeter fence. The outlet from the substation is expected to travel via two 175 MW capacity transmission lines at 345 kV to intersect with an existing NSPI 345 kV transmission line, located approximately 10 km away. The interconnection point is expected to include a four-circuit-breaker ring switching station. The transmission lines are expected to include three ACSR cables supported on guyed steel lattice tangent towers and freestanding steel lattice towers at corners as well as the beginning and end of each line. Two overhead ACSR shield wires are expected to be included in each line to provide lightning protection and for communication and signalling purposes. Calculations for the emissions associated with the fabrication and transport of the electrical infrastructure to the Project site are included in Appendix C. When calculating the transportation distances, all components with the exception of concrete are assumed to be shipped from Dartmouth, Nova Scotia, which is approximately 140 km from the Project site. Concrete is assumed to be transported from the same ready-mix plants at the Folly Lake quarry assumed for other Project components. Metals used in this infrastructure are expected to include copper (transformers), aluminum (conductor cabling and busbars), and steel. Each transformer is expected to also include mineral oil as a cooling medium. Concrete pads with steel reinforcement are included for all transformers and other major substation equipment, the operation and maintenance building slab, and foundations for each transmission tower. Total carbon emissions associated with the fabrication and transport of the electrical infrastructure is estimated to be just over 10,000 T.

2.7.3.2 Operation and Maintenance Phase

During the operation and maintenance phase, any generation of electricity that offsets higher carbon producing sources of electricity will lead to a reduction in the emission intensity of the electrical grid in Nova Scotia, as the electricity produced will be entirely emissions-free, in contrast to other energy sources like coal, natural gas, and oil that are typically associated with emissions during electricity generation. This phase contributes to GHG emissions mitigation, aiming to combat climate change by reducing the concentration of GHGs in the Earth's atmosphere. The production from this Project is intended to form a portion of the energy supply for a green hydrogen production facility to be built in Point Tupper, Nova Scotia.

Maintenance activities, such as the servicing and replacement of turbine components, vegetation management, and road, power line and substation maintenance, are expected to be the only contributor of GHG emissions during operation. Nordex N163 maintenance manuals suggest that each turbine will require 144 kilograms (kg) of replacement lubricating oil and 40 kg of replacement coolant per year based on a 25-year turbine life. Replacement parts will average 328 kg per turbine per year and are assumed to be primarily steel. All replacement parts are assumed to be supplied from the Nordex North American distribution centre in West Branch, Iowa. The distance from West Branch, Iowa, to the Project site is approximately 2,750 km and it is assumed that one truck per year of spare parts will be sent to the Project site. Consumables such as lubricants and coolants for each turbine as well as mineral oil for transformers can be sourced and disposed of through local suppliers in Nova Scotia. Annual emissions associated with the supply and transport, and disposal of spare parts and consumables is 37.7 T carbon dioxide equivalent (CO_2e). Energy consumption for the operation and maintenance building and other Project infrastructure is expected to be supplied from the wind farm output and will have no carbon emissions.

2.7.3.3 Decommissioning Phase

The sources of emissions during the decommissioning phase are anticipated to be similar to those of the construction phase but expected to contribute less emissions. Materials for construction will not be transported to the site; instead, recyclable and waste materials will be transported from the site to the nearest appropriate waste and/or recycling facility. Most of the metal components associated with the Project can be recycled using currently available technology. Fiberglass is currently not easily recycled but advances in recycling technology for this material are ongoing and it is anticipated that fiberglass recycling will be commonly available prior to the decommissioning phase of this Project. Most emissions associated with the decommissioning effort will be linked to the emissions from equipment used to disassemble and remove the Project components and to restore the site.

Decommissioning of this Project is likely to not occur until the 2060s by which time it is anticipated that most construction and heavy transport equipment is expected to be zero emitting.

2.7.3.4 GHG Emission Summary

A summary of the calculated total GHG emissions from the construction, transport, and operation of the wind farm as a producer of electricity entirely for the production of green hydrogen and ammonia for export is presented below:

- Total emissions from fabrication and transport – 236,159 T CO2e
- Loss of CO2e sequestration due to land clearing – 748.8 T per year
- Emissions due to operations and maintenance – 37.7 T per year

Electricity production in Nova Scotia at present produces an average of 14,800 T CO2e per day (NSPI, 2020). The total emissions associated with the fabrication, transport, construction, operation, and maintenance of the Project for 35 years is expected to be equivalent to approximately 18 days of electricity generation in Nova Scotia at present.

2.8 Environmental Management and Monitoring

The Proponent is incorporating environmental management approaches and strategies into Project planning and execution so that the Project is compliant with regulatory requirements and avoids or reduces potential adverse effects to the environment. These approaches and strategies have been and will continue to be incorporated into the Project planning and execution, including the design and location of Project components, avoidance or mitigation of potential environmental effects, and development of a Project-specific EPP. A Project-specific EPP will be developed prior to construction that will incorporate the province’s conditions of approval. Once approved, the EPP will be made publicly available to the Community Liaison Committee. The EPP will be designed to communicate known or potential environmental issues to be addressed during construction and operation and maintenance as well as mitigation measures to be undertaken during Project activities based upon onsite conditions. The EPP is intended to be reviewed and followed by contractors and other onsite personnel prior to commencing Project construction activities and will outline the following:

- Personnel roles and responsibilities
- Personnel environmental training and orientation requirements
- Document control procedures
- Regulatory requirements and commitments
- Scheduling and sequencing of activities
- Working in or near watercourses and wetlands
- Noise, light, and traffic management
- Wildlife management
- Heritage/archaeological resource encounters
- Environmental protection and control measures
  - ESC
  - Blasting management
  - Fire prevention and control
  - Surface water management
  - Waste management
  - Dust control
  - Soil and stockpile management
  - Hazardous substances management and spill prevention
  - Decommissioning and site reclamation
  - Environmental emergency response and contingency
- Environmental monitoring and reporting requirements
- Complaints resolution

2.9 Decommissioning

The anticipated lifespan for the Project is 35 years with the possibility of extension. Under the Municipality of Colchester's Chapter 56 Wind Turbine By-law, the licence for installation and operation of a wind farm will be in effect for 25 years unless otherwise cancelled, suspended, or renewed. As part of the licence application, the Proponent will be required to submit a decommissioning bond worth at least 125 percent of the estimated present-day cost to decommission the wind farm.

Two years prior to decommissioning the Project, a decommissioning and Site Reclamation Plan will be submitted to NSECC for review and approval. Should an individual turbine become inoperative for two years during the Project's operation and maintenance phase, NSECC will be notified of plans for either its recommissioning or removal.

Decommissioning activities will resemble those of the construction phase but will involve the removal of infrastructure to a depth of 1 metre below ground surface (mbgs) (i.e., foundations, underground power lines, overhead power poles, etc.). Currently, it is estimated that between 85 and 90 percent of a wind turbine's total mass can be reused or recycled (Canadian Renewable Energy Association (CanREA), 2021). Most turbine components, including the steel tower, gears, and generator assembly can be recycled or resold as scrap metal. The concrete foundation is also recyclable. However, there are fewer recycling and reuse options available for the blades at the time of this EA, due to their predominant composition of fiberglass, which poses a challenge in recycling processes due to the complex nature of fiberglass materials. Nonetheless, the wind energy industry has made recent strides in this area. New advancements in recycling techniques include shredding the blades (Beauson et al., 2016) and repurposing the fiberglass and plastic resin to create other goods including cement (Paulsen and Enevoldsen, 2021). Anticipated advancements in the next 35 years suggest the emergence of additional innovative strategies and options for recycling, recovery, and reuse of all components.

If turbine parts cannot be recycled or resold at the time of decommissioning, these will be handled by a specialized contractor for disposal in adherence to legislation. Each landowner will have the option as to whether the access roads will remain on their property as part of the restoration process. The restoration of the lands will commence after the removal of Project infrastructure, including topsoil replacement and revegetation/seeding.

Decommissioning of the Project will be completed in several steps.

- The Project will be disconnected from the NSPI provincial power grid, and the substation operation disengaged and removed.
- The PDA will be reconstructed to prepare temporary laydown areas for heavy vehicles, topsoil storage, and equipment around each turbine.
- The blades, hub, nacelle, and tower segments will be dismantled and removed from site.
- Underground infrastructure will be removed to approximately 1 mbgs. Poles will be removed entirely where feasible.
- The Project's overhead electrical lines, including the transmission line that connects to the provincial grid, will be removed unless otherwise requested by NSPI.
- Access roads will remain or be removed as per agreements in place with the individual landowner. Impacted lands will be restored to the land use in place prior to the construction of the access road, as practicable and at the discretion of landowners.
- The MET tower will be removed unless otherwise requested by the Municipality of Colchester, landowner, and/or other stakeholders.

Once infrastructure has been removed to a depth of 1 mbgs, temporary staging areas and any associated temporary decommissioning facilities or components used throughout the decommissioning phase will be restored with stockpiled topsoil or clean fill brought to site. The site will also be graded, contoured, and restored to elevation and appropriate sloping prior to revegetation using native species.

3 Consultation and Engagement

The Proponent and consultants conducted consultation and engagement as part of the Project planning process. Key rightsholders and stakeholders involved in these discussions included the Mi'kmaq of Nova Scotia, various regulatory agencies, municipal leadership, and the public. These interactions were aimed at providing information, gathering input, addressing concerns, and adhering to regulatory requirements.

3.1 Prior Engagement Conducted By RES

RES has been actively fostering connections with the local community since 2012, establishing a profound understanding of diverse viewpoints. This engagement encompasses consultations with municipal authorities, public input, and perspectives from First Nations representatives. The Proponent values the lessons learned from past engagements, demonstrating a deliberate and inclusive decision-making approach in the continuous development of the Project. Through these ongoing discussions, RES has been able to understand community concerns at an early stage and incorporate this knowledge into the Proponent's current engagement plan.

3.1.1 2012 Project Initiated

In 2012, the Windy Ridge project was initiated, and RES actively engaged with various stakeholders and rightsholders, including community groups, municipal councils, and the Mi'kmaq of Nova Scotia. Notable participants included Colchester and Cumberland municipalities, the Native Council of Nova Scotia, Kwilmu'kw Maw-klusuaqn (KMK), and the Folly Lake and Wentworth Preservation Society. Additionally, RES held discussions with entities such as Valley Inn, Wentworth Youth Hostel, Wentworth Development Association, and Orienteering Association of Nova Scotia.

3.1.2 2022 Windy Ridge Engagement

In 2022, RES conducted an extensive engagement program. Discussions and presentations took place with the Municipality of Colchester, Mi'kmaq of Nova Scotia, community members, and community groups such as the Folly Lake and Wentworth Preservation Society, Truro Colchester Alliance for Economic Prosperity, Rural Communities Foundation of Nova Scotia, Centre for Local Prosperity, Ecology Action Centre, snowmobilers, and Living Earth Council.

3.2 The Mi'kmaq of Nova Scotia

As stated in Section 1.3, the Project is set on Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq people. The nearest Mi'kmaq communities to the Project are Millbrook First Nation (19 km southeast of the PDA), Pictou Landing First Nation (54 km northeast), and Sipekne'katik First Nation (39 km south). The Proponent is committed to ongoing, meaningful engagement and collaboration with the Mi'kmaq of Nova Scotia. Regular updates and opportunities for feedback will be provided to the Mi'kmaq during all phases of the Project. The Proponent is also dedicated to minimizing the impact on the Mi'kmaq community in Nova Scotia, while striving to create economic and environmental benefits.

The Proponent has signed memoranda of understanding (MOUs) with Bayside Development Corporation (Paqtnkek) and Potlotek Development Corporation for minority equity investments. Key leaders from Paqtnkek and Potlotek have informed the development process to date, leading strategy conversations, participating in public open houses and presentations, informing Mi'kmaq engagement, and meeting with other rightsholders not directly involved in the Project. The Proponent has also signed an MOU with KMK for a Mi'kmaq Benefits Agreement.

The Project will support community growth through economic development within Mi'kmaq communities. Paqtnkek and Potlotek have strong relationships with other Mi'kmaq communities in Nova Scotia, facilitating meaningful engagement with the Mi'kmaq of Nova Scotia throughout the life of the Project.

In addition to formally engaging with the Mi'kmaq, the Proponent will continue to collaborate with the Mi'kmaq of Nova Scotia and intends to offer the following:

- Pre-construction site visit to support Mi'kmaq Ecological Knowledge Study (MEKS) (completed)
- Tours of the Project to the Mi'kmaq of Nova Scotia during construction and operation
- Contracting and employment opportunities to the Mi'kmaq of Nova Scotia during the Project
- Continuing engagement with the Mi'kmaq through the EA process, and construction and operation phases of the Project
- Meet with Mi'kmaq Communities and organizations to answer questions related to the EA
- Develop a Mi'kmaq Communication Plan
- Develop a Complaint Resolution Plan

The Proponent has undertaken efforts to meaningfully engage with the Mi'kmaq First Nation communities on the proposed Project since December 2021. Initial engagement activities included the KMK, Office of L'Nu Affairs (OLA), Confederacy of Mainland Mi'kmaq, and Native Council of Nova Scotia. The KMK and OLA both recommended that engagement be undertaken with the following 13 Mi'kmaq communities:

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

Building on previous engagement completed by RES, official engagement efforts were initiated by the Proponent through the second half of 2023 and have been following the *Proponents Guide: The Role of Proponents in Crown Consultation with the Mi'kmaq of Nova Scotia* (Nova Scotia Office of Aboriginal Affairs, 2012). The engagement format has consisted of phone conversations, email correspondence, and meetings, including:

- Phone calls to inquire about appropriate contacts within the community to engage.
- Project notification letters sent via email to share information about the Proponent and the Project, including contact information, intended Project timelines, figures illustrating the proposed ICIA, and invitations to participate in a meeting with Project representatives.
- Virtual or in-person meetings with community representatives to introduce the Proponent, present the Project, discuss possible community benefits, and provide the Mi'kmaq an opportunity to respond with questions and comments.
- Phone calls to confirm receipt of the letters with communities who did not initially respond to the Project notification letter and meeting invitation.
- Follow up Project notification letters via email to reemphasize and recommunicate Project information and provide an additional opportunity to respond.
- A presentation (February 8, 2024) at Pictou Landing Band Office included the Chief, Council, Executive Director, Chief Financial Officer for Pictou Landing First Nation and Communications Director on the Windy Ridge project.
- The Union of Nova Scotia Mi'kmaw were contacted in the early project stages by RES and again by Rose Paul in November 2023.

A record of communication and engagement is provided in Appendix D, which summarizes engagement activities to date with the 13 Mi'kmaq communities in Nova Scotia and Mi'kmaq community organizations. This record is organized by date and the nature of contact.

In addition to the above, a MEKS is currently underway and being undertaken by Membertou Geomatics Solutions (MGS) to evaluate historic and current Mi'kmaq land and resource use within the PDA. The MEKS facilitates dialogue between Mi'kmaq communities and Project stakeholders, fostering mutual understanding and collaboration. The MEKS involves active engagement with the Mi'kmaq communities, using methods such as historical research, community interviews, and onsite visits to gather and document traditional ecological knowledge. The field components of the MEKS were completed from May 15 to 17, 2024. MGS was accompanied by the Proponent, CBCL, and Strum Consulting during the field components; KMK was also invited to attend. The MEKS serves as a crucial component for integrating Indigenous perspectives, values, and concerns related to the environment into the Project. The Proponent commits to sharing the MEKS with NSECC for circulation to the Mi'kmaq of Nova Scotia.

EWF is in constant communication with its equity partners to provide updates on all aspects of EWF's broader ambitions, including the Project. Various senior members of the Project's Mi'kmaq equity partners travel with the EWF team to attend conferences, meetings, and commercial discussions.

The wind energy from the Project will be primarily used to power the Point Tupper Green Hydrogen/Ammonia Project – Phase 1, which received EA Approval from the Minister of NSECC on February 7, 2023. As part of the EA for the Point Tupper Green Hydrogen/Ammonia Project – Phase 1, fulsome community engagement was conducted, including with the Mi'kmaq of Nova Scotia about the wind portion of the Project. Engagement focused on the use of renewable energy to power green fuels production and was completed with the following Mi'kmaq communities:

- Paqtnkek Mi'kmaw Nation
- Membertou First Nation
- Potlotek First Nation
- Millbrook First Nation
- Sipekne'katik First Nation

The Proponent has also engaged with Indigenous-led companies and events through the following activities:

- Engaged Indigenous Treaty Partners to undertake cultural training for the Proponent management team and staff; contributions to fund training for various Nova Scotia not-for-profits has also been provided.
- Engaged the President and Chief Executive Officer of Indigevisor Advisory and Consulting to provide the Project Team with cultural competence training and guidance for building relationships with Indigenous communities.
- Working closely with 3D Wave—an Indigenous owned firm supplying three-dimensional (3D) LiDAR-based flyover modelling—and supporting their climate modelling initiatives through funding.

- Collaborating with Ulnooweg on development of educational materials on green hydrogen, the Hydrogen Fuel Cell Marine Pilot Project, and funding for the Ulnooweg Summer Solstice Run and 11th Indigenous Entrepreneur Awards Show.

For detailed information regarding the Proponent's completed engagement with the Mi'kmaq of Nova Scotia, see the Point Tupper Green Hydrogen/Ammonia Project – Phase 1 EA, specifically Section 5.0, which is publicly available on the NSECC website (https://novascotia.ca/nse/ea/everwind-point-tupper-green-hydrogen-ammonia-project/).

3.2.1 Summary of Questions and Concerns Identified During Engagement

As per Appendix D, meetings were held with First Nation communities and organizations and, through engagement, concerns and issues were raised as listed in Table 3.1.

Table 3.1 Summary of Key Concerns/Issues from Engagement with the Mi'kmaq

Mi'kmaq Community/ Organization	Key Concerns/Issues	General Responses/Solutions	EA Registration Document Reference
Pictou Landing First Nation	Concern raised around use of Crown and private land	Revised layout to decrease the number of turbines on Crown Lands, limited the number of roads, and actively engaged with the community on land use.	Chapter 3 and Appendix D: Consultation and Engagement
KMK	Concerns raised about the Mainland Moose population and habitat.	Modified the road and turbine layout to avoid or reduce potential for adverse effects on Mainland Moose. Proposed the concept of a "moose corridor" to describe a collaborative, large-scale, land conservation effort in the region.	Chapter 10: Terrestrial Wildlife Section 10.3.2.1.1
KMK	Question raised regarding Mi'kmaw employment opportunities for individuals and business.	Prior to construction, the Proponent will undertake various actions to promote employment and business opportunities to Mi'kmaw communities and businesses including job fairs, notifications, engagement, and training.	Chapter 3 and Appendix D: Consultation and Engagement
KMK	Questions raised regarding Mi'kmaq Benefits Agreements the Project will have in place.	MOU to develop Mi'kmaq Benefits Agreement in place, ongoing engagement and discussion.	Chapter 3 and Appendix D: Consultation and Engagement

Mi'kmaq Community/ Organization	Key Concerns/Issues	General Responses/Solutions	EA Registration Document Reference
KMK	Concerns raised about tree clearing on the site.	Turbines have been removed from old growth forest and tracts of mature intact forest. Tree clearing will be minimized by using existing roads and previously disturbed areas to the extent practicable.	Chapter 8: Flora

3.3 Regulatory Consultation

Consultation with various regulatory agencies at the federal, provincial, and municipal level was an essential aspect of the Project planning stage. These efforts aimed to introduce the Project, the Proponent, and solicit collaborative feedback on the Proponent's approach to the EA in accordance with regulatory requirements and established protocols. Some of the key regulatory consultations are described below, and a summary of the regulatory consultations completed for this Project is provided in Table 3.2.

Before executing the spring and summer field programs, a meeting occurred with an NSDNRR SAR biologist on April 20, 2023. Prior to this meeting, a consultation package was provided that outlined proposed field methodologies and associated field maps. During the meeting, the methodology for each of the biophysical field programs and maps were presented, seeking input and comments from NSDNRR. The methodology of the field programs was refined before initiation of field work based on the input received during this meeting and subsequent email correspondence.

A follow-up meeting with NSDNRR and the EA Branch took place on December 15, 2023, to provide an update on each of the biological field programs and discuss questions pertaining to data presentation and submission, particularly sensitive habitat, and SAR data.

A consultation package was provided to ECCC for review and comments. Representatives from the Environmental Assessment Environmental Protection Operations Directorate and Environmental Assessment Analyst from the Environmental Stewardship Branch provided updated guidance documents for consideration and comments on the proposed field programs. Comments received on the proposed survey methodology were incorporated as applicable.

An initial meeting with the EA Branch of the NSECC occurred on July 25, 2023, to present an overview of the proposed Project and biological field studies that were undertaken or ongoing as part of the EA. The meeting was intended to foster an open forum for questions and comments from the EA Branch. At the follow-up meeting with NSDNRR and the EA Branch (December 15, 2023), updates regarding a general timeline for submission of the EA Registration Document was provided.

The Protected Areas and Ecosystems Branch of NSECC was contacted on September 26, 2023, to enquire whether there are lands under consideration for conservation or land protection within, or near, the PDA.

CBCL met with NSECC and the EA Branch on January 4, 2024, to provide an overview of the wetland survey results, request clarification on changes to the Nova Scotia Wetland Conservation Policy, and to discuss wetlands of special significance.

Table 3.2 Summary of Regulatory Consultation

Regulatory Agency	Branch/ Representatives	Dates, Nature of Contact, Feedback
Federal Government		
ECCC	Environmental Protection Operations Directorate – Atlantic Michael Hingston Head, Environmental Assessment, Environmental Protection Operations Directorate - Atlantic	March to April 2022 – Email correspondence regarding SAR turtle survey protocols, information on radar and acoustic surveys for migratory birds, and clarification on SAR nightjar survey methodology. Guidance documents were provided for consideration on May 17, 2024.
ECCC	Canadian Wildlife Service (CWS)/ Environmental Stewardship Branch Suzanne Wade Environmental Assessment Analyst, Environmental Stewardship Branch	Submission of consultation package disclosing proposed survey methodology for review was provided to ECCC-CWS on April 13, 2023. On June 7, 2023, ECCC-CWS provided a response indicating they have reviewed the proposed methodology and comments were provided.
ECCC	Weather Radar Coordinator	February 2024 – EMI notification letter sent.
Transport Canada	Questions@tc.gc.ca	August 7, 2023 - Email from the Proponent requesting a meeting with Transport Canada to introduce the Project and gather preliminary feedback.
NAV CANADA	service@navcanada.ca Land Use Specialist	August 7, 2023 – Email from the Proponent requesting a meeting to introduce the Project and gather preliminary feedback. February 2024 – EMI notification letter sent.
Canadian Coast Guard	Wind Farm Coordinator	February 2024 – EMI notification letter sent; receipt of Letter of Non-Objection.
DND	Military Air Defence and Air Traffic Control	February 2024 – EMI notification letter sent; receipt of Letter of Non-Objection.
Innovation, Science, and Economic Development Canada	Nova Scotia District Office	February 2024 – EMI notification letter sent; receipt of Letter of Non-Objection.
RCMP	Wind Farm Coordinator	February 2024 – EMI notification letter sent; receipt of Letter of Non-Objection.

Regulatory Agency	Branch/ Representatives	Dates, Nature of Contact, Feedback
Provincial Government		
Office of L'nu Affairs	Gillian Fielding, Aboriginal Consultation Advisor	November 2023 – Chief Executive Officer of Bayside Development Corporation emailed Nova Scotia OLA the Project notification letter.
Member of the Legislative Assembly	Dr. Stephan Ellis	2023 – Letters, phone calls, and meetings
Member of the Legislative Assembly	Tom Taggart	2023 – Letters, phone calls, and meetings
NSDNRR	Species at Risk Biologist, Mark McGarrigle	April 19, 2023 – Provision of Project consultation package introducing the Project, proposed methodology for the biological field programs, and field maps. April 20, 2023 – Meeting to present methodology of biological field programs and seeking input and comments from NSDNRR. NSDNRR provided some considerations, but also indicated that the methodology and timing windows are adequate. October 2023 – Email correspondence on the Significant Species and Habitats database.
NSECC	Protected Areas Branch, Charles Sangster	March 2022 – Inquiry about lands under consideration for conservation or land protection within the vicinity of the Project. August, September, November 2023 – Follow-up email correspondence seeking updates to lands under consideration for conservation or land protection within the vicinity of the Project.
NSECC	EA Branch, Bridget Tutty	July 7, 2023 – Email to EA Branch to clarify submission timelines. July, October 2023 – CBCL inquiries to EA Branch to clarify wetland setback requirements and functional assessment expectations. October 2023 – Meeting to clarify EA amendment and registration requirements.

Regulatory Agency	Branch/ Representatives	Dates, Nature of Contact, Feedback
NSECC	EA Branch, Bridget Tutty, Candace Quinn, and Lynda Weatherby	July 25, 2023 – RES and CBCL presented an overview of Project and the Proponent during the meeting and discussed detailed studies and approach to EA. Provided an opportunity for the EA Branch to ask questions related to the Project.
NSECC and NSDNRR	EA Branch, Bridget Tutty, Lynda Weatherby, Kelly Maher NSDNRR, Mark McGarrigle	December 15, 2023 – CBCL presented Project updates, shared general submission timelines, posed inquiries to the EA Branch and NSDNRR pertaining to sensitive species data presentation and submission, and shared updates on the field programs executed during the 2023 year. A follow-up consultation brief was prepared and provided in advance of the meeting.
NSECC	Lynda Weatherby Marina Dulmage Kelly Maher	January 4, 2024 – Meeting to present overview of wetland field program methodology, discuss results of the field program, and ask questions regarding changes to the Nova Scotia Wetland Conservation Policy. January 11, 2024 – Follow-up email from Kelly Maher to CBCL to answer questions with respect to inclusion of Wetland Delineation and Wetland functional assessment forms and their inclusion into the EA. January 15, 2024 – Summary of discussion points provided by CBCL to meeting participants.
NSCCTH	John Cormier Alex Hernould	November 7, 2023. A Heritage Research Permit was applied for by Boreas Heritage Consulting to complete the Assessment in 2023. Permit A2023NS Permit A2023NS233 was issues by CCTH. December 20, 2023. A Heritage Research Permit was applied for by Boreas Heritage Consulting to continue assessment work into 2024. Permit A2024NS008 was issued by CCTH.

Regulatory Agency	Branch/ Representatives	Dates, Nature of Contact, Feedback
Municipal Government		
Municipality of Colchester	Colin Forsyth, Development Officer Paul Smith, Director of Community Development Dan Troke, Chief Administrative Officer Christine Blair, Mayor Eric Boutilier, Councillor District 1 Laurie Sandeson, Councillor District 2 Geoff Stewart, Deputy Mayor District 3 Mike Cooper, Councillor District 4 Tim Johnson, Councillor District 5 Karen Mackenzie, Councillor District 6 Michael Gregory, Councillor District 7 Lisa Patton, Councillor District 8 Marie Benoit, Councillor District 9 Victoria Lomond, Councillor District 10	July 28, 2023 – Phone call followed up with an email to confirm where setback distances from residences are measured from. August 1, 2023 – In-person meeting with District 8 and 9 Councillors to introduce the Project, Project Team and summarize the work completed to date. Received feedback from councillors regarding community perceptions and benefits for the Project. August 2, 2023 – Separate follow up emails to District 8 and 9 Councillors summarizing work completed to date, plans for public engagement and next steps. August 23, 2023 – Email outreach to Mayor Blair, inviting her to attend the open houses and asking for a future meeting to present the Project and gather feedback. October 3, 2023 – Presentation to Mayor Blair and Council on Project updates. Discussion topics consisted of community benefits, progress updates since last meetings with Council. November 14, 2023 – Special Council Presentation. First Nation equity partner, EWF and RES staff presented to council the Project in detail. November 16, 2023 – Municipal Council Wind Turbine Development By-law Amendment – Second Reading. EWF terminal staff and First Nation equity partner presented to council, along with local business and general public (22 members in total). Council voted not to approve the Second Reading and the existing Wind Turbine Development By-law remains in effect.

Regulatory Agency	Branch/ Representatives	Dates, Nature of Contact, Feedback
	Wade Parker, Councillor District 11	December 20, 2023 – Teams meeting with Paul Smith to provide Project update and discuss municipal development licence application process and timelines. January 9, 2024 – In-person meeting with District 9 and 10 Councillors and RES representatives to discuss community feedback following the vote on the Wind Turbine Development By-law Amendment and future community engagement strategies. Key recommendations included hosting a presentation style event with a question-and-answer period and providing the community with more information regarding hydrogen and energy exportation. January 18, 2024 – In-person meeting with the Mayor and Chief Administrative Officer and the Project executive to discuss community feedback following the vote on the Wind Turbine Development By-law Amendment and future community engagement strategies. The Mayor and Chief Administrative Officer support the recommendation for a public presentation and question and answer event. January 30, 2024 – Email notification to Mayor and Council inviting them to the community presentation and open house events on February 12 and 13, 2024. February 1, 2024 – Phone call with Colin Forsyth to discuss municipal development licence process in greater detail, requirements, public information meeting, review timelines, and Project schedule. February 23, 2024 – Email to Mayor and Council following up on community presentation and open house events.

An EMI study was conducted in the Municipality of Colchester and a letter soliciting feedback, details, and specifics regarding any potential interference of stakeholder's existing operations as a result of the proposed wind turbine installations was sent out on February 7, 2024. The following stakeholders were engaged in this process:

- Bell Mobility Incorporated
- Canadian Coast Guard
- Debert Fire Department
- DND
- Eastlink Incorporated
- ECCC
- Innovation, Science, and Economic Development Canada
- NAV CANADA
- NCS Managed Services Inc.
- North River Fire Department
- NSPI
- Onslow Belmont Fire Department
- RCMP
- Rogers Communications
- Seaside Communications

Confirmation was received from the Canadian Coast Guard, the RCMP, Innovation, Science and Economic Development Canada, DND, and Bell Mobility Incorporated that they did not expect any interference by the Project and had no objections to it as proposed.

3.4 Public Engagement

Public engagement holds pivotal importance in creating transparency, inclusivity, and the integration of diverse perspectives into a project. As part of the Project, several methods of engagement have been adopted to allow the public to receive information, ask questions, and share local knowledge. Presentations have been developed with Mi'kmaq owners of the Project to incorporate their messages, traditional views, and cultural lens to ensure two-eyed seeing. Communication channels that have been used to engage the public throughout the Project include digital platforms such as websites, newsletters, and mailing lists to establish dedicated Proponent email addresses for inquiries, organizing community engagement sessions, meeting with special interest groups, employing door-to-door outreach, distributing mailed pamphlets, and posting Project updates in community areas.

To initiate the public engagement process, a Project website (https://windyridgewind.com) was developed under public domain. The website, which is still active at the time of EA registration, features general information about the Project such as news and updates, timeline, and contact information. The Proponent will maintain a Project website that will be active and updated throughout the lifespan of the Project.

An email address was created in July 2023 (windyridgewind@everwindfuels.com) to enable community members to submit questions, comments, and concerns directly to the Proponent. The email inbox is actively monitored by the Proponent. This email address has been widely disseminated across various channels, including social media platforms like LinkedIn and Facebook, as well as being featured on Project website, pamphlets, and newsletters. The email address will remain active throughout the lifecycle of the Project, enabling community members to submit questions or concerns related to the Project directly to the Proponent for the duration of the Project's lifespan.

3.4.1 Community Engagement Sessions

Broad, in-person public engagement was implemented by holding two sets of community engagement sessions in early November 2023 and mid-February 2024.

The public engagement sessions held in November consisted of three open houses on November 8, 9, and 10, 2023, as well as a business information session on November 9, 2023. The open houses were designed to accommodate drop-in visits from members of the community, providing flexibility for attendees. The business information session invited local service providers to learn about potential commercial opportunities associated with all phases of the Project, with a particular focus on construction. Local service providers were invited to register their company on the Proponent's website through a QR code provided on the poster boards. The Proponent also plans to hold a job fair prior to construction to engage local community members and service providers in which suitable candidates and businesses will be identified.

Notices of the November 2023 engagement sessions were widely publicized through various channels, including the local newspaper, social media, canvassing within the local community, posters in the community, and the Project website. If residents did not come to the door during the canvassing campaign, Project pamphlets were left in the mailbox or at the residents' doorstep. Details of these sessions were also distributed to every address in the Municipality of Colchester via Canada Post mail drops. Event details were advertised on two radio stations (Bounce and Pure Country) seven times per day for four days leading up to the events. Event details were also distributed by email to Municipality of Colchester Mayor and Council, the 13 Mi'kmaq Communities, Special Interest Groups, and 377 members of the public who opted to be included in the mailing list that was established for the Project. Members of the public can join the mailing list through the Project website and were also provided the opportunity to opt into the Project mailing list upon sign-in at these events.

During the second set of engagement sessions, on February 12, 2024, a presentation-style public meeting was hosted followed by an additional open house on February 13, 2024, which adhered to the format of the November 2023 engagement sessions. The decision to introduce the presentation-style meeting was driven by feedback from the public received during the November sessions and subsequent one-on-one engagements. This format was tailored to accommodate some community members' preference for a more structured and collective interaction. Led by a designated moderator and expert panelists, the presentation delved into specific community questions, supported by a comprehensive slide deck which provided a Project overview including Project updates since November 2023, facilitating ongoing dialogue with attendees. The open house format was maintained for the second event to facilitate ongoing engagement with those preferring one-on-one discussions.

The February 2024 engagement sessions were widely publicized through various channels, including the local newspaper, social media, posters in the community and the Project website. Event details were advertised on two radio stations (Bounce and Pure Country) seven times per day for a week prior to the events. Event details were also distributed by email to Municipality of Colchester Council, the 13 Mi'kmaq Communities, special interest groups, and members of the public who opted to be included in the mailing list that was established for the Project.

The use of multiple communication channels was intended to allow the public to stay informed on updates and enhance attendance.

The primary objectives of the first set of open houses were to introduce the Project and the Project team, share high-level information about the Project, and gather local feedback to inform Project design. This included conveying the Project's key purpose; outlining the Project's scope, tentative timeline, and location; and giving attendees a broad understanding of its potential impacts and benefits. The open houses also provided a platform for the public to raise questions, comments, and concerns related to the Project through face-to-face conversations with the Proponent and Project team and through written feedback forms, which were provided at each meeting. Sign-in sheets were available at the entrance of the conference room, where attendees could provide their contact information and opt to be included on the Project mailing list to receive Project updates. The feedback received during these sessions was collected and documented for further consideration in the Project planning and design, as well as in the EA.

In both the November 2023 and February 2024 open houses, the Project team set up poster panels displayed on easels around the conference rooms of each event location. These boards featured visual representations and detailed information about various aspects of the Project, including a general location and layout, environmental considerations, and potential community enhancements. For the February open houses, these interactive displays facilitated a deeper engagement with the public as more details about the Project were presented. Thirty panels were presented at open houses in November and February. Some of the panels that were presented during the first set of open houses were also displayed during the February open houses; however, the February open houses also included updates on the Project plans, layouts, impacts, and benefits that incorporated feedback from the community, the Mi'kmaq of Nova Scotia, and special interest groups.

During all open houses, panels highlighted community benefit initiatives, such as a proximity payment, a community vibrancy fund, and a bursary fund. The proximity payment involves yearly payments to residents living within a defined distance to a turbine. The vibrancy fund is intended to fund local initiatives and community projects. Oversight of the community vibrancy fund is achieved by a committee comprising community members, council representatives, and Project delegates, with annual allocations. The bursary fund aims to offer a minimum of 10 scholarships to local residents, facilitating their training within the renewable energy sector.

The Proponent is working with the Municipality of Colchester council on a community benefit agreement, which will apply to all Proponent-owned wind farms in Colchester County, that includes commitments for the following:

- $300,000 annually to fund proximity payments
- $100,000 annually to a community vibrancy fund
- $50,000 bursary program for renewables education

The Proponent has also made a commitment to establish a Project office in the Municipality of Colchester, which will serve as a local base to hold site progress meetings and hold site visits. The Proponent aims to hire and create jobs locally in the Municipality of Colchester. They will be collaborating with the Chamber of Commerce and the Truro-Colchester Partnership for job placement and training. The Proponent commits to providing presentations to high schools and other educational institutions and aims to collaborate with the Carbon-Free Colchester Implementation Committee.

The Proponent also signed a memorandum of understanding to offer minority investment to Colchester-Cumberland Wind Field Incorporated (CCWF) who plans to offer ownership to members of the public through a Community Economic Development Investment Fund (CEDIF) ownership.

In addition to the quantitative data, the Proponent held a broad business information session on November 9, 2023, in Truro and invited over 120 local and provincially based businesses to participate in the event. To further support an understanding of the business community, the Proponent met with the Truro Colchester Partnership for Economic Prosperity, local businesses, the Colchester Food Banks, and Colchester District Councillors to better understand the community and the employment opportunities in the region.

The dates, times, locations, and number of attendees at each community engagement session are summarized in Table 3.3. The materials presented at the community engagement sessions are included in Appendix D.

Table 3.3 Community Engagement Session Attendance Information

Date/ Time	Engagement Session	Location	Public Attendance Numbers
October 3, 2023	Council Presentation	Municipality of Colchester, 1 Church St, Truro, NS	16
November 8, 2023 3 pm to 7 pm	Open House	Debert Hospitability Centre, 30 Ventura Dr, Debert, NS B0M 1G0	44
November 9, 2023 10 am to 1 pm	Business Information Session	Best Western Glengarry, 150 Willow St, Truro, Nova Scotia B2N 4Z6	11
November 9, 2023 3 pm to 7 pm	Open House	Royal Canadian Legion Branch 26, 42 Brunswick St, Truro, Nova Scotia B2N 5E5	33
November 10, 2023 2 pm to 7 pm	Open House	North River and District Fire Brigade, 74 Truro Rd, North River, Nova Scotia B6L 6V8	60
November 14, 2023	Presentation for Special Council Meeting	Municipality of Colchester, 1 Church St, Truro, Nova Scotia	36
November 16, 2023	Second Reading of Wind Turbine Development By-law Amendment	Municipality of Colchester, 1 Church St, Truro, Nova Scotia	43
February 12, 2024 6 pm to 8 pm	Presentation with Question & Answer Session	Debert Legion 1252 Masstown Rd, Debert, Nova Scotia B0M 1G0	102
February 13, 2024 3 pm to 7 pm	Open House	Debert Hospitality Centre, 30 Ventura Dr, Debert, Nova Scotia B0M 1G0	25

In addition to the more formal open houses and presentations, the Proponent has hosted Open Office Hours at the Lower Onslow Community Centre to engage with the community, gather feedback, and discuss solutions. Four sessions have been held:

- Thursday, March 28, 2024 from 10 am to 2 pm
- Wednesday, April 10, 2024 from 3 pm to 7 pm
- Thursday, April 25, 2024 from 10 am to 2 pm
- Tuesday, May 7, 2024 from 3 pm to 7 pm

Across the four Open Office Hour sessions, 11 members of the public attended.

3.4.2 Special Interest Group Meetings

Emails were sent by the Proponent to various special interest groups starting in August 2023, requesting a meeting with each group to introduce and present the Project, the

Project team, benefit programs, and gather first impressions and feedback. The special interest groups that the Proponent engaged with included the following:

- African Nova Scotian Affairs
- Acadian Affairs and Francophone Team
- Colchester-Cumberland Wind Field
- Cobequid Eco-Trails Team
- Cobequid Off Highway Vehicle Club
- Ecology Action Centre
- Folly Lake Landowners Association (FLLOA)
- Fundy Trail Snowmobile Club
- Happy Atmosphere Environmental Society
- Hart Lake Cottage Owners Association
- Healthy Forest Coalition
- Living Earth Council
- North River Fire Brigade
- North Shore Snowmobile Club
- Nova Scotia Federation of Anglers and Hunters
- Nova Scotia Nature Trust
- Protect Wentworth Valley
- Rural Communities Foundation of Nova Scotia
- Ski Wentworth
- Sunrise Trails and North Shore all terrain vehicle (ATV) clubs
- The Snowmobilers Association of Nova Scotia (SANS)
- Truro and Colchester Partnership for Economic Prosperity

Based on feedback received through the public engagement process and specifically the February 2024 presentation and open house, the Proponent received comments from the FLLOA concerning the siting of turbine T24, T25, and T26. Through mutual respect, an attempt to foster dialogue, and the willingness of the Proponent to negotiate with communities, the Proponent met in good faith with FLLOA Executive Committee and negotiated to remove turbines that were sited in proximity to the community.

For a complete list of special interest groups engaged, and records of dates, contact information, and nature of contact that took place prior to registering the EA Registration Document, refer to Appendix D. Engagement with these groups is ongoing.

3.4.3 Summary of Concerns Identified During Engagement

Questions, concerns, and issues were received from the public via email, the in-person engagement sessions, public stakeholder meetings, and phone conversations. The main concerns brought forward from the public through these channels of communication are summarized in Table 3.4, along with the Proponent responses and proposed resolutions. Table 3.4 also refers to specific sections of the EA that address these concerns.

Table 3.4 Summary of Key Questions and Concerns from Public Engagement

Subject	Questions and Concerns	General Responses/ Solutions	EA Registration Document Reference
Visual Impacts, Turbine Placement	Concerns expressed from the public regarding turbine visibility from Folly Lake and Ski Wentworth.	A larger capacity turbine was chosen which allowed the Proponent to reduce the total number of turbines proposed to be constructed from 58 to 49. The turbine is also several metres shorter than the model originally proposed which further reduces visual impact. Revised visual simulations were completed and confirm no turbines are visible from Ski Wentworth. Based on feedback received from the community and discussion during and following the February engagement sessions, three turbines closest to Folly Lake were removed to reduce visual impacts. The Proponent also agreed to not build any turbines west of the East Branch of the Folly River.	Sections 2.2 and 13.2.3 Appendix K, Figure 2.2
Biodiversity and Mainland Moose	Concerns regarding Project related impacts to Mainland Moose and other wildlife.	CBCL completed biological field surveys to collect data on the baseline conditions of the PDA. The Proponent has modified the road and turbine layout to avoid or reduce potential for adverse effects on terrestrial wildlife and their habitat (e.g., use of existing access roads to the extent possible), including Mainland Moose. Habitat modelling was completed to identify potential suitable habitat that supports for life cycle requirements for Mainland Moose. Turbines have been removed from wetland areas, areas with high wildlife activity, and intact forest habitats. The Proponent has proposed the concept of a moose corridor to describe a collaborative, large-scale, land conservation effort.	Chapter 10, Figure 2.2

Subject	Questions and Concerns	General Responses/ Solutions	EA Registration Document Reference
Use of Crown Land	Concerns expressed about the proposed placement of turbines in parcels of Crown land that are in the central portion of the Project. The public indicated that this area should be under consideration by the province as a future protected area.	The Proponent incorporated these concerns into the Project design by removing four of the originally proposed eight turbines on Crown land. The four turbines proposed to remain on Crown land are situated along the property boundary of private land, to minimize disturbance to Crown lands.	Sections 1.3 and 2.2, Figure 2.2
French River Watershed	Questions and concerns were raised regarding the proposed placement of turbines within the French River Watershed.	The Proponent removed all turbines located in the French River Watershed by removing three turbines in entirety and micro-siting two other turbines out of the watershed.	Section 2.2, Chapter 6, and Chapter 7, Figure 2.2
Cumulative Effects	As there are several previous and ongoing wind energy Projects being constructed in the Municipality of Colchester as well as other historical activity such as mineral excavation, transportation and recreation, concerns were raised with respect to cumulative effects the Project will have, when combined with other adjacent projects.	Cumulative effects are considered as part of the EA Registration Document. Regulators have been consulted with respect to the analysis of cumulative effects.	Chapter 15
Clearing Requirements	Inquiries about the area of clearing and road enhancements given the existing conditions of the road network.	Considerations have been made to minimize clearing to the extent possible and to this end, the Proponent is planning to use approximately 116 km of existing road network. Road enhancements on existing roads are expected. The Project will require approximately 34 km of new roads; however, this will likely be reduced as Project design is further refined.	Sections 2.4.1 and 2.5.2

Subject	Questions and Concerns	General Responses/ Solutions	EA Registration Document Reference
Timing of Open Houses	Public engagement was not initiated early enough, and concerns were expressed that not enough notice was provided for the first set of open houses.	Planning considerations for the second set of open houses in February included providing more notice time. Notifications for the open houses were released to the public earlier.	N/A
Open House Format	Many members of the public and councillors expressed concern at the open house format and requested a public presentation as well as an opportunity for a public question and answer (Q&A) session.	The Proponent held a presentation with Q&A at the subsequent engagement session, held on February 12, 2024.	N/A
Environmental Monitoring	Several questions were raised related to the need for environmental monitoring, and what factors into requirements.	Environmental management and monitoring is incorporated into Project planning and execution. Monitoring requirements will be determined by the province during their review of the EA Registration Document. An environmental monitor will be on site during construction activities.	Section 2.8 and Chapters 5, 6, 7, 8, 9, 10, 11, 12, 13, 14
Site Accessibility	Questions about site access during construction and operation raised. Many members of the public want to continue to access the site for recreational purposes.	For safety reasons, access to some areas of the Project may be partially limited during construction. With respect to long-term access, the substation and the operation and maintenance building will be fenced for safety, but access will not be restricted to other areas of the Project footprint during operations.	Sections 2.5.4.3 and 2.6.5.
Impact on Property Value	How will this Project impact the property values of the houses in close proximity	Due to the stringent Chapter 56 By-law which restricts any wind development within 2 km of a residence and the location of the Project within the Cobequid Mountains, impacts to residential property values as a result of this Project are not expected.	Section 13.3.2.2
Decommissioning and reclamation of the site	What is the end-of-life plan for the Project, who will pay for the removal and reclamation of the area	The Proponent will establish a bond to ensure sufficient funds are available for the decommissioning, removal, and reclamation at the end of the Project life cycle.	Section 2.9

Subject	Questions and Concerns	General Responses/ Solutions	EA Registration Document Reference
What happens with the turbines at their end of life	Can the components of the turbines be recycled	Between 85% and 90% of all components of wind turbines are currently recyclable except fiberglass blades, which pose certain challenges due to their composition. Currently, blades are either repurposed or sent to landfills. The industry is working collectively on blade recycling and we anticipate blades to be a recyclable by the time of decommissioning.	Section 2.9

4 Assessment Methods and Initial Screening

4.1 Approach

The methods applied to complete the environmental effects analysis for the Project were developed by CBCL to meet the requirements of the Nova Scotia EA Regulations, specifically those outlined within the Guide (NSECC, 2021). The Guide rates wind projects that contain turbines of 150 m or greater in total height, such as this Project, to be Category 4, which is described as having "Very High" site sensitivity because they occur within a known migration or connectivity corridor.

CBCL's assessment methodology consist of the following steps:

- Establish the scope of the EA
  - Describe the Project (i.e., Undertaking) components and activities
  - Identify issues
  - Select valued environmental components (VECs)
  - Establish spatial and temporal boundaries
- Describe the environment as it exists
- Evaluate environmental effects
  - Identify potential Project-environment interactions through analysis of pathways of effects
  - Identify mitigation strategies to avoid or reduce potential adverse environmental effects
  - Characterize the residual environmental effects after mitigation strategies are incorporated
  - Determine the significance of residual adverse environmental effects

The following sections describe the approach to scoping and evaluating the environmental effects for this Project. A description of the methods used to gather information to describe the existing environment and any VEC-specific analyses are provided for each VEC chapter.

4.2 Scoping

Establishing the scope of the environmental effects analysis is an important step that identifies the extent of the Project and the issues raised by regulators and stakeholders. The goal of scoping is to select VECs on which to focus the analysis, i.e., those that are considered important and likely to be substantially affected by Project components or activities. For this Project, the scope includes the Project components and associated activities described in Chapter 2 (Project Description) of this document.

4.3 Existing Environment

Existing baseline conditions and characteristics of the Project assessment areas are highlighted in Chapters 5 to 14. Descriptions of the physical, biological, socio-economic, and cultural environments provide context for the assessment of effects by providing an understanding of the receiving environment within the PDA as well as the surrounding areas. The approach to describing the existing (baseline) environment includes a combination of field surveys, modelling, background information, and literature review and is supported by appended technical reports or references to relevant existing reports or literature.

4.4 Identifying Issues and Selecting VECs

VECs refer to biophysical, socio-economic, or cultural components that could be affected by the Project. Based on the scope and location of this Project, the following information was considered to identify issues and select VECs:

- Understanding of the characteristics of the Project and anticipated work methods
- Consultation with regulatory authorities
- The Guide
- Community and stakeholder concerns about the Project
- Indigenous rights and resource use
- Knowledge of the environment
- Characteristics of potential impacts and environmental effects of the Project
- Professional judgement and lessons learned from similar projects

4.5 Establishing Spatial and Temporal Boundaries

Temporal and spatial boundaries refer to the time periods and geographic extent in which a Project may interact with (or affect) a VEC. Direct and indirect environmental effects were evaluated within these temporal and spatial boundaries established for the Project.

Boundaries are defined for each VEC presented in this EA since they vary based on several considerations:

- Geographic range of the VEC
- Zone of influence of the Project on the VEC
- Timing and schedule of Project phases
- Known ranges and natural variations of each VEC
- Timing of VEC occurrence or presence in the Project zone of influence
- Known timing required to recover from an environmental effect
- Administrative boundaries
- Availability and quality of data and information

4.5.1.1 Spatial Boundaries

Four spatial scope terms have been consistently applied throughout the document, varying for each VEC.

Project Footprint: The permanent space occupied by the Project, including all Project components that will remain once the Project is constructed (such as turbine pads, infrastructure, and access roads) plus the appropriate RoW buffer for each that will remain in place after construction for operational activities.

Potential Development Area (PDA): The permanent footprint plus any temporary areas that will be used during the construction phase only, such as lay-down areas and temporary access roads. The PDA is conservatively estimated to be approximately 1,468 ha as shown on Figure 2.1. As detailed in Section 2.1, the final extent of the PDA is expected to be approximately less than half the area used described in this EA.

Local Assessment Area (LAA): The area including and surrounding the PDA where measurable changes to the environment may be anticipated as a result of the proposed activities at any phase of the Project, either through normal activities or from possible accidents or malfunctions. The geographic boundary depends on the factor being considered (e.g., a local study area defined for the aquatic environment will differ from that of the atmospheric environment).

Regional Assessment Area (RAA): The RAA is the area surrounding the LAA within which potential effects of this Project may interact with the effects of other projects, potentially resulting in cumulative effects. The geographic boundary for the RAA is also specific to the factor being considered. For aquatic effects, for example, the RAA encompasses the secondary watersheds that the PDA overlaps whereas, for wetlands the RAA is 1 km surrounding the PDA.

For effects to the visual landscape, shadow flicker, and acoustic environment VECs, modelling was conducted to define the zone of influence of the Project.

4.5.1.2 Temporal Boundaries

The EA's temporal boundaries span all phases of the Project: construction, operation and maintenance, and decommissioning. If the temporal boundaries do not span all phases of the Project, the VEC assessment will identify the relevant boundaries and provide a rationale.

4.6 Evaluation of Environmental Effects

4.6.1 Identification of Project–Environment Interactions and Pathways of Effects

Potential interactions between the Project and VECs are identified using a matrix approach to systematically identify which Project activities could substantially interact with each VEC. Potential interactions may be characterized as positive, adverse, or neutral depending on whether the interaction will be beneficial, adverse, or neutral for the respective VEC. In some cases, there is potential for both positive and adverse interactions to occur; in other cases, the interaction is neutral as a direct effect on that VEC but may create a pathway for positive or adverse effects on other VECs (i.e., indirect effects).

Where adverse interactions could occur, a more detailed assessment of the potential adverse environmental effects is completed. Each effect is analyzed qualitatively and quantitatively, when feasible. The assessment is based on existing knowledge, professional judgement, and analytical tools, when possible. Further analysis is not conducted for activities that are determined not likely to interact with the VEC, based on existing knowledge.

4.6.2 Identification of Mitigation Strategies

The pathways of effects approach used to identify mechanisms of potential environmental effects is also used to identify mitigation measures or strategies to avoid or reduce adverse Project effects on the VECs. Mitigation measures must be technically and economically feasible and are considered where there is a reasonable expectation that they will be effective. Mitigation strategies will include effective and established measures, if applicable. Where adverse environmental effects cannot be completely avoided or adequately reduced, additional measures are considered, including habitat offsetting, organism relocation, timing, and monitoring.

For each interaction where a mitigation measure is applied, the effectiveness of each mitigation measure applied will be assessed in order to identify any remaining residual effects. Residual effects are effects to VECs that are anticipated to remain following the implementation of mitigation measures.

4.6.3 Characterization of Residual Environmental Effects

The determination of significance is based on the following key criteria: magnitude, geographic extent, timing, duration, frequency, and reversibility. Adverse residual environmental effects that are identified as likely to occur as a result of the Project are characterized for each of these criteria.

Magnitude—the amount of change in a VEC as a result of the effect

Minor: the effect is at, or nominally above, baseline conditions
Moderate: the effect exceeds baseline conditions but does not exceed established regulatory criteria or published guidelines
Large: the effect exceeds established regulatory criteria or published guidelines

Geographic Extent—the area within which an effect of a defined magnitude will occur

- Immediate: the effect is limited to the PDA
- Local: the effect extends beyond the PDA but is within the LAA as defined for each VEC
- Regional: the effect will occur on a regional scale, extending out of the LAA to the RAA as defined for each VEC

Timing—when the effect occurs relative to the sensitive time period for the VEC

- Low: the effect occurs during low or non-sensitive time periods for the VEC
- Moderate: the effect occurs during moderately sensitive time periods for the VEC
- High: the effect occurs during highly sensitive time periods for the VEC

Duration—the period of time the effect persists (i.e., until the VEC returns to baseline conditions)

- Short- term: the effect occurs only during the site preparation or a portion of the construction phase
- Medium-term: the effect occurs throughout construction phase
- Long-term: the effect will persist beyond the construction phase of the Project

Frequency—how often the effect occurs during the Project or a specific Project phase

- Once: the conditions or activities causing the effect occur once
- Intermittent: the conditions or activities causing the effect occur intermittently
- Continuous: the conditions or activities causing the effect occur continuously throughout the Project phases

Reversibility—whether a VEC will recover from an effect and return to baseline conditions

- Reversible: the effect is feasibly reversible
- Irreversible: the effect is permanent

4.6.4 Determination of Significance

The significance of an effect will be determined using established or generally accepted benchmarks for each VEC, where available. Regulatory standards, guidelines, targets, or objectives will be used, when appropriate, to determine benchmarks. Considering the characteristics of the adverse residual environmental effects and comparison to available benchmarks, reasoned argumentation and professional judgment are applied to determine the significance of the effect.

4.7 Initial Screening and VEC Selection

The Project construction, operation and maintenance, and decommissioning activities were screened against the VECs to identify potential Project-VEC interactions and select VECs for further assessment. The potential interactions are identified in Table 4.1. Further description and evaluation of the potential environmental effects related to the identified interactions are provided in each of the VEC assessment chapters that follow.

The purpose of the Project is to act as a source of renewable energy Point Tupper Green Hydrogen/Ammonia project. The Project can also reduce the carbon footprint of the Municipality of Colchester and will contribute to its economy. Based on operational activities, there are VECs that are anticipated to be positively affected that do not require in-depth assessment for mitigation measures:

- Climate
- Economy

Based on the environmental setting and Project activities, pathways to possible adverse effects have been identified for some components of the environment. The assessment is focused on those VECs on which the Project may have adverse effects:

- Air Quality
- Ambient Light
- Acoustic Environment
- Topography and Landform
- Bedrock and Soils
- Groundwater
- Aquatic Environment
- Flora
- Wetlands
- Terrestrial Wildlife
- Bats
- Birds
- Land Use and Value
- Visual Landscape
- Communication and Radar Systems
- Transportation
- Recreation and Tourism
- Human Health
- Archaeological Resources
- Indigenous Cultural Resources

Table 4.1 Potential Project-Environment Interactions and VEC Selection

Project Activities	Environmental Components																						
	Atmospheric Environment				Geophysical Environment			Biophysical Environment						Socio-Economic Environment								Heritage and Cultural Resources	
	Climate and Weather	Ambient Light	Air Quality	Acoustic Environment	Topography and Landform	Bedrock and Soils	Groundwater	Aquatic Environment	Flora	Wetlands	Terrestrial Wildlife	Bats	Birds	Population and Economy	Land Use and Value	Visual Landscape	Electricity and Other Utilities	Communication and Radar Systems	Transportation	Recreation and Tourism	Human Health	Archaeological Resources	Indigenous Cultural Resources
Construction																							
Site Preparation	-	-	X	X	-	X	X	X	X	X	X	X	X	X	X	-	-	-	X	X	X	X	X
Access Road Construction and Modification	-	-	X	X	-	X	X	X	X	X	X	X	X	X	X	-	-	-	X	X	X	X	-
Material and Equipment Delivery and Storage	-	-	X	X	-	-	-	-	X	X	X	X	X	X	-	-	-	-	X	X	X	-	-
Infrastructure Installation	-	X	X	X	-	-	-	X	-	X	X	X	X	X	-	X	-	-	-	X	-	-	-
Restoration of Temporary Areas	-	-	X	X	-	-	-	X	-	-	X	X	X	X	-	-	-	-	-	X	X	-	-
Testing and Commissioning	-	X		X	-	-	-		-	-	X	X	X	X	-	-	-	-	-	-	-	-	-
Operation and Maintenance																							
Turbine Operation and Maintenance	X*	X	-	X	-	-	-	-	-	-	X	X	X	X	X	X	X	X	-	X	X	-	-
Road Maintenance	-	-	X	X	-	X	X	X	X	X	X	X	X	X	X	-	-	-	X	X	X	X	-
Power Line and Substation Maintenance	-	-	-	X	-	-	-	X	X	X	X	X	X	X	-	-	-	-	-	-	-	-	-
Vegetation Management	-	-	X	X	-	-	X	X	X	X	X	X	X	X	-	-	-	-	-	-	X		X
Safety and Security	-	X	-	X	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-
Decommissioning																							
Removal of Infrastructure and Site Restoration	-	X	X	X	-	X	X	X	X	-	X	X	X	X	-	-	-	-	X	X	X	X	X

X = Potential interaction
- = No meaningful interaction
*= Interaction with positive effect that does not require in-depth assessment for mitigation measures

5 Atmospheric Environment

5.1 Overview

The atmospheric environment comprises weather and climate, air quality, ambient light, and acoustic conditions.

Biophysical and socio-economic conditions are closely tied to components of the existing atmospheric environment, effects to which could thereby effect changes to other VECs. Weather conditions such as precipitation and temperature shape features of habitat such as the aquatic environment, wetlands, and vegetation. Skyglow and surrounding noise levels are aspects of habitat and behaviour for terrestrial wildlife, bats, birds, and the human environment. Air quality is a cumulative measure of pollutants in the air from emissions and particulate matter that can settle to our earth and waters, influence climate, and affect health for all forms of life. Interactions of the Project with the atmospheric environment are therefore considered for many VEC assessments that follow within this document.

It is anticipated that the Project will interact with the atmospheric environment via various pathways during construction, operation and maintenance, and decommissioning. Through the EA process, including public engagement and field studies, the Proponent has made changes to the early Project design and committed to mitigation measures that will avoid or reduce interactions of Project activities with the atmospheric environment. The number of turbines has been reduced by approximately 15 percent and setbacks of 2 km from residential homes have been established to control local exposures to increased dust, vehicle emissions, noise, and anthropogenic light. Beyond the changes in design, the Proponent has committed to measures that will further mitigate effects to the atmospheric environment. The overall purpose of the Project is to generate energy that does not produce carbon emissions and, combined with the Point Tupper Green Hydrogen/Ammonia project, will offset the use of fossil fuels and generating carbon emissions savings.

Effects, mitigation measures, and residual impacts to atmospheric environment as a result of the Project are outlined in this chapter and will be further developed in a Project-specific EPP prior to construction to minimize adverse effects.

5.1.1 Regulatory Context

Assessment of the atmospheric environment considers provincial and federal regulations, policy, and guidelines:

- Nova Scotia *Environment Act*
- Nova Scotia Air Quality Regulations
- Canadian Ambient Air Quality Standards (CAAQS)
- The Guide (NSECC, 2021)
- NSECC Guidelines for Environmental Noise Measurement and Assessment (NSECC, 2023)
- Health Canada Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise (Health Canada, 2017)

5.1.2 Assessment Methodology

The description of the existing environment is based primarily on data collected by regional air quality and meteorological monitoring stations as well as online scientific reports:

- ECCC Canadian Climate Normals
- Nova Scotia Ambient Air Quality Data Reports
- Nova Scotia Ecological Landscape Analysis

A noise assessment was completed for the Project by WSP Canada Inc. (WSP, 2024) and is provided in Appendix E. WSP (2024) established a study area for the noise assessment as a 2 km buffer from the Project wind turbines and substation.

Potential noise receptors were selected using publicly available satellite imagery and a field program that identified a total of 21 noise receptors for inclusion in the assessment. Seven of these receptors are located at a distance slightly greater than 2 km from a turbine (i.e., up to 2,100 m). WSP (2024) applied a baseline acoustic value recommended by Health Canada (2017), where 35 dBA is considered the average baseline acoustic level in quiet, rural areas during nighttime periods.

Computer models were used to predict noise levels from operation of the Project as well as the cumulative effect of the operation of the Project combined with the planned Kmtnuk wind facility east of the Project. Details on the computer noise model inputs are provided in WSP (2024) and consisted of source emissions from Project turbines and substation transformers, as well as environmental conditions that are known to influence noise propagation (e.g., ground cover, temperature, humidity, wind conditions).

5.2 Existing Environment

5.2.1 Climate and Weather

The Project is located within the Nova Scotia Uplands ecoregion, which is one of the most humid parts of the Maritime provinces, influenced by the Atlantic Ocean (Marshall et al., 1999). The ecoregion is characterized by warm summers and mild, snowy winters. The Cobequid Hills ecodistrict, while typically having the greatest amount of snowfall, is the driest ecodistrict within the ecoregion with an annual precipitation of 1,200 mm (Province of Nova Scotia, 2015).

Although the nearest weather station to the PDA that records Canadian Climate Normal data is the Debert Weather Station (approximately 10 km south of the nearest turbine), the elevation of Jackson station (approximately 24 km west of the nearest turbine) is more comparable having an elevation of 91.4 m (Debert being only 38.1 m) (ECCC, 2023). Climate Normals, based on the most recently available collection of meteorological data between 1981 and 2010, indicate that the average annual temperature at Jackson was 5.7 °C. The average annual precipitation for Jackson was 1,455.3 mm, with a daily extreme in the form of rainfall being 121.4 mm in August 1987.

Canadian Climate Normals updates are underway by ECCC to reflect the 1991 to 2020 time period. Debert is the nearest station with the updated data (ECCC, 2023). At Debert, the average daily temperature between 1991 and 2020 was 6.2 °C with a daily maximum temperature of 25.0 °C in July; the daily minimum being -12.0 °C in January. These values are nearly identical to that of the previous dataset of 1981 to 2010, having values of 6.1 °C, 24.8 °C, and -11.8 °C, respectively. The average annual precipitation for Debert in the 1991 to 2020 period was 1,178.5 mm, which is comparable to the value of 1,168.3 mm for the decade previous.

Comparing the datasets for Debert and Jackson for the 1981 to 2010 period indicates that temperatures were slightly lower at the high elevation of the Jackson weather station and that overall precipitation is slightly greater than that of Debert (Table 5.1). Averages and extremes appear to have remained similar between the two datasets for Debert.

Table 5.1 Climate Normals Data (°C) for Jackson and Debert Meteorological Stations

Measure	Jackson		Debert	
	1981 – 2010	1991 - 2020	1981 – 2010	1991 - 2020
Average Annual Daily Temperature	5.7	nd	6.1	6.2
Daily Max Temperature	24.5	nd	24.8	25.0
Extreme Max Temperature	34.5	nd	34.0	nd

Measure	Jackson		Debert	
	1981 – 2010	1991 - 2020	1981 – 2010	1991 - 2020
Daily Min Temperature	-13.2	nd	-11.8	-12.0
Extreme Min Temperature	-40.0	nd	-35.0	nd
Total Average Annual Precipitation	1,455.3	nd	1,168.3	1,178.5

nd: no data

As part of the feasibility studies for the proposed Project, a MET tower was erected in the LAA. MET tower M821 is sited at 45.580378 N, 63.481302 W. Data collected intermittently between 2011 and 2023 indicate that winds are predominantly southwest (211.60°) at a mean wind speed of 7.85 m/s.

5.2.2 Air Quality

Nova Scotia shares air quality monitoring data with the federal government to inform the Air Quality Management System (AQMS) across Canada. The Canadian Council of Ministers of the Environment (CCME) assesses provincial values against the CAAQS (CCME, 2024) for fine particulate matter ($PM_{2.5}$), ground-level ozone, sulphur dioxide (SO_2), and nitrogen dioxide (NO_2). The CAAQS are meant to work progressively toward improving the air quality of Canada and are reviewed every five years. The CAAQS for 2020 and 2025 are presented in Table 5.2.

Table 5.2 Canadian Ambient Air Quality Standards

Pollutant	Averaging Time	Standards (concentration)	
		2020	2025
$PM_{2.5}$	24-hour (calendar day)	27 µg/m^3	Under review
$PM_{2.5}$	Annual (calendar year)	8.8 µg/m^3	Under review
Ground level Ozone	8-hour	62 ppb	60 ppb
SO_2	1-hour	70 ppb	65 ppb
	Annual	5.0 ppb	4.0 ppb
NO_2	1-hour	60 ppb	42 ppb
	Annual	17.0 ppb	12.0 ppb

$PM_{2.5}$: Particulate matter having a size of 2.5 micrometres (µm) or less
ppb: parts per billion
µg/m^3: micrograms per cubic metre

Nova Scotia is divided into four air zones; the Project is located within the northern air zone, where ambient air is monitored by the province at Pictou. The northern air zone contains a population of 0.2 million people, extending across the entirety of the northern shore of mainland Nova Scotia and to a southern extent that includes the communities of Sherbrooke and Truro (Health Canada, 2023).

Based on the 2021 data (which is the most current at the time of EA preparation) the CAAQS were met in all four air zones in Nova Scotia (NSECC, 2023a). With a goal to prevent deterioration of ambient air quality, two parameters in the northern air zone have been categorized as “yellow” under the CCME’s Air Zone Management System, reflecting an aim to further reduce ground-level ozone and $PM_{2.5}$ annual concentrations. Although ground-level ozone values have risen from 45 to 51 ppb since 2016, the 2021 value is still within the target range of 51 to 56 ppb for the 2020 to 2024 period. The $PM_{2.5}$ annual levels in the northern zone have decreased from 6.6 to 5.0 μg/m^3 since 2016, reaching a value within the 2024 target range of 4.1 to 6.1 μg/m^3 per year.

5.2.3 Ambient Light

The PDA is predominantly enclosed within a mountainous treed area with little exposure to anthropogenic light sources. Recreational vehicles use headlights to travel the roads and trails at night throughout the year. Ambient light in the surrounding area is typical of rural settings. Streetlights are present where there are clusters of homes and along Highway 104. Cross-country and downhill trails and lifts are lit in the evenings for nighttime skiing at Ski Wentworth during the winter season approximately 5 km from the PDA. During summer months, full foliage in the mountainous terrain limits the distribution of light pollution in the area.

5.2.4 Acoustic Environment

During the daytime, natural sounds such as that from songbirds are present in the LAA (as further described in Chapter 12: Birds) as well as anthropogenic noise from road and off-road traffic and activities that use heavy equipment, such as quarrying and forestry.

The 2 km noise assessment area is considered to match the Health Canada description of being a quiet rural area where natural noise sources tend to dominate, having baseline sound levels of 35 dBA during nighttime periods (Health Canada, 2017 in WSP, 2024). A-weighted measures of sound consider the full frequency of human hearing and are a standard used in hearing damage risk assessment. C-weighting provides another measure of sound that considers impacts of low-frequency sound on human hearing and is used to measure impulse noise. On the C-weighted scale, the assessment area is considered to have baseline sound levels of 42 dBC, which is representative of a quiet rural area during nighttime (Young et al., 2015 in WSP, 2024).

5.3 Effects Assessment

5.3.1 Boundaries

Air Quality: According to the United States (US) Environmental Protection Agency, influences on air quality are generally limited to a range of 500 to 600 feet (152 to 183 m) downwind from the vicinity of heavily travelled roadways or along corridors with significant trucking traffic or rail activities (US Environmental Protection Agency, 2014). A conservative boundary of 500 m surrounding the PDA has therefore been selected as the LAA for air quality. The Project is anticipated to affect air quality within the LAA for the lifetime of the Project, predominantly during activities that involve earthworks. The RAA is considered to be within the limits of Nova Scotia's northern air zone assessed within the AQMS by ECCC through monitoring at Picou, which includes both the LAA and the Point Tupper Green Hydrogen/Ammonia project that will be powered by the Project's renewable energy.

Ambient Light: Effects from anthropogenic light depend on properties of the light source and height as well as atmospheric conditions. An LAA of 1 km around the PDA has been selected for effects to light levels to the surrounding receptors; the RAA is limited to the airspace within which the ADLS is triggered by approaching aircraft—approximately 5.5 km (3 nautical miles).

Acoustic Environment: An LAA of 2 km from turbines has been selected as per the Guide. An RAA of 2 km combining both the Project turbines and those of the adjacent Kmtnuk project was also assessed by WSP. It is anticipated that sound levels in the LAA and RAA will be affected for the lifetime of the Project.

5.3.2 Potential Effects and Mitigation

Several changes were implemented for the Project to minimize potential direct and indirect impacts on the atmospheric environment, where reasonable, while meeting engineering and design constraints. Detailed design of the Project and micrositing of turbines will further reduce potential interactions between the Project and potential receptors of air, noise, and light effects. Micrositing involves exact placement of the turbine within the turbine sites as shown in the PDA. The proposed layout has been designed to use existing roads for most of the PDA access.

Direct and indirect effects of the Project on components of the atmospheric environment could occur through various interconnected pathways. During construction, operation and maintenance, and decommissioning, vehicular emissions, fugitive dust, and noise are expected to be produced—which will affect air quality. Ground lighting of the Project footprint and aerial lighting on turbines will contribute to ambient light in the PDA and LAA. There will also be effects to the acoustic environment during all phases of the Project when people and vehicles are on site and turbines are in operation.

Project activities can affect the atmospheric environment as indicated in Table 5.3; these potential effects do not consider the detailed design of the Project and micrositing of turbines that is yet to be completed or the implementation of mitigation measures described herein.

Table 5.3 Potential Environmental Effects of the Project on the Atmospheric Environment

Project Activity	Potential Environmental Effects		
	Change in Air Quality	Change in Ambient Light	Change in Acoustic Environment
Construction			
Site Preparation	X	-	X
Access Roads Construction and Modifications	X	-	X
Material and Equipment Delivery and Storage	X	-	X
Infrastructure Installation	X	X	X
Restoration of Temporary Areas	X	-	X
Testing and Commissioning	-	X	X
Operation and Maintenance			
Turbine Operation and Maintenance	-	X	X
Road Maintenance	X	-	X
Power Line and Substation Maintenance	-	-	X
Vegetation Management	X	-	X
Safety and Security	-	X	X
Decommissioning			
Removal of Infrastructure and Site Restoration	X	X	X

X = Potential Interaction
- = No Interaction

5.3.2.1 Air Quality

The following key measures to mitigate the potential effects of the Project on air quality will be further detailed in a Project-specific EPP to be implemented prior to and during construction:

- Onsite workers will visually monitor the construction site and report any dust concerns to the site inspector.
- Dust control measures (e.g., application of water) will be used during any periods of significant dust generation.
- Use of petroleum product for dust control is prohibited.
- Good housekeeping practices will be employed to prevent dust from leaving the PDA.
- Any disturbed areas where soil is exposed will be reestablished as soon as the season permits and in accordance with contract specifications.

- Idling of heavy machinery and vehicles will be minimized as practicable.
- Heavy machinery and vehicles will be regularly checked and maintained for optimal operational emission levels.
- Speed limits will be enforced.
- Drop heights will be minimized when unloading trucks.
- Construction activities during high winds will be avoided whenever possible.
- No burning of cleared or grubbed materials will be permitted on site; surplus clearing and grubbing materials will be hauled off site for disposal.
- A Complaint Resolution Plan will be developed prior to construction.

5.3.2.2 Ambient Light

Activities associated with lighting of the PDA will occur throughout the life of the Project. In the short term, there may be some nighttime construction activities, which will require flood lights for human safety. Construction will be conducted seven days per week. While light diffusion depends on atmospheric conditions and sightlines, it is anticipated that the LAA is limited to 1 km around the PDA. During operation and maintenance, turbine towers will require lighting for the safe navigation of aircraft during Project operation. Some site lighting, such as that for the substation and operation and maintenance building, will also be required for the duration of the operation and maintenance phase. Lighting will be limited to safety and security needs during construction and operation. During construction and maintenance, if lighting on site is required, spill-over light will be minimized and be side-shielded and directed downward, where possible. Construction activities will be limited to the daylight hours, when possible. Turbine and transmission line lighting levels will be minimized, while meeting Transport Canada's requirements for aeronautical safety. Dark sky friendly lighting options, such as ADLS lighting, are being evaluated. With these mitigations, change to ambient light levels is expected to be low for the lifespan of the Project.

The following key measures to mitigate the potential effects of the Project on ambient light will be further detailed in a Project-specific EPP to be implemented prior to and during construction:

- Nighttime construction activities will be minimized.
- Onsite lighting will be installed to the minimum required for safety.
- Where onsite lighting is installed near the perimeter of the LAA, open areas will be avoided where possible.
- An ADLS is expected to be used; turbine lighting will not exceed the minimum standards in the Canadian Aviation Regulations (i.e., Standard 621, Section 12.2).
- The fewest number of site-illuminating lights possible will be used in the PDA. Minimize lighting to the extent possible, while maintaining Transport Canada requirements.
- Site lighting will be shielded downward to minimize light pollution to the surrounding environment and adjacent habitat, without compromising safety.
- Movement detection lighting will be used on office structures, doors to turbines, gates, etc., which will turn off when not in use.
- A Complaint Resolution Plan will be developed prior to construction.

5.3.2.3 Acoustic Environment

The primary noise sources associated with construction will include trucks and other vehicles used to transport workers and materials to the PDA, backhoes and graders, cranes, and smaller equipment such as welding units. Blasting may be necessary for construction or upgrades of access roads. During operation and maintenance, the primary noise emissions are expected to occur through operation of the turbines. The modelling results (Appendix E) predict sound levels ranging from 14.9 to 37.5 dBA during operation at 20 of the 21 receptors. The modelled operation noise levels are therefore compliant with the regulated noise level limits at all but one receptor: a camp located within 2 km of a turbine, where the noise level is predicted to exceed the 40 dBA as provincial the regulation. However, the owner of the camp has an agreement with the Proponent waiving the requirement to comply with regulated noise level limits.

In combination with natural and non-industrial anthropogenic sources, WSP (2024) determined that Project operation will comply with the permissible sound levels outlined in the provincial noise guidelines within both the LAA and the RAA (Appendix E).

The following key measures to mitigate the potential effects of the Project on acoustic environment will be further detailed in a Project-specific EPP to be implemented prior to and during construction:

- Nearby residents will be notified about scheduled noisy activities (e.g., blasting) to reduce disruption.
- A Blasting Management Plan will be developed.
- Blasting will be conducted by a certified blaster.
- Blasting patterns and procedures that minimize shock or instantaneous peak noise levels will be used, where possible.
- Blasting activities will be limited to that which is absolutely necessary.
- Blasting will not occur near fuel storage facilities.
- Construction will occur during daytime hours and will be restricted at night, when possible.
- Work areas and travel paths will be designed to reduce the amount of time that equipment must operate in reverse in order to reduce the use of back-up alarms.
- Noise-reducing technologies will be used to minimize construction noise.
- Construction equipment and vehicles will be kept in good working order and loud machinery will be muffled when possible.
- A Complaint Resolution Plan will be developed prior to construction.

5.3.3 Residual Effects

Effects to the atmospheric environment are not anticipated to increase air quality parameters in the LAA to levels above CAAQS. Effects will be temporary, occurring predominantly during construction, but will occur intermittently during operation and maintenance activities and temporarily during decommissioning. Lighting of the footprint will be the minimum required for safety of the operations crew, and wooded areas will absorb most ground light diffusion within the LAA. Aerial light diffusion will be intermittent during operation, triggered only by aircraft passing through the ADLS sensory zone. The noise assessment predicts that Project construction and operation is not expected to result in unacceptable noise effects in either the LAA or the RAA. Overall, the Project's contribution to renewable energy will have positive environmental effects for the air quality of the RAA; effects to ambient lighting and the acoustic environment will be reversed upon decommissioning of the Project.

5.4 Monitoring

Aside from general observations and mitigation during work activities, monitoring is not proposed. A Complaint Resolution Plan will be developed prior to Project commencement. The plan will include noise monitoring methods should an operational noise related complaint require investigation by the Proponent.

6 Geophysical Environment

6.1 Overview

The geophysical environment comprises the surficial topography (both natural and artificial) and underground resources, such as bedrock and soils, as well as groundwater. Surficial geology and topography shape the bioterrain of the ecological environment and is therefore closely related to other VECs assessed in this EA. Changes in topography can affect surface water flow, effecting change on the aquatic environment, wetlands, and groundwater recharge. Soil and bedrock matrices influence dust formation and erosion. Changes in groundwater can affect the surrounding ecosystems (aquatic and terrestrial) and socio-economic environment, namely human health.

It is anticipated that the Project will interact with the geophysical environment via various pathways during construction, operation and maintenance, and decommissioning. Site works in the PDA will involve the reshaping of the surface during construction that will affect the site's topography and run-off. Existing roads will be used to the extent possible, but excavation and blasting will be used where needed to achieve road grades of 8 percent or less and/or prepare turbine foundations. During decommissioning, while surface infrastructure will be removed (with the exception of access roads where landowners opt for retainment), it is anticipated that the PDA will be restored to an approximate depth of 1 mbgs below which remaining structural components will remain in place.

Effects, mitigation measures, and residual impacts to the geophysical environment as a result of the Project have been outlined in this chapter and will be further developed in a Project-specific EPP prior to construction to minimize adverse effects.

6.1.1 Regulatory Context

Assessment of the geophysical environment considers characteristics of the existing environment and measures effects using provincial and federal legislation and guidelines:

- Nova Scotia *Environment Act*
- Nova Scotia *Water Resources Protection Act*
- French River Watershed Protected Water Area Regulations (NSECC, 2022)
- Sulfide Bearing Material Disposal Regulations NS. Reg. 57/1995
- Health Canada Guidelines for Canadian Drinking Water Quality (2022)

- The CCME Soil Quality Guidelines for the Protection of Environmental and Human Health (CCME, 2007)

6.1.2 Assessment Methodology

The description of the existing environment is based primarily on available online data sources, which were appended with data collected during site visits:

- Ecological Land Classification for Nova Scotia
- Nova Scotia Geoscience Maps, Reports, and Data
- Nova Scotia Water Resource Reports and Maps
- Nova Scotia Well Logs Database
- Nova Scotia Groundwater Atlas

Strum Consulting (Strum) began a geotechnical investigation at private properties within the LAA between July 21 and October 16, 2023. The draft report (Strum, 2023) describes that the work so far has included the following:

- 53 boreholes
- 52 monitoring wells in the completed boreholes
- 3 shallow test pits
- 2 in situ thermal resistivity tests
- 52 electrical resistivity locations
- A seismic survey

Investigations are ongoing, including work on Crown lands, as well as groundwater investigations and seismic surveys.

Field verification of groundwater wells within 2 km of the PDA was completed by CBCL on September 6 and 7, 2023. An attempt was made to visit each civic address to visually identify and photograph each well and identify well type (drilled versus dug). This data was appended to registered wells on the Nova Scotia Groundwater Atlas (Appendix F).

6.2 Existing Environment

6.2.1 Topography and Seismicity

Nova Scotia, as a whole, is part of the Appalachian region. The PDA lies within Ecodistrict 340: Cobequid Hills in the Nova Scotia Highlands Ecoregion and has one of the highest elevations in mainland Nova Scotia at 365 masl. The ecodistrict overlaps the Cobequid-Chedabucto Fault System, also known as the Glooscap Fault System, which is responsible for the considerable topographical variation between the highlands of the Cobequid Mountains and the lowlands in the south. (Nova Scotia Department of Lands and Forestry (NSDLF), 2019). The fault blocks consist of pre-Carboniferous metamorphic sediments, volcanic deposits such as granite, and sedimentary deposits including sandstones, shales, and limited deposits of limestone. The fault is known as a strike-slip fault, where the topography was created through rock strata displacing horizontally, parallel to the fault line. Seismic reflection surveys in the northern portion have indicated that there has been no shearing activity in the fault over the past 15,000 to 18,000 years (Fader, 2005). The province forms part of the Northern Appalachian Seismic Zone, which is not located near the edges of tectonic plates and is, therefore, considered low risk for major earthquakes. A seismic survey has been completed in the PDA and results in the draft geotechnical report indicate that the land is suitable for the Project components (Strum, 2023).

A history of ground disturbance within the slopes of the Cobequid Hills has further contributed to naturally undulating terrain. Within the LAA, elevations range from 178.5 to 355.3 masl and there exists a dirt/gravel road network totalling more than 100 km in length. Logging, forestry, quarrying, and ditching have affected surficial stability and have resulted in a myriad of drainage channels vulnerable to erosion.

6.2.2 Bedrock and Soils

The ecodistrict's bedrock geology comprises rocks from the Precambrian and Carboniferous periods of igneous, metamorphic, and sedimentary origins (NSDNRR, 2006). Granite, gabbro, gneiss, siltstones, argillite, sandstone, agglomerate stratified rocks, and plutonic rocks are typical. Barite and graphite, iron ore, copper, and gold are known to exist in the bedrock geology, along with hydrocarbon deposits.

Interactive mapping provided by the province is based on that originally produced by J.D. Keppie, 2000 (NSDNRR, 2006). The majority of the LAA is underlain by igneous rock. Extrusive igneous rock from the Byers Brook and Diamond Brook formations to the north are typically basalt and rhyolite. Intrusive igneous rock from the Devonian–Carboniferous period spans east-west across the central portion, composed of granite, granodiorite, diorite, and gabbro. Significant portions of the southwest region are composed of metamorphic rock from the Gamble Brook and Folly River formations. Slate, marble, schist, and gneiss are common and are underlain by clastic sedimentary rocks from the Pictou group including conglomerate, sandstone, siltstone, shale, and coal.

The till within this region is derived from sandstone of the Horton bedrock (Boreas, 2022). There are deposits of gravel, glacial fluvial sands, and plutonic rocks through the ridges and valleys that are extracted for use as aggregate resources.

Soils within the PDA consist mostly of Cobequid soils—a stony, dark brown, gravelly loam underlain by a dark brown gravelly loam (Boreas, 2022). Additionally, Folly soils and Truro soils are also present within the southern portion. Folly soils are characterized by a light brown, gravelly loam over yellowish-brown gravelly sandy loam and Truro soils are composed of a light brown sandy loam underlain by a red sandy loam with stone-free, loose soil.

The following site-specific conditions are described in the draft geotechnical report (Strum, 2023):

- Surface soils consisted of topsoil and rootmat overlying a thin layer of undisturbed glacial till; in some instances, exposed bedrock.
- Glacial till was characterized as sandy silty clay with gravel, including some boulders and cobbles.
- Depth to bedrock ranged from 0.2 to 8.4 mbgs, however bedrock was encountered within 1 mbgs at the majority of the borehole locations (39 of 53). Samples submitted to a laboratory to date did not contain high sulphate or chloride concentrations that are typically associated with degrading concrete foundations or contributing to acid rock leachate.
- Based on results to date, the site has been deemed favourable for the Project's anticipated foundation loads for turbines and laydown areas.
- The existing till was determined to be suitable for use in restorations of temporary areas and grading, but characterized as being susceptible to erosion.

6.2.3 Subsidence and Sinkholes

The PDA lies primarily in areas of low karst. Karst is associated with subsidence and sinkholes where soluble evaporite or carbonate rocks can dissolve (NSDNRR, 2021a). Sinkholes have appeared in areas characterized as high risk in Cumberland County, most recently at Slade Lake (2020) and Oxford (2018). Geophysical investigations have determined that the water features themselves were most likely formed as a result of sinkhole formations there in the past (Harbourside Geotechnical Consultants, 2020). Slade Lake is colloquially known as Dry Lake because it has a history of emptying (Coleman, 2020). Voids detected in boreholes during geotechnical investigation near Route 321, approximately 60 km northwest of the LAA, suggest a high risk to critical infrastructure such as portions of Highway 104 (GHD, 2019). Further studies in 2020 were performed adjacent to the Trans-Canada Highway 104 in the Oxford area, where it was determined that there has likely been slow subsidence in the past as indicated by small depressions in the pavement that have been filled and repaired (Harbourside Geotechnical Consultants, 2020). It has also been suggested that subsidence along the highway may be a result of infilling during construction activities rather than karst activity. Subsurface hazards such as karst topography and sinkholes were not observed in 2023 during the onsite geotechnical investigations (Strum, 2023).

6.2.4 Groundwater

Groundwater flow is influenced by the primary porosity (pore spaces) and secondary porosity (fracture occurrence) in the bedrock. Sedimentary rock is typically highly fractured, and groundwater flows through pore spaces in the rock and along bedding planes and fracture zones. Igneous and metamorphic rock relies on faults and fractures to transmit water. For example, basalt present in large portions of the assessment area commonly exhibits significant vertical jointing. Vertically jointed rock at high elevations is associated with significant groundwater recharge zones and downward vertical flow systems. Flow systems originating within the high elevation assessment area may represent a significant component of water available from sedimentary aquifers found on the lowlands north and south of the Cobequid range.

There are several geologic contacts in the region, originating from west to east along the axis of the Cobequid range. The Cobequid Fault marks the transition between the predominantly crystalline rocks of the upland area and sedimentary rocks in the lowland areas. Fault systems in this context can promote artesian conditions and may be associated with significant springs. The yields of the production wells serving the Debert municipal system (approximately 5 km south of the PDA) are exceptional and may benefit from the combination of upland vertically jointed rock adjacent to a major fault system as well as coarse-grained sedimentary rock.

6.2.4.1 Watersheds and Groundwater Flow Divides

The majority of the LAA is part of the Bay of Fundy drainage basin, receiving flow from the Debert and Salmon River watersheds (Nova Scotia Environment, 2011). The northwest and northeast portions of the area flow to the Philip / Wallace rivers and River John, respectively, both of which discharge to the Northumberland Strait. These regional watersheds also represent groundwater recharge areas and flow divides. Southern systems discharge to Cobequid Bay and the Bay of Fundy. Groundwater flow patterns are likely influenced by the variety of geologic formations and rock types present within the assessment area.

Groundwater–surface water interactions are influenced by a variety of factors such as permeability of surficial sediments and bedrock, precipitation that contributes to groundwater recharge, and the presence of wetlands, lakes, and rivers which are influenced by topographic relief. The dramatic topographic relief across the RAA, and the presence of this surficial hydrology, results in complex groundwater–surface water interactions. Lakes, ponds, and rivers could serve as areas of focused groundwater recharge, especially where surficial sediments are thin and bedrock porosity is high. Groundwater springs are likely present toward the bottom of steeper hills and cliffs as groundwater flows from regions of high to low pressure, often reflecting surface topography.

6.2.4.2 Protected Wellfields and Municipal Water Supplies

The two nearest public water supplies are the Tatamagouche Water Utility, which draws water from the French River, and the Debert Water Utility, which draws water from two municipal groundwater wells.

The Tatamagouche Water Utility draws water from the French River, near the intersection of River Road and Cooper Road. The French River watershed (Figure 6.1), which discharges water to French River, was designated as a Protected Water Area in January 2022 under Regulation 8/2022 of the *Environment Act*. Four of the proposed turbine locations in the northeastern area of the PDA, as well as portions of associated access roads, are located on the border of this protected area. Section 6 of the Regulation states,

> *A person must not undertake any activity within the Protected Water Area requiring grubbing or earth moving that would expose an area of ground 0.40 ha or greater in area without developing an erosion and sedimentation control plan as described in the Erosion and Sedimentation Control Handbook for Construction Sites published by the Department, or its successor document or code of practice.*

It is also legislated that clearing must maintain an undisturbed buffer of 10 m from the French River. The Tatamagouche Water Works Operator is to be notified in writing 15 days prior to clearing activities. There are also prohibitions listed for disposal areas and requirements related to agricultural, ground exploration, quarrying, and mining activities within the watershed.

The Debert Water Utility draws water from two municipal groundwater wells: Well 1-C on Canso Cresent, approximately 6 km south of the PDA, and Well 2-A on Dakota Road, approximately 5 km south of the PDA. Each well has a designated Groundwater Protection Area that extends north of the well heads, following the theoretical direction of source water for the wells (Municipality of the County of Colchester, 2023). The Groundwater Protection Area for Well 1-C extends 3 km north; the groundwater protection area for Well 2-A extends 3.5 km northwest. Both protection areas are located more than 3 km from the PDA.

6.2.4.3 Potable Water Wells

A search of the Nova Scotia Well Logs Database (NSECC, 2023), in combination with wells observed in the field, identified 66 wells within 2 km of the PDA, 52 of which are within 1 km of a Project access road, as illustrated in Figure 6.1 and listed in Appendix F. Only 31 of these well records provide information pertaining to structural characteristics and water quality analyses. The wells within 1 km of the PDA are primarily used for domestic, single-family dwellings. Information regarding depth to bedrock, total well depth, casing depth, static water level, and estimated yield (cubic metres per day (m^3/day)) for these wells is summarized in Table 6.1. Wells that were solely identified in the field, or had no reported data on the database, were excluded from Table 6.1, leaving 25 to 31 well records available for statistical analysis.

Table 6.1 Summary Table for Wells Within 1 km of the PDA

	Bedrock Depth (m)	Well Depth (m)	Casing Depth (m)	Static Water Level (m)	Estimated Yield (m^3/day)
Minimum	2.1	12.2	6.1	0	16
1st Quartile[1]	5.2	30.8	12.2	3	39
Median	6.4	36.5	15.2	7	98
Mean	7.6	37.3	17.7	6.4	101

	Bedrock Depth (m)	Well Depth (m)	Casing Depth (m)	Static Water Level (m)	Estimated Yield (m^3/day)
3rd Quartile[2]	8.5	42.9	18.3	7.9	131
Maximum	20.4	76.1	49.3	12.2	392
Number of Record Entries	25	31	31	25	30

[1] 1st Quartile – The value below which 25% of the data points are found when arranged in ascending order
[2] 3rd Quartile – The value below which 75% of the data points are found when arranged in ascending order

Records indicate that well depths are relatively shallow (median value of 37.1 m) and provide moderate yields (median value of 98 m^3/day), which is more than enough water for domestic use.

Pumping test data provided on the provincial database in the vicinity LAA is sparse. Several pumping tests conducted in the Wolfville formation south of the PDA, surrounding the community of East Mines, indicate long-term yields between 400 and 1,000 m^3/day. There are no records of pumping tests completed in the igneous and metamorphic rock that underlies much of the LAA. A study by Hennigar (1972) compiled records from three 1-hour pumping tests completed in slate and granite bedrock of the Cobequid Complex and reported long-term yields between 16 and 45 m^3/day—typical for fractured slate and granite.

A provincial observation well in Debert (number 068), located approximately 6 km south of the PDA, has water levels recorded periodically since 1993 (NSECC, 2023). The well is 46.6 m deep and drilled into sedimentary bedrock of the Wolfville formation. Water level data between 1993 and 1995 vary seasonally between 22 and 25 masl. A gap in the data exists between 1995 and 2007. Between 2007 and 2023, seasonal water levels are consistent, with high water levels reaching 27 masl in the spring and low water levels of 23 masl in the late summer.

Most wells identified within the LAA are in concentrated residential areas such as Belmont, Staples Brook, East Wentworth, and the north end of Folly Lake; each home likely serviced by either a dug or drilled well (Figure 6.1). These communities exist primarily on the perimeter of the LAA. Nearby communities that also rely on domestic wells as a source of potable water include Belmont, Debert, and North River, south of the PDA, as well as Folly Lake and Hart Lake in the north. Drilled wells in these areas likely draw water from shallow and intermediate flow systems that originate in higher elevation areas. Other features in the area that are likely to be supported by local and intermediate flow systems are Folly Lake and the Debert River, as well as numerous local streams and wetlands. The community of Byers Lake northeast of the PDA is primarily populated with small cabins and cottages, likely serviced by dug wells (as observed during the field surveys) or having no groundwater supply at all. Dug wells here and in other areas of high topographic relief in the area could be more vulnerable to surface water or shallow groundwater contamination culminating from Project activities. Other notable groundwater users within 2 km of the PDA include two campgrounds: Camp Evangeline to the south and Hidden Hilltop Family Campground southwest.

6.2.4.4 Groundwater Quality

Groundwater quality in general varies depending on the type of rock forming the aquifer through which the groundwater flows. Groundwater from igneous and metamorphic rock in Nova Scotia tends to exhibit higher concentrations of dissolved metals such as iron and manganese. Risk maps of the province available from the Nova Scotia Department of Mines show some instances of elevated manganese in regional well water (Kennedy, 2021).

The PDA is underlain by a variety of arsenic-bearing rock formations. In Nova Scotia, arsenic in groundwater is derived from bedrock hosting sulphide minerals (primarily pyrite/pyrrhotite-bearing slate and granite). Much of the west and central portions of the LAA has been designated as a high risk zone for arsenic (Figure 6.2), associated with granite and gabbro igneous formations (Kennedy and Drage, 2017). Medium risk zones have also been identified that are associated with sedimentary deposits of the Nuttby formation.

Uranium has been identified in elevated concentrations across many groundwater wells in Nova Scotia. Uranium occurs in both igneous and sedimentary rock. Sedimentary deposits from the Pictou group in the southern area of the PDA have been labelled as high risk for uranium in groundwater (Figure 6.3), and granitoid rock types across the PDA have been labelled as medium risk (Kennedy and Drage, 2020). Radon is naturally occurring product of the breakdown of uranium. Radon is not considered a risk for drinking water (NSECC, undated); however, the PDA is underlain by areas of low to high risk potential for radon in indoor air (Figure 6.4). Water quality is assessed using Health Canada's Guidelines for Canadian Drinking Water Quality (Health Canada, 2022), which have been adopted by NSECC (NSECC, 2024a). Arsenic, uranium, and radon are further discussed in Chapter 13 (Socio-Economic Environment) in relation to human health.

The draft geotechnical report (Strum, 2023) indicates that 52 groundwater monitoring wells were installed during summer 2023 and further geotechnical investigation is ongoing, which will include groundwater draw-down testing.

6.3 Effects Assessment

6.3.1 Boundaries

Bedrock and Soils (Quantity and Quality): Physical changes in bedrock and soil characteristics will be limited to the PDA for the lifetime of the Project; some infrastructure will remain after decommissioning.

Groundwater (Quantity and Quality): An LAA of 1 km outside the PDA boundary has been established. An RAA that includes the extent of the primary watershed boundary will also be considered.

6.3.2 Potential Effects and Mitigation

Several changes were implemented for the Project to minimize potential direct and indirect impacts on the geophysical environment, where reasonable, while meeting engineering and design constraints. For example, three turbine locations previously proposed for siting within the French River Watershed Protected Water Area have been removed or relocated to outside its boundary. As described in Section 2.1, the estimated extent of disturbance in the PDA is a conservative estimate that will ultimately be smaller after detailed design is complete. Detailed design of the Project and micrositing of turbines will reduce potential interactions between the Project and the geophysical environment. Micrositing involves exact placement of the turbine within the turbine sites as shown in the PDA.

Direct and indirect effects of the Project on the geophysical environment could occur through various interconnected pathways. During construction, there will be blasting in some locations and fill brought to the PDA for developing access roads and turbine pads, which could affect ground stability and possibly future land use. Infrastructure at a depth greater than 1 mbgs, such as turbine foundations, will remain after decommissioning and landowners will have the option to retain access roads. Project activities can affect the geophysical environment as indicated in Table 6.2; these potential effects do not consider the detailed design of the Project and micrositing of turbines that is yet to be completed or the implementation of mitigation measures described herein.

Table 6.2 Potential Environmental Effects of the Project on the Geophysical Environment

Project Activity	Potential Environmental Effects			
	Bedrock and Soils		Groundwater	
	Change in Quantity	Change in Quality	Change in Quantity	Change in Quality
Construction				
Site Preparation	X	X	-	X
Access Roads Construction and Modifications	X	X	X	X
Material and Equipment Delivery and Storage	-	-	-	-
Infrastructure Installation	X	X	X	X
Restoration of Temporary Areas	-	-	-	-
Testing and Commissioning	-	-	-	-
Operation and Maintenance				

Project Activity	Potential Environmental Effects			
	Bedrock and Soils		Groundwater	
	Change in Quantity	Change in Quality	Change in Quantity	Change in Quality
Turbine Operation and Maintenance	-	-	-	-
Road Maintenance	X	-	-	X
Power Line and Substation Maintenance	-	-	-	-
Vegetation Management	-	-	-	X
Safety and Security	-	-	-	-
Decommissioning				
Removal of Infrastructure and Site Restoration	-	X	-	X

X = Potential Interaction
- = No Interaction

There are specific activities that could impact geophysical characteristics:

- Site preparation as well as operation and maintenance that includes vegetation clearing could impact nutrient loading to groundwater and remove or compact native soil. Increases in soil erosion rates could also occur.
- Site preparations involving earthworks and drainage features could alter groundwater recharge pathways and impact groundwater recharge rates.
- Construction and upgrades of access roads will introduce new material and cause soil compaction.
- Construction of turbine foundation footings that involve blasting could disturb established bedrock fracture networks that affect groundwater quantity (i.e., flow paths) and/or groundwater quality (i.e., expose leachable elements such as arsenic or uranium).
- Temporary dewatering requirements during construction could lower groundwater table elevations in the areas surrounding the foundations.
- Decommissioning of infrastructure would involve heavy machinery and earthworks, which could impact the soil quality.

6.3.2.1 Change in Soil Quantity and Quality

Earthworks activities, such as constructing turbine foundations and new access roads, and/or improving existing access roads, will result in clearing vegetation and exposing soils within the immediate area of the PDA that will affect the characteristics of the site's terrain. Sloping in some areas may affect drainage features and will require ditching and/or installation of berms and culverts. Pathways and effects to surface water resources are described further in Chapter 7 (Aquatic Environment) and Chapter 9 (Wetlands).

Activities associated with earthworks as well as the use of vehicles and heavy equipment will occur throughout the lifetime of the Project, particularly during construction, and result in changes in ground stability where granular fill is used for building access roads, foundations, and temporary pads for cranes. During decommissioning, landowners may opt to retain access roads, which will continue to be vulnerable to erosion.

Access road materials generally require gravel consisting of stone, sand, and fine particles with a binding characteristic to form a smooth, firm surface that can withstand weight and environmental effects. Appendix F of the Generic EPP used by the NSDPW recommends that Gravel Type II be applied at a thickness of 125 mm, covered by Gravel Type I to a thickness of 75 mm before shaping, compacting, and crowning access roads (NSDPW, 2005). The combination of adding fill to some portions of the PDA while excavating in others will affect soil quantity in those locations.

Below depths of 1 m, portions of foundations may remain after decommissioning. Compacted areas, blasted bedrock, and buried turbine foundations will change the characteristics of the underlying soil and ground stability that could affect land use opportunities after decommissioning.

The following key measures to mitigate the potential effects of the Project on soil quantity will be further detailed in a Project-specific EPP to be implemented prior to and during construction:

- Access to turbine locations will use established roads to the extent practicable.
- Areas of clearing and grubbing will be limited to that required to construct the Project.
- Where practicable, roots of trees and shrubs will be left intact to prevent soil erosion.
- Disturbed or compacted soils will be restored using topsoil and revegetation during the course of construction and decommissioning.
- Where possible, surface soil will be reused. Material that cannot be reused on site will be disposed of off site following applicable regulations and guidelines such as the CCME Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health (CCME, 2007) and parameter-specific updates.
- Drainage features will be installed as per the Project-specific EPP and guidance from the generic NSDPW EPP (NSDPW, 2005).
- An ESC Plan will be developed and implemented to mitigate soil erosion during earthworks.

Soil quality in the PDA and LAA is also at risk of being adversely affected. Dust and gravel produced during construction as well as operation and maintenance of roadways and foundations could settle into undisturbed areas of the LAA, impacting soil quality at the surface. Vegetation management including vegetation clearing would also impact soil quality as destroyed vegetation decays at a rapid rate into the soil.

The following key measures to mitigate the potential effects of the Project on soil quality will be further detailed in a Project-specific EPP to be implemented prior to and during construction:

- Topsoil and subsurface excavated material will be stored separately to prevent mixing and will be reused and/or disposed of separately.
- Where possible, surface soil will be reused. Material that cannot be reused on site will be disposed of off site following applicable regulations and guidelines.
- Fill brought to site for access road maintenance will meet CCME Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health (CCME, 2007) and parameter-specific updates appropriate for the site's land use.

6.3.2.2 Change in Groundwater Quantity and Quality

Groundwater is recharged from the surface via infiltration through porous rock, unconsolidated sediment, and/or bedrock fractures. Any alteration in these flow pathways resulting from Project activities could impact groundwater recharge volumes.

Construction and decommissioning activities have the potential to impact both groundwater quantity and quality. Blasting for access road construction can cause changes within established bedrock fracture networks, resulting in changes to flow to wells within the LAA. These changes could either partially or fully seal fractures that previously provided water to nearby wells. Alternatively, blasting could open new, or expand, existing fracture networks, thereby providing more, or differently sourced, water to nearby wells. Blasting will only be necessary in select locations where the road needs to achieve a grade of 8 percent, so it is anticipated that only a small fraction of the 51 wells will be within 800 m of a blast, and vibrations will weaken through distance from the blasting point.

General earthworks, including turbine foundation construction and roadwork, could change infiltration rates and thus groundwater recharge across the PDA, as surfaces and permeability are altered. This could have an impact on the volume of water recharging the water-bearing fractures, and thereby water availability for nearby wells. However, planned access road and foundation construction accounts for less than 10 percent of the total surface area of the LAA. Furthermore, surfaces made less permeable during construction, such as roadways, will drain to constructed ditches or undisturbed areas of the LAA, which would in turn contribute to recharge of the aquifer in the same way as pre-construction.

If shallow water tables are encountered during blasting and excavation at foundation locations, temporary dewatering would be required to allow the curing of the concrete. This has the potential to temporarily impact groundwater table elevations and groundwater flow pathways immediately surrounding the excavation, which could lower water levels in the area surrounding excavations. However, well depths within 1 km of the PDA are typically much deeper (median of 36.5 m), the shallowest well being 12.2 m, than the depth of the turbine foundations (3 to 7 m). The 2023 draft geotechnical report submitted by Strum stated that groundwater seepage was not encountered in test pits (Strum, 2023). This could indicate that minimal dewatering would be required during foundation construction. Furthermore, while the Nova Scotia Groundwater Database indicates that there are wells within the LAA, the nearest registered well to any turbine foundation is located approximately 2 km north (Figure 6.1), far beyond the extent of any drawdown caused by dewatering. Field-verification indicated that there may be a few wells located approximately 1.8 km from a turbine that are not listed in the database, but those would still be well outside the LAA.

The following key measures to mitigate the potential effects of the Project on groundwater quantity will be further detailed in a Project-specific EPP to be implemented prior to and during construction:

- Where blasting is necessary, it will be undertaken by a qualified professional and explosives will be stored off site.
- Blasting will be avoided near residential areas where possible. Pre-blasting well water surveys will be completed for those within 800 m of the activity. Bedrock monitoring wells installed during geotechnical investigations will be used to detect changes in water quantity.
- If demonstrable changes in groundwater quantity to a well are detected, an alternative water supply, of equal or better quantity than that impacted, will be provided to the landowner.
- A Complaint Resolution Plan will be developed and implemented.

While wells are beyond the LAA for turbine construction and decommissioning, blasting for access road construction and upgrades could have potential adverse impacts on groundwater quality. Blasting during construction can expose uranium or arsenic-bearing bedrock to groundwater (i.e., new fracture development) or surface water (following excavation), which could introduce these contaminants to the groundwater system and impact nearby wells through increased turbidity. Excavated rock piles exposed to rainfall have the potential to leach contaminants from the rock into surface water, and subsequently into groundwater. Blasting also has the potential to open new fracture networks that connect to contamination sources such as surface water bodies, which could transmit sediment to nearby wells, but the risk is low. Finally, byproducts of blasting such as ammonium nitrate and sediment can enter the groundwater system and affect nearby wells. There are 52 wells within the LAA; 51 are within the proposed 800 m pre-blast survey area.

Clearing of vegetation during both the construction and operation and maintenance phases could also deteriorate groundwater quality. Vegetation clearing has the potential to temporarily enhance the nutrient loading (as cleared vegetation decomposes over time) to surface water and groundwater systems, impacting well water quality. Herbicides can leach into the groundwater.

The following key measures to mitigate the potential effects of the Project on groundwater quality will be further detailed in a Project-specific EPP to be implemented prior to construction:

- Refuelling will occur in designated areas at least 30 m from a water feature.
- Where blasting is necessary, it will be undertaken by a qualified professional and explosives will be stored off site.
- Blasting will be avoided near residential areas where possible. Pre-blasting well water surveys will be completed for those within 800 m of the activity. Monitoring wells installed during geotechnical investigations will be used to detect changes in water quality.
- If demonstrable changes in groundwater quality to a well are detected, an alternative water supply, of equal or better quality than that impacted, will be provided to the landowner.
- The Proponent will consult NSECC to determine whether rock samples from areas to be excavated require further analysis for sulphide-bearing materials per the Sulfide Bearing Material Disposal Regulations NS. Reg. 57/1995. The geotechnical investigation that includes sulphide analysis is in progress. Response and mitigation measures to control acid rock exposure will be described in the Project-specific EPP.
- Site-specific measures will be developed to restore and maintain infiltration areas and receiving water bodies in the Project-specific EPP.
- An ESC Plan will be developed and implemented to mitigate soil erosion during earthworks.
- A Complaint Resolution Plan will be developed and implemented.

6.3.3 Residual Effects

6.3.3.1 Change in Soil Quantity

Changes in soil quantity directly within the PDA where road building and foundation construction takes place cannot be avoided. The magnitude of these effects will be moderate, and the geographic extent of the impact immediate. These changes will permanently impact soil quantity (compaction, volume) as soil will be removed and roads and foundations are established. Therefore, the duration is anticipated to be long-term and the frequency continuous, as the access roads will be in place for the duration of the operation of the wind facility. Furthermore, the portions of the foundation slabs at 1 m and below will remain in place; as such, the impact to these areas is irreversible. The timing is considered to have a low effect on this VEC.

6.3.3.2 Change in Soil Quality

Changes in soil quality directly within the PDA where road building and foundation construction take place cannot be avoided. The magnitude of these effects is anticipated to be minor, and the geographic extent of the impact immediate, limited to the PDA. These changes will temporarily impact soil quality (pouring concrete and gravel, compacting existing soil) as soil will be removed and roads and foundations established. Therefore, the duration is medium-term and the frequency continuous, as the access roads will be in place for the duration of the operation of the wind facility, with some compacted areas being restored following Project construction. The timing is considered to have a low effect on this VEC.

6.3.3.3 Change in Groundwater Quantity

Changes in groundwater quantity resulting from dewatering, should it be necessary, will result in temporary changes in the groundwater flow system, however the magnitude of this effect is anticipated to be minor. The geographic extent of this effect is considered local, extending beyond the PDA but not beyond the LAA. If dewatering occurs in the summer, the timing impact could be higher as groundwater table elevations in unconfined aquifers are typically lower during the summer months, and dewatering would cause further drawdown around the impacted area. This effect will be short term, occurring only once per foundation installation. This effect is also reversible. Once the foundations are poured, site dewatering will cease, and the groundwater table will be allowed to recharge. The vertically jointed rock in the LAA is associated with significant groundwater recharge zones.

Changes in groundwater quantity resulting from blasting changing fracture occurrence or orientation could result in changes in the groundwater flow system, however the magnitude of this effect is anticipated to be minor. The geographic extent of this effect is considered local, extending beyond the PDA but not beyond the LAA. The timing of these impacts could be high, if groundwater flow pathways to wells were sealed off during the summer, when groundwater tables are typically lower. In the event where a water bearing fracture was sealed, this would be irreversible with continuous, long-term impacts on groundwater flow.

Neither of these changes, however, are likely to affect private wells due to their distance from the turbine pads (at least 2 km), and their significantly deeper depths: public records indicate a median domestic well has a depth of 36 m and a median casing depth of 15 m compared to the relatively shallow turbine foundation depth (maximum 7 m). Should proven adverse effects related to Project activities occur after mitigation, the Proponent will re-drill the affected well.

6.3.3.4 Groundwater Quality

Similar to the effects on groundwater quantity, changes in groundwater quality resulting from blasting changing fracture occurrence or orientation could result in changes in the groundwater flow system and carry particulates, however the magnitude of this effect is anticipated to be minor. The geographic extent of this effect is considered local, extending beyond the PDA but not beyond the LAA. Long-term, continuous, and irreversible impacts could result from this effect.

Blasting is unlikely to affect private wells due to their distance from the turbine pads (at least 2 km), and their significantly deeper depths: public records indicate a median domestic well has a depth of 36 m and a median casing depth of 15 m compared to the relatively shallow turbine foundation depth (maximum 7 m). Blasting may occur at some sections of access roads but changes in water quality are not anticipated.

6.4 Monitoring

Construction monitors will report issues observed during earthworks; operation and maintenance staff will report signs of subsidence and erosion. A pre-blast well water survey to be conducted on domestic water wells located within 800 m of a blast site will be part of the Project-specific EPP and Blasting Management Plan. A Complaint Resolution Plan will be used to address complaints regarding well water quantity or quality should they arise. There is no continuous groundwater monitoring proposed for this Project.

7 Aquatic Environment

7.1 Overview

The assessment of the Project on the aquatic environment includes the aquatic ecosystem found within and associated with watercourses and waterbodies which interact with the Project. Waterbodies support essential ecological and socio-economic functions that are connected to flora (Chapter 8: Flora), wetlands (Chapter 9: Wetlands), and wildlife (Chapter 10: Terrestrial Wildlife, Chapter 11: Bats, and Chapter 12: Birds).

This section evaluates the potential impacts of the Project on the aquatic environment, with emphasis on fish and fish habitat, and provides mitigation, and construction and operational management practices to minimize these possible effects. The information collected for the assessment will also be used to provide input during the detailed design stage of the Project. The Project has the potential to affect the aquatic environment both directly, (i.e., change in fish habitat during construction due to installation of watercourse crossings, or change in water quality during construction, operation and maintenance, and/or decommission phases from sedimentation), as well as indirectly due to increased use of Project roads and riparian habitat loss, fragmentation, and modification. In addition, aquatic species (i.e., fish) may exhibit short-term or long-term behavioural changes to avoid habitats subject to disturbance or changes in water or habitat quality, depending on the fish species and level of tolerance to disturbance.

In response to concerns raised by the public and stakeholders, as well as constraints identified during field assessments, the Proponent has modified the road and turbine layout for the Project to avoid or reduce potential for adverse environmental effects on multiple VECs, including the aquatic environment. Turbines have been removed from the French River Watershed Protected Water Area and have been moved away from headwater streams in other watersheds. Additionally, the road network is undergoing detailed design to maximize use of existing roads and minimize new clearing as much as possible.

As discussed in the following subsections, the Project avoids impacts to the aquatic environment through detailed design, micrositing, and avoiding instream disruptions to fish habitat during key periods of fish life cycles by working within the least risk window for all instream construction (June 1 to September 30). Additionally, the Project will mitigate effects and protect the aquatic environment by acquiring required environmental permits for instream works (e.g. watercourse alteration approval), implementation of ESC measures at watercourse crossing sites, working in the dry and conducting fish salvages, and restoring all sites to pre-construction conditions, or better, after watercourse crossings have been completed. DFO will assess the potential for harmful alteration, disruption or destruction of fish habitat during the permitting phase of the Project and may require offsetting to counterbalance any losses in fish habitat from the Project.

Effects, mitigation measures, and residual impacts to the aquatic environment as a result of the Project are outlined in this Chapter and will be further developed in a Project-specific EPP prior to construction to minimize adverse effects.

7.1.1 Regulatory Context

Assessment of the aquatic environment considers relevant provincial and federal legislation and guidelines:

- *Fisheries Act*
- SARA
- *Canadian Environmental Protection Act*
- Nova Scotia *Environment Act*
- NSESA

7.1.2 Assessment Methodology

The assessment of aquatic environment focused on identifying watercourses and waterbodies, and the fish species present or likely to be present, within or near the LAA, including any fish SAR[1] or species of conservation concern (SoCC)[2] and their habitat. This was achieved though literature review, habitat analysis, and field surveys. The data collected from this assessment was used to evaluate the impact of the Project on the aquatic environment. The description of the existing environment is based primarily on data collected through the following resources followed by field surveys:

- Provincially mapped watercourses
- Watercourse Database
- AC CDC (2023) Data Report
- DFO Aquatic SAR Database
- Natural History of Nova Scotia (Davis and Browne, 1996)
- NSDNRR (2018) Significant Species and Habitat Database

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[1] SAR are those species that listed under SARA (Schedule 1) or the NSESA.

[2] SoCC are those species that have been assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as Endangered, Threatened, or Special Concern, but not yet listed under SARA or the NSESA. SoCC also includes those species tracked by the AC CDC and assigned conservation ranks of S1, S2, or S3.

Existing biophysical features within the LAA were mapped using available geospatial data. The aquatic environment assessment focussed on determining the presence of predicted watercourses (i.e., GIS modelled and provincially mapped) and the evaluation of fish habitat within those watercourses in the five secondary watersheds in the PDA. A total of 755 watercourse assessments were conducted within the PDA (Figures 7.1 to 7.4). The number of watercourse assessments by watershed are shown in Table 7.1 below.

Table 7.1 Total Number of Watercourse Assessments in the PDA

Watershed	Number of Watercourse Assessments	Percent of Total
Chiganois	193	25.6
Debert	264	35.0
Folly	164	21.7
French	41	5.4
Wallace	93	12.3
TOTAL	755	100.0

7.1.2.1 Habitat Assessment

Detailed fish and fish habitat assessments, including fish sampling, habitat biophysical measurements, and water quality sampling, were conducted between June and October 2023. Fish habitat assessments followed the standards and methods provided in the Nova Scotia *Fish Habitat Suitability Assessment: A Field Methods Manual* (NSLC Adopt a Stream, 2018), and those used in the *Reconnaissance (1:20 000) Fish and Fish Habitat Inventory: Standards and Procedures* (Resources Inventory Standards Committee, 2001) and *Reconnaissance (1:20 000) Fish and Fish Habitat Inventory: Site Card Field Guide* (Resources Inventory Standards Committee, 2008). These included the assessment of the following parameters and characteristics at each assessed site:

- Channel biophysical features (mean channel/wetted width, mean channel/bankfull depth, pool depth, mean bank height, percent gradient, barriers to fish movement)
- Geomorphologic features (channel morphology, confinement, pattern, bank features)
- Fish habitat characteristics and quality (channel substrates, instream cover, spawning, migration)
- Velocity (seconds per metre)
- Riparian features (vegetation stage, vegetation type, crown closure)
- Human disturbance indicators (abandoned channels, erosion, sediment wedges)
- Water quality (dissolved oxygen, pH, temperature, turbidity)
- Watercourse classification (permanent, intermittent, ephemeral)
- Watercourse stage (high, mid, low, dry, frozen)

Habitat assessments were conducted at five locations (i.e., transects) on each watercourse to represent the conditions above, at, and below the interaction of the Project with the existing watercourse. The following locations were assessed at each watercourse:

- At the intersection of the Project and watercourse (i.e., the crossing or centreline)

- 50 m upstream
- 100 m upstream
- 50 m downstream
- 100 m downstream

Watercourses assessed during the detailed field assessments were given a classification based on channel width and characteristics. The watercourses were classified as one, or a combination, of the following: no channel, ephemeral, intermittent, small permanent, or large permanent based on the definitions provided in the Table 7.2

Table 7.2 Description of Watercourse Types

Watercourse Type	Channel Width	Description
Large Permanent	Greater than 5 m	• Defined channels • Defined beds and banks • Year-round flow • Fish habitat
Small Permanent	Less than 5 m	• Defined channel • Defined beds and banks • Year-round flow • Fish habitat
Intermittent	Typically less than 2 m	• Defined channels with scour • Defined beds and banks • Seasonal water flows (e.g., spring, fall) • May be seasonally fish-bearing • Potential for fish habitat
Ephemeral	Typically less than 1 m; channel not always defined	• Signs of infrequent flow; minor scour • No defined bed or banks • Typically resulting from rain events or snowmelt • Signs of surface flow or flooding • Roadside ditches • Typically not fish-bearing • Typically not fish habitat
No Channel	N/A	• No defined channel or scour • Surface or subsurface drainage • Potential subsurface flow • Potential mapping error • Not fish-bearing • Not fish habitat

The watercourse depth classification was determined from the depth information collected for each watercourse assessed. Depth classification was based on three depth ranges, as indicated in Table 7.3, and based on, but modified from, the British Columbia Fish Habitat

Assessment Procedures (Johnston and Slaney, 1996) and the Alberta *Fisheries Habitat Enhancement and Sustainability Program Habitat Data Collection Manual* (Alberta Environment and Parks, 2019).

Table 7.3 Watercourse Depth Classification

Depth Classification	Depth Criteria
Class 1	> 1 m
Class 2	0.5 m to 1.0 m
Class 3	< 0.5 m

Watercourses were also assessed based on the potential for fish habitat, using information gathered from both in situ water quality via a handheld multimeter and a rapid evaluation of the presence and quality of spawning, rearing, migration, foraging, and overwintering habitats, based on the following:

- Spawning habitat quality—water flow and depth, presence of groundwater upwelling, and substrate size, embeddedness, and composition (i.e., large and small gravels)
- Rearing habitat quality—based on cover abundance and type, water flow, and habitat connectivity
- Migration—based on connectivity of habitat to upstream and/or downstream areas, water depth, and waterflow
- Foraging—based on substrate size and quality for invertebrate presence, riparian and overhanging vegetation, and observed invertebrates
- Overwintering habitat quality—based on the presence of deep pools (50 centimetres (cm) or greater), adequate water quality, and the potential for year-round flow

Where species presence was unknown or uncertain, salmonid habitat was used as the default benchmark criteria for comparison as salmonid species are less adaptable than other fish species and typically have had more studies completed to understand the limits for their survival. Dominant and subdominant substrates were assessed based on the size classification presented in Bain and Stevenson (1999), Cummins (1962), Hooper and Hubbart (2016), and the Wentworth Scale (Wentworth, 1922) for habitat assessments, as per Table 7.4.

Table 7.4 Substrate sizes and classes

Substrate Type	Size
Fines	< 2 mm
Silt and Clay	< 0.06 mm
Sand	0.06 to 2 mm
Small Gravel (e.g., pebbles)	2 to 16 mm
Large Gravel (e.g., pebbles)	16 to 64 mm
Cobble	64 to 256 mm
Boulder	> 256 mm
Bedrock	Continuous slab (> 2m diameter)

Fish habitat quality was determined through evaluation of existing conditions present in the assessed watercourses and the suitability of those conditions for the life stages of the fish species likely to be present in the watercourse.

Fish habitat quality was assessed at the intersection of the Project and each watercourse, which is also referred to as the crossing location for the watercourses in the PDA. The five main habitat types assessed for presence and quality in each watercourse were rearing, spawning, migration, overwintering, and foraging along with overall habitat quality. Each was assessed and ranked on a scale of None to Good. A ranking of None is equivalent to either no fish habitat being present in the assessed area, or the habitat present would not be suitable for the species anticipated to use the watercourse. A ranking of Good was used when fish would be expected in the area and could use the habitat for the assessed purpose (e.g., spawning). Rankings were based on the presence of key habitat features or physical parameters (e.g., substrates, cover, flow) and subject to interpretation by the assessor (i.e., environmental professional) based on previously reviewed published literature or guidance.

A conservative approach has been taken to the classification of the watercourses assessed for the aquatic environment baseline study. Watercourses that were identified during the field assessment as intermittent or permanent were treated as potentially fish bearing. Baseline data collected provide a snapshot of the existing conditions observed or measured at the time of the baseline study. The collected data does not represent the conditions of the aquatic environment at all times of the year; however, for the purpose of the assessment we have used the conditions observed as a representation of the typical conditions at that time of year.

Fish habitat type and quality determined during the field assessments were typically based on the most sensitive species found in the region, which for the Project was salmonids (e.g., Brook Trout). Where habitat characteristics were suitable for multiple species, the rating was based on the species most likely to use the area; where this was unknown, the default was to rate the habitat based on the value for salmonids.

7.1.2.2 Fish Sampling

Active fish sampling was completed using a backpack electrofisher unit in a subset of watercourses in the PDA. Sampling locations were determined based on the habitat assessment and physical characteristics of the watercourses assessed, including watercourse width, depth, and water quality, measured during the habitat assessment program.

Passive fish sampling was conducted within the assessment area using baited Gee-Type minnow traps (Figure 7.5). The minnow traps used were cylindrical mesh traps that come apart into two pieces (halves) and are approximately 40 cm in length and 20 cm in diameter at each end. The opening for the fish to enter the trap is approximately 4.5 cm in diameter, and the mesh size is approximately 3 to 4 mm.

7.1.2.3 Water Quality Analysis

A YSI Multimeter, a handheld multiparameter water quality meter, was used to measure water quality within streams with adequate flow and depth (greater than 0.05 m). Field surface water quality parameters measured using the YSI multimeter at each assessment site were the following:

- Temperature in degrees Celsius (ºC)
- pH
- Conductivity in micro-siemens per cm (mS / cm)
- Total Dissolved Solids (TDS) in milligrams per litre (mg/L)
- Dissolved Oxygen (mg/L) and percent saturation (when available)
- Salinity (parts per thousand (ppt))

Turbidity was qualitatively recorded by visual assessment of water clarity and recorded as clear, low, moderate, or turbid.

Water quality parameters (i.e., temperature, pH, and dissolved oxygen) measured in the field were compared to the water quality guidelines[3] presented in Table 7.5 to provide a likelihood of fish presence.

Table 7.5 Water Quality Limits for the Protection of Aquatic Life and Salmonids

Water Quality Parameter	CCME Water Quality Guideline for the Protection of Aquatic Life (Freshwater) (CCME, 2017)	Brook Trout Tolerance and Optimum Range (Raleigh, 1982)
pH	6.5 to 9.0	Tolerance: 4.0 to 9.5 Optimal: 6.5 to 8.0
Temperature (ºC)	N/A	Tolerance: 0.5 to 22 Optimal: 11.0 to 16.0
Dissolved Oxygen (mg/L)	**Cold water: between 6.5 and 9.5	Tolerance: ≥ 5.0 Optimal: ≥ 7.0

** Depending on the life stage

Water samples were collected at the selected sites, stored in a cooler containing ice, and submitted to the analytical laboratory on the same day they were collected. Samples were submitted to the Bureau Veritas environmental analytical laboratory located in Bedford, Nova Scotia. Sampling locations for laboratory water quality analysis were selected to encompass each of the five watersheds in the PDA. Locations were chosen based on the fish habitat assessment information to determine the appropriate locations (i.e., permanent watercourses) to collect suitable water quality samples. Results from the water

[3] Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines for the Protection of Aquatic Life (CCME, 2017) and Brook Trout tolerance and optimal ranges for water quality (Raleigh, 1982)

quality analysis were compared to the NSECC Tier 1 Environmental Quality Standards (EQS) (NSECC Tier 1 EQS Freshwater) for Surface Water (Fresh Water Receptor Pathway) (NSECC, 2021) and the CCME guidelines. The water samples were analysed for the following water quality parameters:

- Carbonate, bicarbonate, and hydroxide
- Alkalinity
- Chloride
- Colour
- Conductance – water
- Hardness (calculated as calcium carbonate ($CaCO_3$))
- Total metals (suite of 30 metals analysed)
- Ion balance (percent difference)
- Anion and cation sum
- Nitrogen ammonia – water
- Nitrogen – nitrate + nitrite
- Nitrogen – nitrite
- Nitrogen – nitrate (as N)
- pH
- Phosphorus – ortho
- Sat. pH and Langelier Index (@20ºC)
- Sat. pH and Langelier Index (@4ºC)
- Reactive Silica
- Sulphate
- TDS (calculated)
- Organic carbon – total (TOC)
- Turbidity

7.1.2.4 Aquatic Invertebrates

Aquatic invertebrate presence was assessed within watercourses during the Fish Habitat Assessment program. Observations of aquatic invertebrates were made and recorded as part of the habitat assessment conducted at each assessment location. At each assessment location with suitable conditions (i.e., gravel or larger substrates and presence of water), at least three cobble-sized rocks (if present) were selected, flipped over, and observed for the presence of aquatic invertebrates or larvae. Visual observations of invertebrates on the surface or in the watercourse were also recorded as part of the assessment. Presence of aquatic invertebrates was recorded using a density scale of None, Low (up to 25 percent), Moderate (25 to 50 percent), and High (greater than 50 percent); based on the number of locations / rocks with invertebrates observed versus the total number of locations sampled.

7.2 Existing Environment

7.2.1 Hydrology / Watersheds

The Project is located in the Cobequid Hills Ecodistrict, which encompasses an area of 186,764 ha. The surface water in Cobequid Hills Ecodistrict is limited, characterized by a small number of smaller sized freshwater lakes (1 percent of surface area) (NSDNRR, 2019a). The larger lakes in this ecodistrict occur on the west side, outside of the PDA and include Simpson, Economy, Folly, and Sutherland lakes. The Cobequid Hills have created a watershed with streams running north and south down the hills in deep ravines and waterfalls or cascades.

The PDA intersects three primary watersheds. The largest of the primary watersheds that overlap the PDA is the Salmon / Debert watershed, which flows south into the Bay of Fundy and overlaps most of the PDA. The other two primary watersheds are the Philip Wallace watershed and the River John watershed, which both flow north into the Northumberland Strait. There are five secondary watersheds within the PDA (Figure 7.6): Chiganois River, Debert River, French River, Folly River, and Wallace River. The two largest secondary watersheds in the Project area are the Chiganois and Debert watersheds, which encompass a large portion of the PDA.

Within the LAA are clusters of small lakes such as Blakeney Lake, Chain Lakes, Island Lake, and Frog Lake. There is also Roodes Pond and Pine Lake to the south, Farm Lake, Little Snare Lake, and Juniper Lake to the northeast along with Bear Lake, Lily Ponds, Rorys Pond, Big and Little Totten Lake, Long Lake, and Steven's Lake to the north / northwest. Additionally, there are numerous tributaries that feed into, or out of, the lakes, including Chain Lakes Brook, East Branch Chiganois River, Debert River, East Branch Swan Brook, Long Lake Brook, East Branch Folly River, Pine Brook, and Weatherby Brook. Both Folly Lake and the Folly River sit just outside of the western edge of the PDA boundaries. Folly Lake is the largest lake near the PDA at 80 ha and up to 100 m in depth (refer to Figure 7.6).

In the Cobequid Slopes Ecodistrict, freshwater resources account for 0.4 percent of the land, even less than the Cobequid Hills Ecodistrict (NSDNRR, 2019b). The Minas Lowlands Ecodistrict also has few waterbodies (NSDNRR, 2019c).

7.2.2 Fish and Fish Habitat

The dominant watercourse type identified was No Channel, with a total of 254 locations of the 755 assessment locations identified as such. These locations had no indication of water, scour, or directed flow path. Additionally, of the 755 watercourse assessment locations, only 13 Large Permanent (greater than 5.0 m in width) watercourses were identified, the fewest of the watercourse types observed. A summary of the watercourse types, by watershed, is presented in Table 7.6.

Table 7.6 Watercourse Types within Secondary Watersheds Intersecting the PDA

Watercourse Type	Count	Percent	Watershed				
			Chiganois	Debert	Folly	French	Wallace
Large Permanent	13	1.7	1	2	5	0	5
Small Permanent	46	6.1	16	17	7	3	3
Small Permanent/ Intermittent	54	7.2	19	21	9	2	3
Intermittent	50	6.6	11	22	10	1	6
Intermittent/ Ephemeral	124	16.4	34	45	21	2	22
Ephemeral	214	28.3	68	74	36	6	30
No channel	254	33.7	44	83	76	27	24
Total	**755**	**100.0**	**193**	**264**	**164**	**41**	**93**
Percentage of Watercourses by Watershed			25.6	35.0	21.7	5.5	12.2

7.2.2.1 Fish Habitat

Substrates are important for fish habitat as they support a range of uses for fish, from spawning, to cover, to foraging areas. Fines were determined to be the dominant substrate type in approximately 66 percent of the watercourse channels assessed. Gravel was the second most common dominant substrate observed at approximately 20 percent. Dominant substrate types for the watersheds within the LAA are summarized in Table 7.7. The most common subdominant substrate type (second most common in a watercourse) was gravel, followed closely by cobble, at 35.1 and 34.7 percent respectively (Table 7.8). In permanent watercourses (small and large) with suitable fish habitat, gravel was the most common dominant substrate type, followed by fines, then cobble. However, the most common sub-dominant substrate type in permanent watercourses was cobble, followed by gravel, then boulder. Frequency of substrate types, by watershed, for each watercourse type, are provided in Appendix G.1. Dominant substrate type data, by watershed, is provided in Appendix G.2.

Table 7.7 Dominant Substrate Types by Watercourse Type Intersecting the PDA

Watercourse Type	Dominant Substrate Type					
	Bedrock	Boulder	Cobble	Gravel	Fines	Totals
Large Permanent	1	3	3	4	0	**11**
Small Permanent	1	4	10	20	11	**46**
Small Permanent/Intermittent	2	2	1	16	31	**52**
Intermittent	2	1	5	10	17	**35**
Intermittent/Ephemeral	0	3	6	12	67	**88**
Ephemeral	0	1	2	7	66	**76**
No channel	0	0	1	0	39	**40**

Watercourse Type	Dominant Substrate Type					
	Bedrock	Boulder	Cobble	Gravel	Fines	Totals
TOTAL	**6**	**14**	**28**	**69**	**231**	**348**
Percentage	1.7	4.0	8.1	19.8	66.4	**100.0**

Table 7.8 Subdominant Substrate Types by Watercourse Type Intersecting the PDA

Watercourse Type	Subdominant Substrate Types					
	Bedrock	Boulder	Cobble	Gravel	Fines	Totals
Large Permanent	0	3	3	5	0	**11**
Small Permanent	2	10	21	9	2	**44**
Small Permanent/Intermittent	5	7	13	15	7	**47**
Intermittent	2	4	13	11	5	**35**
Intermittent/Ephemeral	2	13	23	29	4	**71**
Ephemeral	1	3	11	18	4	**37**
No channel	0	2	3	1	0	**6**
TOTAL	**12**	**42**	**87**	**88**	**22**	**251**
Percentage	4.8	16.7	34.7	35.1	8.7	**100.0**

Instream cover provides areas for rearing and avoiding predation. Cover type and abundance are part of the characteristics used to determine the suitability of available habitat for various life stages of fish. Overhead vegetation and small woody debris were the dominant and sub-dominant cover types observed (Table 7.9 and 7.10). In permanent watercourses with suitable fish habitat, boulder cover was the most common cover type, followed by overhead vegetation. The most common sub-dominant cover type for permanent watercourses was again boulder, followed by small woody debris. Frequency of cover habitat types by watercourse type, and watershed, is provided in Appendix G.3. Dominant cover data, by watershed, is provided in Appendix G.4.

Table 7.9 Dominant Instream Cover Types by Watercourse Type Intersecting the PDA

Watercourse Type	Dominant Cover Type								
	Boulder	Overhead Vegetation	Undercut Bank	Large Woody Debris	Small Woody Debris	Instream Vegetation	Uprooted Tree	Deep Pool	Totals
Large Permanent (>5.0 m)	9	1	0	0	0	0	0	1	**11**
Small Permanent	17	6	5	2	6	4	2	4	**46**
Small Permanent/ Intermittent	8	13	8	3	11	6	0	2	**51**
Intermittent	8	11	2	1	9	0	2	2	**35**
Intermittent/ Ephemeral	9	34	3	1	21	8	1	2	**79**
Ephemeral	2	15	2	3	11	1	0	0	**34**
No channel	0	0	0	0	0	0	0	0	**0**
TOTAL	**53**	**80**	**20**	**10**	**58**	**19**	**5**	**11**	**256**
Percentage	20.7	31.2	7.8	3.9	22.7	7.4	2.0	4.3	**100.0**

Table 7.10 Subdominant Instream Cover Types by Watercourse Type Intersecting the PDA

Watercourse Type	Sub-dominant Cover Type								
	Boulder	Overhead Vegetation	Undercut Bank	Large Woody Debris	Small Woody Debris	Instream Vegetation	Uprooted Tree	Deep Pool	Totals
Large Permanent (>5.0 m)	4	0	1	0	1	1	0	4	**11**
Small Permanent	14	8	9	2	7	0	0	6	**46**
Small Permanent/ Intermittent	9	10	10	3	13	4	0	1	**50**
Intermittent	8	6	5	3	8	3	0	1	**34**
Intermittent/ Ephemeral	10	20	10	3	14	14	0	1	**72**
Ephemeral	5	9	3	3	9	2	0	0	**31**
No channel	0	0	0	0	0	0	0	0	**0**
TOTAL	**50**	**53**	**38**	**14**	**52**	**24**	**0**	**13**	**244**
Percentage	20.5	21.7	15.6	5.8	21.3	9.8	0.0	5.3	**100.0**

Within the LAA, out of 387 assessment locations where fish habitat was determined to be present, only 23 were identified as having Good overall fish habitat. Of these 23 locations, nine were Large Permanent watercourses, while the other 14 were Small Permanent or Small Permanent – Intermittent watercourses. No Intermittent or Ephemeral watercourses assessed were found to have Good overall fish habitat. The Debert River and Folly River watersheds each had seven assessed watercourses with Good overall fish habitat. The French River watershed only had one watercourse, out of 27 assessed, with Good overall fish habitat. Fish habitat quality, by watercourse type, for the six habitat quality parameters is presented in Table 7.11 below, with additional detailed provided in Appendix G.5.

Table 7.11 Overall Habitat Quality by Watercourse Type Intersecting the PDA

Watercourse Type	Overall Habitat Quality						
	Good	Mod-Good	Mod	Mod-Poor	Poor	None	Total
Large Permanent	9	1	2	0	0	0	12
Small Permanent	13	13	14	0	3	1	44
Small Permanent/Intermittent	1	3	11	0	22	2	39
Intermittent	0	1	2	0	0	3	6
Intermittent/Ephemeral	0	0	3	0	58	35	96
Ephemeral	0	0	0	0	34	85	119
No channel	0	0	0	0	2	69	71
TOTAL	23	18	32	0	119	195	387

As part of the watercourse and fish habitat field assessment program, fish passage barriers were identified when encountered. Fish passage barriers are those where the fish species expected to be present in the watercourse cannot pass upstream, or downstream, of the barrier due to the conditions present. The most common barriers encountered during the assessment program were loss of channel definition and debris barriers. Barriers such as debris, log jams, and beaver dams are considered partial or temporary barriers to fish passage. Large areas of the PDA had sections of debris from recent storm events that were blocking watercourse channels. Additionally, damaged culverts were encountered in many areas of the PDA. Waterfalls/cascades, underground/subsurface sections, hanging or perched culverts, and beaver dams were only occasionally encountered in the PDA. The locations of the observed permanent and temporary fish barriers are shown in Figure 7.7.

7.2.2.2 Aquatic Species

Fifty-nine sites within the LAA were sampled for fish presence. Of the 59 watercourses sampled, 48 were found to contain fish. Sampling occurred once in each watercourse. Non-detection of fish in watercourses does not confirm the absence of fish in those watercourses. Additionally, three swamps were identified as having confirmed presence of American Eel (Chapter 9: Wetlands, subsection 9.2.1). The watercourse types by watershed that were found to contain fish are presented below in Table 7.12.

Table 7.12 Number of Fish Bearing Watercourses by Type and Watershed

Watercourse Type	Fish Bearing in Watershed					
	Chiganois	Debert	Folly	French	Wallace	Total
Large Permanent (>5.0 m)	1	4	1	0	5	11
Small Permanent	9	8	4	2	0	23
Small Permanent/ Intermittent	3	1	1	1	2	8
Intermittent	0	2	0	0	1	3
Intermittent/ Ephemeral	2	0	0	0	0	2
Ephemeral	1	0	0	0	0	1
No channel	0	0	0	0	0	0
Totals	16	15	6	3	8	48

The species of fish captured in the LAA by electrofishing during the fish sampling program are indicated in Table 7.13 by watershed. A total of four fish, representing two species, were captured at three minnow trap sites. Three Brook Trout (*Salvelinus fontinalis*) and one Creek Chub (*Semotilus atromaculatus*) were captured during the minnow trapping program. Detailed results of the electrofishing efforts are presented in Appendix G.6 and detailed efforts for fish capture by species life stage and watershed are provided in Appendix G.7. The sites in the Wallace River watershed had the highest catch per unit effort, while the watercourses in the French River watershed had the lowest.

Table 7.13 Number of Species Captured During Fish Sampling by Watershed

Watershed	American Eel	Banded Killifish	Brook Trout	Brown Trout	Common Shiner	Creek Chub	Lake Chub	Total
Chiganois	6	11	104	0	1	3	0	125
Debert	13	0	82	0	0	0	0	95
Folly	3	0	75	0	0	0	31	109
French	0	0	19	1	0	0	0	20
Wallace	0	0	131	0	0	0	0	131
TOTALS	22	11	411	1	1	3	31	480

A number of other aquatic species are known to occur in the PDA, including various salamander, newt, and mollusc species. A single Red-spotted Newt (*Notophthalmus viridescens viridescens*) was captured during an electrofishing sampling event. This species is considered secure in Nova Scotia. Additionally, a number of Predacious Diving Beetles (Family: *Dytiscidae*) and Giant Waterbugs (*Lethocerus americanus*) were captured during the minnow trapping field program.

7.2.2.3 Species at Risk

Two at risk species of fish have been observed within 5 km of the PDA and have the potential to be present in the PDA: the Inner Bay of Fundy (IBoF) population of Atlantic Salmon (*Salmo salar* pop.1) and the American Eel (*Anguilla rostrata*). Other species of concern that are likely to be present are Brook Trout, which is stocked in a number of lakes in the province, including at least one in the PDA.

The IBoF population of Atlantic Salmon are genetically different from other populations of Atlantic Salmon and are listed as Endangered under SARA and the NSESA. Their distribution may include up to 50 rivers that drain into the Inner Bay of Fundy. As occurs with other populations of Atlantic Salmon, the IBoF population are anadromous and spend much of their life feeding and growing at sea and then returning to reproduce in their natal freshwater streams. Although Atlantic Salmon were not observed in the PDA, a number of rivers that drain into the Debert/Salmon River watershed are or were previously known to contain IBoF Atlantic Salmon, including Debert, Chiganois, and Great Village rivers. Salmon were once observed in great numbers and have still been known to spawn in these systems; however, IBoF salmon are not likely to spawn in proximity to the PDA as habitat features are not suitable for this life history stage.

American Eel (listed as Threatened under SARA) are native to fresh, estuarine, and coastal waters connected to the western Atlantic Ocean (COSEWIC, 2012). They are found in freshwater rivers and lakes in the LAA. The American Eel is catadromous, spending most of its life in fresh water and returning to the Sargasso Sea (a large body of warm oceanic water off the coast of the southeastern US, the only known spawning area for the eels) between August and December. Juvenile eels arrive in estuarine waters between May and July in the Gulf of St. Lawrence (COSEWIC, 2012), and soon after, migrate to estuarine, brackish, and upstream freshwater habitats wherein they spend from 5 to 20 years, which is typically the remainder of their adult lives.

Adult eels typically burrow in sediment, or seek refuge in interstitial spaces, before nightly foraging activities; shallow, protected waters with rocks, fine sediment, woody debris, and aquatic vegetation, including eelgrass, are important habitat characteristics (COSEWIC, 2012). Overwintering typically occurs in muddy bottoms in shallow bays and estuarine habitats in which adults enter a state of torpor; however, their winter habitats are poorly understood. Adult eels forage on a variety of organisms, including small fish, molluscs, crustaceans, insect larvae, surface-dwelling insects, worms, and occasionally plants; some evidence suggests periodic foraging occurs through the winter months (COSEWIC, 2012). After a period of time (upward of 20 years) adult American Eel migrate back to the Sargasso Sea to spawn and complete their lifecycle (COSEWIC, 2012; Murua and Saborido-Rey, 2003). Peak migration occurs in the September to October period. American Eel may use watercourses within the PDA for migration, foraging, and overwintering.

Brook Trout (AC CDC rank: S3) are a popular sport fish that are found widely around the province in clear, cool, well oxygenated streams. Brook Trout can live in salt or fresh water;

however, they may spend their entire life in fresh water and never migrate to the ocean. Both sea run and freshwater Brook Trout spawn in fresh water. Brook Trout generally prefer to spawn over gravel substrates in lakes or small protected streams with groundwater or areas of spring upwelling. Spawning occurs in September and October and trout fry emerge from the gravel between February and April. Juvenile trout feed on plankton, progressing to insects, while adults feed primarily on insects but are opportunistic and will feed on a wide variety of prey. As they mature, Brook Trout will move into deeper waters for protection and foraging opportunities. A stocking program is active in Nova Scotia, where Brook Trout are stocked in up to 200 lakes around the province in the fall, including Farm Lake (see Figure 7.4) within the LAA (Nova Scotia Government, undated).

No freshwater SAR mussel species, were observed, known, or reported to occur in the PDA.

7.2.3 Water Quality

In situ water quality measurements were collected at the watercourse assessment locations, where sufficient waterflow and depth was present. Data collected represent a snapshot view of the water quality in the watercourse at the time of assessment. The field habitat assessment and water quality program for the Project was completed from June to October 2023. Due to temperature changes and precipitation events during the field program some of the water quality parameters have a large amount of variance in the values recorded. The summary of in situ water quality parameters collected during the field program is presented below in Table 7.14. Additional in situ water quality measurements, by watershed, are presented in Appendix G.8.

Important water quality parameters for determining fish habitat were recorded, with emphasis on temperature, pH, and dissolved oxygen. A qualitative observation of water clarity/turbidity was recorded as well. During sampling, the maximum temperature recorded in the watercourses was 24.5 ^{o}C, while the minimum temperature recorded was 6.9 ^{o}C. The median value for pH measured was just under 6, with the lowest value recorded at 4.3. The average dissolved oxygen measurement was approximately 7.3 mg/L, with the lowest value measured at 0.81 mg/L. Overall, the water in the majority (95 percent) of the watercourses where turbidity was measured (107 of 113) was clear or had low turbidity.

Table 7.14 Summary Statistics of In Situ Water Quality Measurements

Parameter	Average	Maximum	Minimum	Median
Temperature (^{o}C)	15.66	24.50	6.90	15.60
DO (mg/L)	7.27	11.71	0.81	7.67
pH*	-	7.74	4.30	5.96
Conductivity (mS/cm)	21.62	129.30	10.00	19.90
Salinity (ppt)	0.02	1.00	0.00	0.01
TDS (mg/L)	10.38	85.10	0.00	11.35

* Average pH was not calculated

A total of 18 water quality samples, from 16 sites, were collected in the field for laboratory analysis. Water quality sampling locations in the PDA are shown in Figure 7.8. Of the 18 samples collected, two were field duplicates to evaluate the precision of the analysis and the error associated with sampling processes. The results of the laboratory water quality analyses, as compared to guideline limits, are presented in Appendix G.9.

Of the 55 parameters analyzed by Bureau Veritas laboratory, seven parameters had values above the NSECC Tier 1 EQS Freshwater and CCME guidelines:

- All water samples collected and analyzed had reported concentrations of total aluminium that exceeded the NSECC Tier 1 EQS Freshwater and CCME guideline.
- Nine of the analyzed water samples had concentrations of total iron that exceeded the NSECC Tier 1 EQS Freshwater and CCME guidelines.
- Four of the analyzed water samples had concentrations of total zinc that exceeded the NSECC Tier 1 EQS Freshwater and CCME guideline.
- One water sample had a reported concentration of total cadmium that exceeded the CCME guideline.
- One water sample had a concentration of total cobalt that exceeded the NSECC Tier 1 EQS Freshwater and CCME guideline.

7.3 Effects Assessment

7.3.1 Boundaries

For the aquatic environment, the LAA has been set as 100 m upstream and 100 m downstream from the point of interaction of the Project with a watercourse (e.g., crossing location). This is based on the path of the river and not a straight-line distance. The LAA is based on the largest area where the extent of the effects from Project activities are likely to be detected and is based on the observed local conditions, assessed habitat, and typical size and flows in watercourses within the PDA.

The RAA for the aquatic environment is set as the boundaries of the secondary watersheds that the PDA overlaps: Chiganois, Debert, Folly, French, and Wallace rivers watersheds (Figure 7.7). The determination of the RAA is based on the physical and biological conditions present and the type and location of other past, present, or reasonably foreseeable future projects or activities that have previously, or may be, implemented. The RAA is used to inform the cumulative effects assessment resulting from activities occurring within the RAA (Chapter 15: Consideration of Cumulative Effects).

7.3.2 Potential Effects and Mitigation

Several changes were implemented for the Project to minimize potential direct and indirect impacts on the aquatic environment, such as removing turbines from the French River Watershed Protected Water Area and siting turbines away from wetlands and headwater streams in other watersheds (see Figure 2.2). Detailed design of the Project and micrositing of turbines will further avoid aquatic habitat when practicable and will reduce potential interactions between the Project and the aquatic environment. Micrositing involves exact placement of the turbine within the turbine sites as shown in the PDA.

Direct and indirect effects of the Project on the aquatic environment could occur through various interconnected pathways. During construction, activities like earthworks and vegetation clearing may lead to changes in riparian habitat, as well as changes in water quality. Increased road width and density will require additional watercourse crossings which may result in changed to fish habitat and aquatic species movement. Additionally, sensory disturbance from noise during construction (e.g., blasting) has the potential to cause injury or mortality to fish or could impact aquatic organism behaviour.

The Project has the potential to result in adverse effects on the aquatic environment as a result of short-term activities during the construction phase, as well as long-term activities during operation and maintenance. The potential effects include a loss of fish habitat, change in water quality, and mortality or injury of fish. Project construction activities, predominantly earthworks, will result in immediate alteration of fish and riparian habitat and may result in a loss of fish habitat within the PDA. Changes to fish habitat as a result of Project activities are anticipated to occur within the PDA.

Earth disturbing activities can lead to changes in the local surface water drainage with potential indirect effects on water quantity and quality in watercourses. Project activities can affect the aquatic environment as indicated in Table 7.15; these potential effects do not consider the detailed design of the Project and micrositing of turbines that is yet to be completed or the implementation of mitigation measures described herein.

Table 7.15 Potential Environmental Effects of the Project on the Aquatic Environment

Project Activity	Potential Environmental Effects			
	Change in Fish Habitat		Change in Water Quality	Mortality or Injury of Fish
	Instream Habitat	Riparian Area		
Construction				
Site Preparation	X	X	X	-
Access Roads Construction and Modifications	X	X	X	X
Material and Equipment Delivery and Storage	-	-	-	-
Infrastructure Installation	-	-	X	X
Restoration of Temporary Areas	-	X	X	-
Testing and Commissioning	-	-	-	-

Project Activity	Potential Environmental Effects			
	Change in Fish Habitat		Change in Water Quality	Mortality or Injury of Fish
	Instream Habitat	Riparian Area		
Operation and Maintenance				
Turbine Operation and Maintenance	-	-	-	-
Road Maintenance	-	-	X	-
Power Line and Substation Maintenance	-	X	-	-
Vegetation Management	-	X	-	-
Safety and Security	-	-	-	-
Decommissioning				
Removal of Infrastructure and Site Restoration	-	X	X	-

X = Potential Interaction
- = No Interaction

Potential adverse effects on fish habitat in the aquatic environment have been determined through an evaluation of the DFO (2018b) Pathways of Effects diagrams based on the proposed Project activities. These effects are described in this section in terms of the loss of fish habitat, changes to water quality, and mortality or injury to fish. Mitigation measures are applied to avoid or minimize the effects of the activities required for the Project, where possible. Avoidance is the first step of the hierarchy of measures for the conservation and protection of fish and fish habitat, described in DFO (2019), followed by mitigation, then offsetting.

Detailed design, which will include the micrositing of turbines and adjustment to the location of required access roads, and watercourse crossing locations, will help the Project reduce or avoid impacts to the aquatic environment. The micrositing of the Project infrastructure is the fine scale adjustment of infrastructure location within the Project sites in the PDA.

The primary locations of effects to the aquatic environment from Project activities are at watercourse crossings where culvert or bridge works, during road upgrades or new road construction, will occur. The crossings will also require removal of riparian areas. Additional locations of works may include construction of the turbine pads and temporary laydown areas in ephemeral watercourses or drainages.

Effects to the aquatic environment are possible during all stages of the Project but are most likely to occur during the construction phase of the Project when direct interaction with watercourses will occur (i.e., watercourse crossing installation or replacement). Generally, effects are anticipated to be short-term, occurring regularly during the construction phase, localized to the area immediately in or adjacent to watercourses, and expected to be mostly reversible upon completion of the construction. Mitigation measures are anticipated to be highly effective at preventing effects to the aquatic environment at most construction locations in the PDA. Details on the anticipated effects to the aquatic environment and applicable mitigation measures are presented in the following subsections.

7.3.2.1 Change in Fish Habitat

Although the Project layout and implementation methods have been designed to minimize adverse impacts to the aquatic environment, including watercourses that support, or could support, fish and fish habitat, Project activities can interact with the aquatic environment and potentially cause a change in aquatic (i.e., fish) habitat, including direct losses of instream and riparian fish habitat. Without mitigation, the Project has the potential to change the base flow in existing watercourses in the PDA during construction of the road network and turbine pads through the excavation of surface water drainage ditches, slopes, and landforms. Changes to slopes can result in changes in pathways of surface or groundwater flows which can change the quantity of water available in watercourses which in turn affects the availability and useability of fish habitat. A reduction in water quantity in existing fish bearing watercourses can cause a loss of usable area and a change in the availability of suitable habitat for important life stages of fish and aquatic organisms. The change in quantity can result in a reduction in quality of the existing water through increased temperature or changes in availability of food and nutrients.

Habitat loss has the potential to occur where watercourse crossings occur, specifically where road crossing culverts require replacement or upgrades. Existing clear span bridges that require replacement or upgrades are not anticipated to cause a loss of fish habitat as they will not have structures within the high-water mark of the watercourse. There are 450 mapped watercourses within the PDA; however, not all permanent or intermittent watercourses in the PDA will be crossed by the Project. A review of the design, information collected during the aquatic environment assessment, and the predicted watercourse layer indicates that at least 40 of the 450 watercourses are estimated to be no channel. Based on the latest design, the Project may intersect with approximately 410 watercourses. Of these 410 watercourses, approximately 60 to 75 locations (15 to 20 percent) may require a new crossing structure, depending on final design. Refinement of the Project design may reduce the number of new crossing structures/culverts.

Riparian clearing required for the Project will be limited to only those areas required for the upgraded access roads or work area. Revegetation or seeding of slopes and banks, where possible, will occur as soon as possible after clearing. Additionally, works within watercourses will be completed in the dry, during appropriate timing windows (i.e., June 1 to September 30), and all areas disturbed will be restored to their previous condition, or better. The potential loss of instream habitat from sedimentation is not anticipated after the implementation of mitigation measures.

Mitigation measures implemented during the installation of culverts and bridges will include proper culvert and bridge design, including ensuring adequate flow conveyance, embedding culverts, and maintaining migration through the installed culverts. Additionally, all culverts installed for the access roads will meet or exceed the minimum Nova Scotia Watercourse Alteration Standard (NSECC, 2015). Although the minimum standard for culverts in Nova Scotia is 450 mm, all culverts installed will be able to convey a minimum of the 1 in 100-year event flows. These measures are anticipated to be effective at preventing changes in base flows in the watercourses where crossing culverts upgrades or installations are required. Fish habitat will be established in embedded culverts through the placement of appropriately sized substrates to create cover and foraging habitat, while not impeding migration. Instream areas around culvert and bridge work areas will be modified, if necessary, to improve fish habitat through placement of appropriately sized substrates to create cover, foraging, and potentially spawning habitat.

Changes in fish habitat due to Project activities may require offsetting through DFO's *Fisheries Act* authorization process. DFO's (2019) habitat offsetting policy provides guidance on offsetting; benefits from offsetting must balance the adverse effects of the Project and provide benefit to the ecosystem. There are four types of offsetting that can be used: habitat restoration and enhancement, habitat creation, chemical or biological manipulations, or complementary measures (research, data collection for conservation purposes). If required, offsetting for Project effects on fish habitat will be determined during the permitting phase.

The following key measures to mitigate the potential effects of the Project on fish habitat will be further detailed in an EPP and will be implemented prior to and during construction:

- Work areas that overlap with watercourses below the high-water mark (i.e., in-water work areas) will be avoided, where not directly in the construction area.
- Applicable permits will be obtained prior to the start of any activity that has the potential to impact the aquatic environment. The Project will follow the conditions set out in the acquired permits for works in the aquatic environment.
- Watercourse crossings will be installed in compliance with the Nova Scotia Guide to Altering Watercourses.
    - All work will occur in the dry
    - In-stream work will occur between June 1 to September 30
- Restoration and offsetting
    - Restoration of instream and riparian areas will occur as required by regulatory permitting
    - Installation of new or upgraded culverts will meet provincial standards and DFO design criteria for fish passage
    - Where required by regulatory permitting, offsetting will be completed and focus on replacing lost fish habitat with similar or suitable habitat
- The Proponent will develop and implement ESC procedures.

7.3.2.2 Change in Water Quality

Without mitigation, construction and operation and maintenance activities in or adjacent to the aquatic environment may result in a change to the baseline surface water quality in watercourses and waterbodies in the PDA, which could extend through the LAA. Effects on water quality may potentially occur during construction or during operation of the Project in areas where ground disturbance occurs. Effects on water quality are anticipated to be short-term in duration and localized to the LAA or immediately downstream of the construction area in flowing watercourses. Effects to water quality from Project development are not anticipated as they can be mitigated with highly effective mitigation measures. If they are to occur, effects are reversible with additional inputs into the watercourse and are not anticipated to have long-term or residual effects.

Mitigation measures are known to be effective at preventing changes in water quality through the development and implementation of appropriate, and site specific, EPPs, including ESC and spill prevention plans. Protection plans will be prepared, including a Waste Management Plan and hazardous substances management and Spill Prevention Plan as components of an EPP for the Project. These plans will provide site-specific mitigation measures to prevent contamination of the watercourses in the PDA during construction, operation and maintenance, and decommissioning of the Project. Mitigation measures will include those aimed at minimizing the potential for spills during construction, including during concrete works, or storage and handling of POL. A hazardous substances management and Spill Prevention Plan will be designed and implemented to mitigate impacts to the aquatic environment from contaminants.

The following key measures to mitigate the potential effects of the Project on water quality and fish habitat will be further detailed in a Project-specific EPP and implemented prior to construction:

- ESC Measures
  - Implementation of ESC measures around work areas for the duration of construction, especially upslope of wetlands and/or watercourses. ESC measures may include silt fencing, flow checks (e.g., fibre filtration tubes, check dams), coir mats, ESC blankets, etc., as appropriate. ESC measures will be periodically inspected by the onsite environmental monitor and will be modified as needed to respond to storms, changes in topography, sedimentation events, etc.
  - Exposed soils, especially on slopes, will be stabilized as soon as possible following completion of construction (e.g., with coir mats/erosion control blankets or reseeded with a local seed mixture).
  - Riparian clearing will be conducted in stages to minimize exposure size and duration for soils. In general, the contractor should minimize riparian clearing to only that necessary for the Project.
  - All banks will be graded to a stable slope and revegetated/seeded where possible.
  - Environmental monitoring will occur during all in-water works, or where works have the potential to adversely impact the aquatic environment.
- Acid Rock Drainage (ARD) Procedures (if required)

- Site-specific measures will be developed for managing runoff from bedrock that is newly exposed during excavation and/or blasting. These could include controlling the rock pile size and extent, as well as managing new drainage pathways such that infiltration is diffused rather than concentrated to a specific waterbody or watercourse.
- An ARD Management Plan will be developed, if required, to manage and mitigate any potential effects from ARD.

- Spills and Fuel Storage
  - Storage and handling of POL and other deleterious substances will be conducted greater than 30 m away from watercourses/waterbodies and wetlands.
  - Spill kits will be kept in easily accessible locations within work areas.
  - All machinery working in, or near watercourses will be required to have a spill kit with the machine, while a larger work site spill kit will be required when working near water.

7.3.2.3 Potential Fish Mortality

Project activities during construction, operation and maintenance, and decommissioning of the Project have the potential to cause mortality or injury to aquatic organisms (i.e., freshwater fish). Project activities in watercourses for access road construction can include the placement or upgrades of crossing structures, culverts, as well as the placement of materials (e.g., boulders) that support the infrastructure. These activities can cause mortality or injury of fish/eggs/ova from physical crushing as a result of equipment use within watercourses. Equipment used in the water during construction can result in mortality of fish. Sediment, contamination, and excess nutrients have the potential to cause mortality to fish/eggs/ova through the disruption of physiological functions within the organisms. If required during construction, in proximity to existing fish bearing watercourses or waterbodies, explosives have the potential to cause lethal or sublethal effects to fish. Through the blasting of rock or materials, the activity may cause the ejecta to land in adjacent waters where, if present, fish could be harmed or killed. Additionally, the vibrations and sound pressure from the blast can cause damage to internal organs, including swim bladders, which can affect the ability of a fish to regulate buoyancy in the water column, as well as affecting their ability to detect sound or pressure changes (Blanco & Unniappan, 2022; Wright & Hopky, 1998).

Mitigation measures to prevent or reduce loss of fish habitat and change in water quality will also prevent or reduce fish mortality and injury. Project activities within watercourses will be completed in the dry, in the appropriate timing window, and with a fish salvage and relocation program.

The following key measures to mitigate the potential effects of the Project on fish will be further detailed in an EPP and will be implemented prior to and during construction:

- Acquire approvals and permits for in-water works. These will include provincial and federal approvals.

- Follow recommendations and requirements of the approvals and permits issued for the Project to prevent fish mortality.
- Follow instream work windows to protect fish. In-water works will be conducted between June 1 and September 30, unless otherwise permitted by regulators.
- Equipment will not be used directly in flowing water.
- Equipment will not ford any watercourses.
- Isolate the work site with a coffer dam (or similar) and dewater the site.
- Conduct a fish salvage to capture and relocate any fish observed in the work area. Works will not start until the area has been salvaged and the environmental monitor is confident in the area being free of fish. Conduct additional fish salvages after any site breaches.
- Conduct any works in the channel in the dry. Continue to monitor water within the site and pump water from the site to a vegetated area away from the watercourse.
- Pump water within the watercourse around the site to maintain downstream flows.
- An environmental monitor will be on site to observe works and check the operation of equipment to prevent failures and potential fish mortality (e.g., pump failure, coffer dam breach).
- Avoid the use of explosives, where possible, in the aquatic environment or within the setback from the aquatic environment as per the guideline criteria for various substrates as per Wright & Hopky (1998), or as per a distance as directed by DFO. Any storage or of explosives will be a minimum of 30 m away from watercourses unless authorized by applicable regulatory authorities.
- Debris from blasting will not be allowed to be ejected into any watercourses to prevent direct injury or mortality to fish.

7.3.3 Residual Effects

After mitigation, micrositing, detailed design, and restoration as well as offsetting in accordance with permit conditions, residual effects in the aquatic environment are not anticipated within the LAA. Although habitat losses for instream and riparian areas are anticipated to occur, residual effects from the Project activities are not anticipated in the aquatic environment after the implementation of any required offsetting. Effects to water quality and mortality or injury of fish can be mitigated so no anticipated residual effects will occur.

7.4 Monitoring

If required, a detailed monitoring plan will be developed prior to the start of construction to meet the conditions of any required regulatory permits for the project, including NSECC Watercourse Alteration Approvals and DFO *Fisheries Act* Authorization (if required) for the Project. The monitoring plan will identify locations and methods to protect the aquatic environment, particularly fish and fish habitat, from potential mortality during construction, operation and maintenance, and decommissioning of the Project. Monitoring locations will be based on the final project design and the location of impacts to the aquatic environment, including culvert and bridge installations or upgrades. Monitoring stations will be established where long term observations and measurements can be conducted to monitor changes in the aquatic environment through photographs and in situ measurements. Monitoring targets and goals will be determined during the permitting phase of the Project in coordination with the applicable regulatory agency (e.g., DFO, NSECC).

Monitoring locations will be based on pre-construction conditions and will be monitored through construction and post-construction as required by conditions of permits.

- Experienced environmental monitors will be on site during works in or near the aquatic environment to monitor the effectiveness of implemented mitigation measures and to provide support to the construction team for any environmental issues that arise.
- Environmental monitors will be given authority to stop or modify activities that have the potential to cause, or are causing, an adverse impact to the aquatic environment. The environmental monitor will also have Stop Work authority for the entire work site to mitigate an impact to the aquatic environment due to failing or improperly functioning mitigation measures. Details of the environmental monitor’s responsibilities and authority will be defined in a Project-specific EPP.

8 Flora

8.1 Overview

The assessment of the Project on terrestrial flora encompasses the vegetation communities and the individual plant, lichen, and bryophyte species (including SAR and SoCC) that constitute them. Interactions of the Project with vegetation communities are closely tied to Project interactions with other VECs that are assessed in the respective chapters, including the aquatic environment (Chapter 7), wetlands (Chapter 9), terrestrial wildlife (Chapter 10), bats (Chapter 11), and birds (Chapter 12).

This chapter evaluates the possible implications of the Project on vegetation communities and flora (vascular and non-vascular) and provides mitigation, as well as construction and operational management practices to minimize these possible effects. The Project has the potential to affect flora both directly (i.e., direct habitat loss during pre-construction clearing), as well as indirectly due to habitat modification and degradation leading to reduced flora habitat quality. Strategic site planning will be employed to minimize disturbance to flora and vegetation communities. This includes using existing roads and areas previously harvested, as well as maintaining vegetated buffers around wetlands and watercourses. In addition, the Proponent is committed to enhancing the quality of vegetation habitat within the LAA through implementation of invasive species management procedures.

In response to concerns raised by the public and stakeholders, as well as constraints identified during field assessments, the Proponent has modified the Project road and turbine layout to avoid or reduce potential for adverse environmental effects on multiple VECs, including terrestrial flora (see Figure 2.2). Proposed turbine locations have been removed from old growth forest and tracts of mature intact forest areas, including those situated on Crown land parcels.

As discussed in the following subsections, habitat loss and degradation will be minimized by using existing roads and previously disturbed areas. Additionally, construction access roads that are not retained will be decommissioned, and vegetation will be gradually restored in the Project to mitigate the long-term impacts to vegetation and vegetation communities. The possible effects, mitigation measures, and residual impacts to terrestrial flora as a result of the Project are outlined in this chapter and will be further developed in an EPP prior to construction to minimize adverse effects.

8.1.1 Regulatory Context

Assessment of the terrestrial flora considers the following provincial and federal regulatory guidelines:

- SARA
- *Canadian Environmental Protection Act*
- NSESA
- Nova Scotia *Wildlife Act*
- Nova Scotia *Biodiversity Act*
- Nova Scotia *Environment Act*
- Nova Scotia *Wilderness Areas Protection Act*
- At-Risk Lichens–Special Management Practices (NSDNRR, 2018)
- Old-Growth Forest Policy for Nova Scotia (NSDNRR, 2022)
- Nova Scotia Silvicultural Guide for the Ecological Matrix (McGrath et al., 2021)

8.1.2 Assessment Methodology

The assessment of terrestrial flora focused on identifying terrestrial flora species present or likely to be present within or near the LAA, with emphasis on identifying any SAR or SoCC and their habitat. This was achieved though literature review, habitat analysis, and field surveys. The information gathered during the literature review and habitat analysis was used to design and execute field surveys targeting any SAR or SoCC likely to be present. The data collected from this assessment was used to evaluate the impact of the Project on terrestrial plants and lichens. This information was then used to inform and refine siting of Project infrastructure and develop measures to minimize adverse effects of Project construction and operation and maintenance.

The description of the existing environment is based primarily on data collected through the following resources plus field surveys carried out for this Project:

- NSDNRR (2018) Significant Species and Habitat Database
- AC CDC (2023) Data Report
- iNaturalist.ca Observation Database (2023)
- Global Biodiversity Information Facility Occurrence Database (2023)
- NSDNRR Provincial Landscape Viewer
- NSDNRR Nova Scotia Old Growth Policy and Old Growth Potential Index
- Ecological Land Classification for Nova Scotia 2015
- Nova Scotia Parks and Protected Areas Map
- Global Forest Watch Tree Cover Loss 2001-2022 (Global Forest Watch, 2024)
- Canada Landsat Disturbance 2017
- NSDNRR Wetland and Wet Areas mapping
- Nova Scotia topographic data and LiDAR elevation data
- Surficial geology mapping
- Species at Risk Public Registry documents for federal SAR
- Boreal Felt Lichen predictive habitat layer (NSDNRR, 2012)

- Provincial SAR Core Habitat Data (NSDNRR, 2023)
- Eastern Waterfan Critical Habitat Data (ECCC, 2021)
- Natural History of Nova Scotia (Davis and Browne, 1996)
- Nova Scotia Plants (Munro et al., 2014)

A habitat assessment of the terrestrial plant and lichen SAR and SoCC known to occur within 100 km radius of the LAA was completed using available habitat information and species occurrence data (including federal critical habitat and provincial core habitat data layers). The habitat assessment was used to identify important areas within the LAA for SAR and SoCC and develop field surveys to target possible SAR and SoCC plant and lichen species. The assessment of old-growth forests in the LAA used the Old-Growth Policy layer and the Old-Growth Potential Index layer provided by NSDNRR through a data sharing agreement (Province of Nova Scotia, 2022). A habitat suitability model was also developed to direct field surveys to target suitable habitat of federally and provincially Threatened Eastern Waterfan (*Peltigera hydrothyria*) an aquatic lichen with known occurrences in close proximity to the Project (a stream on the west side of Trunk 4 that flows into to the Folly River). The critical habitat of this occurrence overlaps with the current PDA (ECCC, 2021). Details of the habitat model are provided below.

8.1.2.1 Eastern Waterfan Habitat Suitability Mapping

A habitat suitability model was developed to assess the quantity of suitable habitat for Eastern Waterfan. Spatial parameters representing attributes of Eastern Waterfan habitat were aggregated to determine suitable habitat within the PDA and LAA. Sites that met all habitat parameters were considered suitable habitat. The selection of habitat parameters was informed though consultation with species experts and habitat description in the species COSEWIC reports.

The following spatial layers were used to represent and identify suitable habitat:

- NSDNRR Nova Scotia Forest Inventory
- Global Forest Watch Tree Cover Loss 2001-2022 (Global Forest Watch, 2024)
- GeoNOVA Data Locator – Elevation Explorer

A GIS-based Stream Network model was developed from a bare-ground digital elevation model for the LAA (500 m). The digital elevation model was built using Nova Scotia LiDAR Point Cloud data retrieved from the GeoNOVA Data Locator – Elevation Explorer portal. Streams were modelled using the D8 algorithm and a channelization threshold of 4 ha, and stream order assigned using the Strahler method (Tarboton, 1991).

Eastern Waterfan Habitat Description

Eastern Waterfan is typically found in cool, clear, partially shaded backwater streams, outside of the main water flow (COSEWIC, 2013). Its habitat occurs both underwater and along stream margins, however the species has been known to occur outside of water during periods of receding water levels (COSEWIC, 2013). High humidity and year-round wetness are key habitat parameters for Eastern Waterfan; the presence of partial shade plays an important role in maintaining these conditions especially during summer months when the lichen may be exposed (Clayden et al., 2011; COSEWIC, 2013). Sean Haughian, Curator of Botany at the Nova Scotia Museum shared that the species exhibits a preference for mature hardwood and mixedwood forests and is not found in exclusively softwood stands (S. Haughian, pers. comm., February 15, 2024).

Based on the above habitat description, the following attributes were used to model suitable Eastern Waterfan habitat:

- Forest Type – Any stand classified as hardwood or mixedwood in the Nova Scotia Forest Inventory
- Stream Order – Any stream classified as 1st order in the Stream Network Model (S. Haughian, pers. comm., February 15, 2024)
- Forest Cover Change – Any site with tree cover loss from 2001 to 2022 was considered unsuitable habitat for Eastern Waterfan. Loss of tree cover renders streams inhospitable to Eastern Waterfan by increasing stream temperature and siltation, and reducing humidity (ECCC, 2021)

8.1.2.1 Field Surveys

The objective of the field surveys was to assess the presence and distribution of flora across the LAA, focussing on SAR/SoCC species and their habitats identified during the desktop assessment and in consultation with NSDNRR. Field surveys for flora species and communities were conducted between May and October 2023, and were generally conducted concurrently. The survey design targeted areas with the highest potential of hosting SAR/SoCC and old growth forests and where habitat intersected with the PDA, while also covering representative habitat types present across the LAA. Habitats within the LAA considered to be highest-priority areas for plant and lichen species inventory included wetlands, mature or fertile forest areas, floodplains, and old-growth forests. Where present, mature forested areas within the LAA were identified and classified in the field using the Forest Ecosystems Classification for Nova Scotia (Neily et al., 2010).

Field surveys of old-growth forest stands with high potential for old-growth, as indicated by the Old-Growth Potential Index layer, were completed during the geotechnical program performed by Strum using old growth scoring procedures outlined in NSDNRR's (2022) Old Forest Assessment document. Further field assessments for old-growth conditions will be conducted to inform the detailed design process in areas where Project infrastructure intersects with Crown land.

Surveys to target Eastern Waterfan were conducted along with turtle surveys (see Chapter 10, Terrestrial Wildlife) where habitat was suitable. Additional observations of terrestrial flora were gathered as incidental observations during the biological field programs conducted in the LAA. These incidental observations were included in the assessment of the existing environment.

8.2 Existing Environment

8.2.1 Vegetation Communities

The Project is situated in the Cobequid Hills Ecodistrict within the Nova Scotia Uplands Ecoregion, an elevated area that hosts one of the largest remaining intact Acadian Forests of shade-tolerant hardwoods in mainland Nova Scotia (NSDLF, 2019). Within this ecodistrict, plateaus support forests of Sugar Maple, Yellow Birch, and American Beech. The plateaus are interlaced with softwood-dominant forests at higher elevations and mixedwood forests in sheltered ravines. In poorly drained depressions, stands are dominated by Balsam Fir (*Abies balsamea*) and Black Spruce (*Picea mariana*) (Davis and Brown, 1997).

The Nova Scotia Provincial Landscape Viewer indicates that most of the area near the Project is characterized by an equal mix of Red and Black Spruce Hummocks and Tolerant Hardwood Hills eco-elements. The remaining area is composed of other eco-elements such as Tolerant Mixedwood Slopes, Tolerant Mixedwood Hummocks, Red Spruce Hummocks, and water. General descriptions of the eco-elements within the vicinity of the Project are as follows:

- Red and Black Spruce Hummocks—conifer-dominated forests occur on imperfectly- to well-drained soils at upper elevations of the Cobequid Hills. Imperfectly-drained sites are dominated by Black Spruce with some Red Maple (*Acer rubrum*) and a shrub layer dominated by hollies (*Ilex* spp.). Well-drained sites are dominated by Red Spruce.
- Tolerant Hardwood Hills—hardwood-dominated forests are dominant in the middle elevations of the Cobequid Hills and on the Cobequid Slopes, typically on well-drained soils. Common canopy species include Sugar Maple, American Beech, Yellow Birch, White Ash (*Fraxinus americana*), and Hop-hornbeam (*Ostrya virginiana*). Shrub layer and groundcover species are mostly shade-tolerant plants and include a diversity of spring ephemeral wildflowers as well as Hobblebush (*Viburnum lantanoides*), Fly Honeysuckle (*Lonicera canadensis*), and Beaked Hazel (*Corylus cornuta*).
- Tolerant Mixedwood Slopes—well-drained soils on steep ravine slopes support a mix of hardwood and coniferous canopy species such as Sugar Maple, Yellow Birch, Red Spruce, Eastern Hemlock (*Tsuga canadensis*), and Eastern White Pine (*Pinus strobus*). The slopes supporting this eco-element frequently contain seepages and springs, which can provide important habitat for wildlife.
- Tolerant Mixedwood Hummocks—isolated areas of imperfectly-drained soils on upper-elevation plateaus in the Cobequid Hills support a mix of hardwood and coniferous species such as Sugar Maple, American Beech, Yellow Birch, and Red Spruce.
- Red Spruce Hummocks—rolling, imperfectly-drained hills, especially on the Cobequid Slopes, support forests dominated by Red Spruce.

Several conserved and protected areas occur within a 5 km radius of the PDA. These include the Wentworth Valley Wilderness Area, Cook Conservation Lands, Wentworth Conservation Lands, Douglas Meadow Brook Wilderness Area, and one pending area: Staples Brook Nature Reserve. These protected areas are all located in the Wentworth Valley and Cobequid Mountain natural landscape area, with the exception of Douglas Meadow Brook Nature

Reserve, which is slightly further north and within the Northumberland Strait Plain natural landscape area. These areas host large tracts of mature hardwood-dominated forests and a variety of other habitats.

Other protected areas within relatively close proximity to the PDA include Gully Lake Wilderness Area, Calvary River Wilderness Area, and Dalhousie Mountain Nature Reserve, which are all located roughly 15 to 25 km east of the PDA. These areas are located in the Central Rolling Hills natural landscape area of Nova Scotia and protect remnant mature stands of mainly hardwood-type forests dominated by Yellow Birch and Sugar Maple as well as several other habitat types.

Landcover within 2 km of the PDA was analyzed through the Nova Scotia Forest Inventory layer (this distance was selected to include the habitats covered by the LAAs for the VECs assessed within this document) (Figure 8.1). The majority of the landcover surrounding the PDA is categorized as forested stands (83 percent) with hardwood, softwood, and mixedwood stands comprising 18, 42, and 23 percent, respectively. Other land cover types include wetland (2 percent) and clearcut (1 percent), with the remaining cover types making up less than 1 percent of the total landcover. The outdated forest inventory layer, however, is not representative of current site conditions. Much of the forested lands in the LAA have been subject to industrial forestry operations within the past 20 years (see section 1.3 and Figure 1.3). The Global Forest Watch Tree Cover Loss (2001 to 2022) data indicates that 34 percent of the PDA has experienced forest loss in this period, which more closely reflects what was observed in the field. Remnant forests are generally dominated by Acadian Forest species, with most mature stands occurring on steep slopes, along watercourses, and unharvested Crown land parcels. During the field surveys, the majority of the forests within the LAA were deemed too immature or disturbed to classify according to the Forest Ecosystems Classification.

None of the forest stands within the LAA are classified as old-growth according to the Old-Growth Forest Policy (2022) (Figure 8.1). The Old-Growth Potential Index identified five stands with high potential for old-growth within the Crown land parcels of the PDA (Figure 8.2), and these were assessed using old-growth scoring procedures. None of the assessed stands were confirmed as old-growth (see Table 8.1 for scoring results).

Table 8.1 Results of the Old-Growth Field Assessments (source: Strum Consulting)

Stand ID	Stand Size (ha)	Plot #	Species Cored[1]	DBH[2] (cm)	Height (m)	Age (years)	Old Growth Reference Age (years)	Avg. Stand Age	Old Growth Status
E163-02944	14.7	1	yB	34.2	10	76	125	68	Not Old-Growth
		2	bF	10.4	7	15			
		3	rS	44.8	14	75			
		4	rS	40.6	16.5	79			
		5	yB	35.8	16	124			
		6	rS	35.7	16.5	46			
		7	rS	65.1	17	58			
E163-02900	4	1	rS	42.4	16.5	65	125	67	Not Old-Growth
		2	rS	34.4	16	70			
		3	rS	30.3	18	67			
E163-02804	16.6	1	sM	22.9	11	52	140	56	Not Old-Growth
		2	sM	27	11	57			
		3	yB	14.1	11.5	37			
		4	sM	35.5	13.5	103			
		5	bE	28.6	10	68			
		6	yB	19.7	10.5	29			
		7	yB	13.1	10	32			
		8	bE	35.6	12.5	66			
E163-04816	16.8	1	yB	19.8	11	38	100	45	Not Old-Growth
		2	r/bS	23.5	10.25	92			
		3	yB	18	11.5	35			
		4	yB	27.2	14.75	55			
		5	rS	15.1	11.75	37			
		6	rS	12.4	9	23			
		7	rS	25.4	12.25	40			
		8	rS	19.8	11	38			
E163-02925	11.2	1	rS	38.1	18.5	95	100	70	Not Old-Growth
		2	rS	37.9	17.5	70			
		3	rS	24.2	12	54			
		4	rS	32.4	15	67			
		5	rS	21.7	15.5	62			

[1]rS = red spruce; sM = sugar maple, yB = yellow birch, rS = red spruce, bS = black spruce, bE = American beech

[2]DBH = Diameter Breast Height

8.2.2 Vascular and Non-vascular Flora

The AC CDC (2023) Data Report includes observations of 445 flora SAR and SoCC that have been recorded within a 100 km radius of the LAA (see Appendix B). Of the 445 species, 275 are vascular plants and 170 are non-vascular species (104 lichens and 66 bryophytes).

Vascular Plants

The list of SAR and SoCC vascular plant species in the AC CDC database occurring within 5 km of the PDA as well as other available records are provided in Table 8.2. The only SAR known to occur within 5 km of the Project is Black Ash (*Fraxinus nigra*), which is considered a location-sensitive species in Nova Scotia. A search of Nova Scotia core habitat layer (provided by NSDNRR, 2023) reveals occurrences of Black Ash core habitat within a 5 km radius of the PDA. This core habitat polygon occurs approximately 4.3 km north of the nearest Project infrastructure.

Table 8.2 SAR and SoCC Vascular Plant Species Occurring Within 5 km (AC CDC and other available sources)

Scientific Name	Common Name	NSESA	SARA	COSEWIC	AC CDC
Fraxinus nigra	Black Ash	Threatened	-	Threatened	S1S2
Allium schoenoprasum	Wild Chives	-	-	-	S1?
Lilium canadense	Canada Lily	-	-	-	S2
Platanthera macrophylla	Large Round-leaved Orchid	-	-	-	S2
Boechera stricta	Drummond's Rockcress	-	-	-	S2S3
Carex adusta	Lesser Brown Sedge	-	-	-	S2S3
Carex comosa	Bearded Sedge	-	-	-	S2S3
Eleocharis ovata	Ovate Spikerush	-	-	-	S2S3
Scirpus pedicellatus	Stalked Bulrush	-	-	-	S2S3
Carex tribuloides	Blunt Broom Sedge	-	-	-	S3
Carex tuckermanii	Tuckerman's Sedge	-	-	-	S3
Dryopteris fragrans	Fragrant Wood Fern	-	-	-	S3
Eleocharis rostellata	Beaked Spikerush	-	-	-	S3
Neottia bifolia	Southern Twayblade	-	-	-	S3
Platanthera grandiflora	Large Purple Fringed Orchid	-	-	-	S3

Scientific Name	Common Name	NSESA	SARA	COSEWIC	AC CDC
Viola nephrophylla	Northern Bog Violet	-	-	-	S3
Spiranthes ochroleuca	Yellow Ladies'-tresses	-	-	-	S3?
Diphasiastrum complanatum	Northern Ground-cedar	-	-	-	S3S4
Diphasiastrum sitchense	Sitka Ground-cedar	-	-	-	S3S4
Equisetum pratense	Meadow Horsetail	-	-	-	S3S4
Fagus grandifolia	American Beech	-	-	-	S3S4
Fragaria vesca	Woodland Strawberry	-	-	-	S3S4
Huperzia appressa	Mountain Firmoss	-	-	-	S3S4
Juncus acuminatus	Sharp-Fruit Rush	-	-	-	S3S4
Liparis loeselii	Loesel's Twayblade	-	-	-	S3S4
Nuphar microphylla	Small Yellow Pond-lily	-	-	-	S3S4
Platanthera obtusata	Blunt-leaved Orchid	-	-	-	S3S4
Platanthera orbiculata	Small Round-leaved Orchid	-	-	-	S3S4
Verbena hastata	Blue Vervain	-	-	-	S3S4

During the 2023 field surveys, 515 species of vascular flora representing 82 families were encountered within and near the LAA (for survey coverage see Figure 8.3). Of these, two are considered to be SAR and 11 are considered to be SoCC (Table 8.3). The two vascular plant SAR, Black Ash and Eastern White Cedar (*Thuja occidentalis*), were detected during the field surveys within the LAA. Two Black Ash trees were observed in a floodplain wetland, over 1 km from the nearest proposed Project infrastructure. A single Eastern White Cedar sapling was observed on a disturbed roadside gravel habitat within the PDA. Due to the location and habitat, this individual specimen of Eastern White Cedar is not considered to be naturally occurring. While naturally established cedars have been reported in Cumberland County, the disturbed nature of the roadside habitat where this occurrence was observed does not align with the criteria for natural Eastern White Cedar habitat in Nova Scotia (NSDNRR, 2010). Given its habitat and the lack of nearby habitat or individuals, it is presumed that this specimen was introduced by human activities and not considered further.

Table 8.3 SAR and SoCC Vascular Plant Species Observed During Field Surveys in 2023

Scientific Name	Common Name	NSESA	SARA	COSEWIC	AC CDC
Fraxinus nigra	Black Ash	Threatened	-	Threatened	S1S2
*Thuja occidentalis**	Eastern White Cedar	Vulnerable	-	-	S2S3
Carex adusta	Lesser Brown Sedge	-	-	-	S2S3
Scirpus pedicellatus	Stalked Bulrush	-	-	-	S2S3
Eleocharis rostellata	Beaked Spikerush	-	-	-	S3
Platanthera grandiflora	Large Purple Fringed Orchid	-	-	-	S3
Spiranthes ochroleuca	Yellow Ladies'-tresses	-	-	-	S3?
Fagus grandifolia	American Beech	-	-	-	S3S4
Fragaria vesca	Woodland Strawberry	-	-	-	S3S4
Juncus acuminatus	Sharp-fruit Rush	-	-	-	S3S4
Nuphar microphylla	Small Yellow Pond-lily	-	-	-	S3S4
Platanthera obtusata	Blunt-leaved Orchid	-	-	-	S3S4
Platanthera orbiculata	Small Round-leaved Orchid	-	-	-	S3S4

* not considered a natively occurring specimen

The most commonly encountered SoCC during the surveys was American Beech, which was widespread throughout the PDA and LAA. Most of the trees were in poor health, due to the effects of invasive beech bark disease and Beech Leaf-mining Weevil (*Orchestes fagi*).

Of the 515 species of vascular plants, 101 plants considered non-native in Nova Scotia were recorded (Table 8.1 in Appendix H). Two species observed, Glossy Buckthorn (*Frangula alnus*) and Purple Loosestrife (*Lythrum salicaria*), are considered an invasive species in Nova Scotia (Nova Scotia Invasive Species Council, 2024). A single small patch of Purple Loosestrife was observed in a roadside ditch outside of the PDA and Glossy Buckthorn was reported from several locations within the PDA.

Non-vascular Plants

The list of SAR and SoCC non-vascular plant species in the AC CDC database occurring within 5 km of the PDA as well as other available records are provided in Table 8.4. Several other lichen SAR and SoCC records are incorporated into this list, including species compiled in EA documents for nearby infrastructure projects including Higgins Mountain Wind Farm (Strum Consulting, 2023a) and the Kmtnuk Wind Farm (Strum Consulting, 2023b).

Table 8.4 SAR and SoCC Non-vascular Plant Species Occurring Within 5 km (AC CDC and other available sources)

Scientific Name	Common Name	NSESA	SARA	COSEWIC	AC CDC	No. of Records	Source of Record(s)
Peltigera hydrothyria	Eastern Waterfan	Threatened	Threatened	Threatened	S1	6	AC CDC, 2023
Pannaria lurida	Wrinkled Shingle Lichen	Threatened	Threatened	Threatened	S2S3	5	Strum, 2023
Pectenia plumbea	Blue Felt Lichen	Vulnerable	Special Concern	Special Concern	S3	2	AC CDC, 2023
Sclerophora peronella (Atlantic pop.)	Frosted Glass-whiskers (Atlantic population)	-	Special Concern	Special Concern	S3S4	1	Strum, 2023
Heterodermia squamulosa	Scaly Fringe Lichen	-	-	Threatened	S3	1	Strum, 2023
Aloina rigida	Aloe-Like Rigid Screw Moss	-	-	-	S1?	1	AC CDC, 2023
Anaptychia palmulata	Shaggy Fringed Lichen	-	-	-	S3S4	1	AC CDC, 2023
						20	CBCL, 2023
Timmia megapolitana	Metropolitan Timmia Moss	-	-	-	S1S2	1	AC CDC, 2023
Stereocaulon condensatum	Granular Soil Foam Lichen	-	-	-	S2S3	32	CBCL, 2023
Stereocaulon grande	Grand Foam Lichen	-	-	-	S1S3	1	AC CDC, 2023
Fissidens taxifolius	Yew-leaved Pocket Moss	-	-	-	S3	13	CBCL, 2023
Fuscopannaria ahlneri	Corrugated Shingles Lichen	-	-	-	S3	5	CBCL, 2023
Leptogium milligranum	Stretched Jellyskin Lichen	-	-	-	S3	2	AC CDC, 2023

Scientific Name	Common Name	NSESA	SARA	COSEWIC	AC CDC	No. of Records	Source of Record(s)
Parmelia fertilis	Fertile Shield Lichen	-	-	-	S2S3	1	AC CDC, 2023
Peltigera collina	Tree Pelt Lichen	-	-	-	S3	1	AC CDC, 2023
						3	CBCL, 2023
Phaeophyscia pusilloides	Pompom-tipped Shadow Lichen	-	-	-	S3	2	CBCL, 2023
Evernia prunastri	Valley Oakmoss Lichen	-	-	-	S3S4	1	AC CDC, 2023
Heterodermia neglecta	Fringe Lichen	-	-	-	S3S4	16	CBCL, 2023
Heterodermia speciosa	Powdered Fringe Lichen	-	-	-	S3S4	3	AC CDC, 2023
						22	CBCL, 2023
Leptogium acadiense	Acadian Jellyskin Lichen	-	-	-	S3S4	1	AC CDC, 2023
						22	CBCL, 2023
Scytinium subtile	Appressed Jellyskin Lichen	-	-	-	S3S4	2	CBCL, 2023
Scytinium teretiusculum	Curly Jellyskin Lichen	-	-	-	S3S4	1	CBCL, 2023

During the 2023 field surveys, 185 species of non-vascular flora were identified within or near the LAA. This included 106 lichen species representing 27 families, and 79 species of mosses and liverworts (bryophytes), representing 36 families (see Appendix H, Table 8.2). Of the 185 non-vascular species identified, 11 are SoCC (Table 8.5). No SAR non-vascular species were identified during the field survey program.

Table 8.5 List of SoCC Non-vascular Plant Species Observed During Field Surveys in 2023

Scientific Name	Common Name	NSESA	SARA	COSEWIC	AC CDC
Stereocaulon condensatum	Granular Soil Foam Lichen	-	-	-	S2S3
Phaeophyscia pusilloides	Pompom-tipped Shadow Lichen	-	-	-	S3
Fuscopannaria ahlneri	Corrugated Shingles Lichen	-	-	-	S3
Peltigera collina	Tree Pelt Lichen	-	-	-	S3
Fissidens taxifolius	Yew-leaved Pocket Moss	-	-	-	S3
Leptogium acadiense	Acadian Jellyskin Lichen	-	-	-	S3S4
Scytinium subtile	Appressed Jellyskin Lichen	-	-	-	S3S4
Scytinium teretiusculum	Curly Jellyskin Lichen	-	-	-	S3S4
Heterodermia speciosa	Powdered Fringe Lichen	-	-	-	S3S4
Anaptychia palmulata	Shaggy Fringed Lichen	-	-	-	S3S4
Heterodermia neglecta	Fringe Lichen	-	-	-	S3S4

Two of the lichen species reported within 5 km, Wrinkled Shingle Lichen (*Pannaria lurida*) and Eastern Waterfan, are federally listed species while Blue Felt Lichen is provincially listed as Vulnerable.

Wrinkled Shingle Lichen is a leafy lichen that typically grows in patches on the trunks of deciduous trees, usually in or near wetlands (COSEWIC, 2016). No critical habitat for Wrinkled Shingle Lichen has been identified to date and this species was not detected during the 2023 flora surveys.

Blue Felt Lichen (*Pectenia plumbea*) is a distinctive large gray-blue foliose lichen that primarily grows on mature deciduous trees in deciduous or mixed deciduous/coniferous forests (COSEWIC, 2010). It tends to be more common in low-lying areas with frequent fog or at higher elevations where there is cloud, or in areas with topographic features that help to trap moisture, such as valleys, swamps, and near watercourses (COSEWIC, 2010). No core or predicted habitat mapping for Blue Felt Lichen is currently available. Blue Felt Lichen was not observed during the 2023 flora surveys.

The Boreal Felt Lichen Layer was reviewed to identify potential habitat within the LAA. No predicted Boreal Felt Lichen habitat polygons occur within the Cobequid Hills, as this species occurs primarily within a 30 km-wide strip along the Atlantic coast of Nova Scotia (NSDNRR, 2012).

A search of Nova Scotia critical/core habitat layers revealed occurrences of Eastern Waterfan critical habitat within a 5 km radius of the PDA. This critical habitat polygon overlaps with the PDA in the location of Stevens Road. The overlap of the PDA with the Eastern Waterfan critical habitat is seemingly downstream from the occurrence of Eastern Waterfan used to define the area of critical habitat on the west side of Trunk 4 (COSEWIC, 2021). Surveys for Eastern Waterfan were conducted as part of plant and lichen surveys throughout the 2023 growing season simultaneously with many of the Wood Turtle habitat assessments and visual encounter surveys conducted in watercourses within the PDA in May and June of 2023. CBCL did not observe any occurrences of Eastern Waterfan or suitable habitat during the field surveys. Results of the Eastern Waterfan habitat suitability mapping are provided below.

8.2.2.1 Eastern Waterfan Habitat

Eastern Waterfan is an aquatic leafy lichen that grows attached to rocks in partly-shaded streams. In Eastern North America, it typically occurs in cool mineral-enriched streams with summer pH values above 6, which contain small waterfalls, exposed boulders and/or sinuous stream configurations that create quiet backwaters where the lichen can grow outside the main water flow (COSEWIC, 2013). Only streams that have water of a suitable pH (typically 6 to 7) and the ability to buffer reduced surface water pH caused by acid rain are likely to support Eastern Waterfan (COSEWIC, 2013). The habitat suitability mapping reveals habitat within the LAA that possibly supports Eastern Waterfan (Figure 8.3). This map will be used to target additional field surveys during the detailed design phase where Project infrastructure may overlap identified suitable habitat.

8.3 Effects Assessment

8.3.1 Boundaries

For the purpose of this assessment, the LAA for flora includes the PDA and a 200 m buffer. The RAA for flora incorporates the LAA and all contiguous natural habitat areas.

8.3.2 Potential Effects and Mitigation

Several changes were implemented for the Project to minimize potential direct and indirect impacts on flora, where reasonable, while meeting engineering and design constraints. Detailed design of the Project and micrositing of turbines will further avoid sensitive terrestrial habitats when practicable and will reduce potential interactions between the Project and terrestrial flora, including SoCC and old-growth forest. Micrositing involves exact placement of the turbine within the turbine sites as shown in the PDA.

Direct and indirect effects of the Project on flora could occur through various interconnected pathways. During construction, activities like soil disturbance, vegetation clearing, and infilling may cause direct habitat loss for sensitive terrestrial flora species and habitats. Increased road width and density will increase vegetation community fragmentation and edge effects. The rise in Project-related vehicle traffic poses a risk through the possible increase and spread of invasive flora species, decrease in air quality including an increase in dust deposition on terrestrial flora. While some flora species are adaptable to a variety of habitat types and environmental conditions, others are more specialized when it comes to habitat preferences and requirements. Species that are naturally more rare or sensitive, including SAR and SoCC, may be more heavily impacted by direct or indirect habitat loss.

Project activities can affect terrestrial flora as indicated in Table 8.6; these potential effects do not consider the detailed design of the Project and micrositing of turbines that is yet to be completed or the implementation of mitigation measures described herein.

Table 8.6 Potential Environmental Effects of the Project on Terrestrial Flora

Project Activity	Potential Environmental Effects		
	Habitat Loss and Fragmentation	Loss of Flora SoCC	Degradation of Flora Habitat
Construction			
Site Preparation	X	X	X
Access Roads Construction and Modifications	X	X	X
Material and Equipment Delivery and Storage	-	-	X
Infrastructure Installation	-	-	-
Restoration of Temporary Areas	-	-	-
Testing and Commissioning	-	-	-
Operation and Maintenance			
Turbine Operation and Maintenance	-	-	-
Road Maintenance	-	-	X
Power Line and Substation Maintenance	-	-	X
Vegetation Management		X	X
Safety and Security	-	-	-

Project Activity	Potential Environmental Effects		
	Habitat Loss and Fragmentation	Loss of Flora SoCC	Degradation of Flora Habitat
Decommissioning			
Removal of Infrastructure and Site Restoration	-	-	X

X = Potential Interaction
- = No Interaction

8.3.2.1 Habitat Loss and Fragmentation

The Project may result in habitat loss and fragmentation for terrestrial flora species within the LAA.

The Project will cause direct habitat loss by increasing road width and construction of new roads, turbine pads, temporary staging areas, and other Project infrastructure. Habitat loss will primarily occur during the construction phase through vegetation clearing, removal of topsoil, and the addition of fill and hardscapes (e.g., concrete). Construction activities within the PDA may lead to the clearance of up to 8.4 square kilometres (km^2) of relatively undisturbed habitat (i.e., forested habitat that has not been cleared in the past twenty years). As described in Section 2.1, after detailed design, the area to be cleared is expected to be approximately half this amount or less. The clearing activities may result in both short-term and long-term loss of flora habitat within the PDA. Some terrestrial flora habitats within the PDA will be permanently affected or directly lost. In the post-construction phase, the fill added for temporary roads and laydown areas will be removed, and efforts will be made to restore these areas to their natural habitat. The majority of the LAA is currently subject to industrial timber harvesting and at least 36 percent (3 km^2) of the PDA has been subject to forest loss, as discussed in Section 8.2.1. As discussed in Chapter 10 (Terrestrial Wildlife), the Proponent has proposed the concept of a moose corridor, primarily to improve ecological connectivity and habitat for Mainland Moose, that will also conserve habitat for flora (see Section 10.3.2.1.1).

The Project may also lead to the indirect loss of terrestrial flora habitat. Clearing for construction purposes may disrupt existing surface and groundwater flow patterns. This can indirectly cause changes or loss of some flora species or communities dependent on specific hydrological conditions (Hartsog, 1997). Soil compaction may occur on roads and construction areas within the PDA from vehicles or machinery. Compaction and disturbance of soil during construction activities may have impacts on soil structure and nutrient availability, leading to changes in plant composition and diversity. Mitigation measures to avoid soil compaction and disruption of surface and groundwater flow pattens are outlined in Sections 6.3.2.1, 6.3.2.2, and 7.3.2.2.

Disruption of contiguous habitats due to the placement of Project infrastructure may lead to fragmentation and isolation of flora populations. Disruption and fragmentation of intact forested areas can also alter canopy cover and natural moisture regimes of intact forest stands, impacting atmospheric and shade conditions important for certain terrestrial flora species, most notably lichens (Boudreault, 2008). Plant-pollinator interaction is also indirectly impacted by habitat fragmentation and habitat loss, as habitat size and connectivity directly or indirectly influence the abundance of plant pollinator species (Yian, 2016).

Although Eastern Waterfan was not observed during the 2023 surveys, a small portion of the PDA overlaps with critical habitat of this species. Additionally, habitat for this species was identified within the LAA using a habitat suitability model. Additional field surveys will be completed during the detailed design phase to minimize impacts to this species. Eastern Waterfan is sensitive to siltation/sedimentation due to road construction/upgrades and watercourse or wetland alterations. Should occurrences of this species be found within the PDA, mitigation measures will be applied to reduce the adverse impacts of the Project.

It is anticipated that direct impacts of habitat loss and fragmentation to flora species and their habitat in the LAA will be minor due to the quality of habitat to be lost and can be mitigated through strategies to reduce these effects. The iterative Project design process has prioritized avoidance and minimization of interactions with important terrestrial flora habitat such as wetland and mature forest (see Figure 2.2).

The following key measures to mitigate the potential effects of the Project on terrestrial flora habitat will be implemented prior to and during construction:

- Careful site planning will be implemented to minimize habitat disturbance and to reduce habitat loss and fragmentation.
- Utilize existing roads and areas that have been previously altered, such as harvested areas.
- Avoid wetland alteration to the extent practicable.
- No in-stream work or road widening within Eastern Waterfan critical habitat will occur.
- Habitat that supports terrestrial flora SoCC and habitat modelling will be reviewed during the detailed design phase to avoid important habitats and minimize habitat loss in general. During detailed design, turbines will be oriented to avoid severing or intersecting intact forest or natural habitat linkages wherever possible.
- Watercourse crossings, both temporary and permanent, will be constructed in accordance with current applicable guidelines and regulatory requirements, and will be maintained in proper working order throughout the duration of the Project.
- Natural vegetation, topsoil, and useable grubbed material will be preserved, retained, and reused to the greatest extent possible to facilitate reestablishment of native vegetation via their contained seed banks.
- Vegetated buffers around wetlands and watercourses will be maintained to support connectivity for habitat where possible.
- Terrestrial flora habitat restoration and revegetation programs (using native species) after construction will be implemented, ensuring that natural habitat components are preserved or replaced.

- Roads will be decommissioned where possible to reduce long-term effects of habitat loss and fragmentation. Temporary areas within the PDA will be progressively restored during Project construction, with the revegetation of roadsides and cleared areas prioritized.
- To minimize the impacts of habitat loss during operation, vegetation will be maintained in cleared areas (cutting tree species while preserving low shrub species that do not interfere with Project infrastructure or site access).
- Based on the final detailed design, variances from the assessed PDA layout may be required, and additional surveys will be completed as required to target any proposed new or upgraded infrastructure on sensitive habitats including watercourses, wetlands, and high-potential old-growth stands.
- The Proponent will develop and implement ESC procedures.

8.3.2.2 Loss of Flora SAR/SoCC

Field surveys in the LAA identified occurrences of 24 flora species listed as SAR or SoCC. The one SAR flora species, Black Ash, was not observed within the PDA, and therefore will not be removed through Project clearing activities. Nine vascular and nine non-vascular SoCC were recorded within the PDA and individuals are anticipated to be lost during the construction phase of the Project (see Tables 8.2 and 8.3 in Appendix H for SoCC flora species recorded within the PDA). The total number of each species expected to be directly impacted by the Project is unknown at this time as detailed design has not been finalized. The habitat loss resulting from clearing activities will directly lead to the loss of vascular and non-vascular SoCC flora, including several epiphytic forest lichen species and two ground-dwelling non-vascular species. To minimize the loss of SoCC flora, strategic site planning, including the use of existing roads and previously altered areas, will be implemented and the locations of terrestrial flora SoCC will be reviewed during the detailed design phase to further minimize their loss. Additional pre-construction flora surveys will be conducted due to changes in the project layout since the completion of surveys conducted in 2023.

The following key measures to mitigate the potential effects of the Project on terrestrial flora SoCC will be implemented prior to and during construction:

- Careful site planning will be implemented to minimize loss of flora SoCC including, using existing roads and areas that have been previously altered, such as clearcuts and harvested areas.
- Locations of terrestrial flora SoCC will be reviewed during the detailed design phase to minimize loss of flora SoCC from areas with known occurrences.
- Project personnel will be educated on possible SAR and SoCC that may be present in the LAA.
- Additional surveys for Eastern Waterfan will be conducted by a lichenologist in streams intersecting the PDA if they also contain critical habitat for this species. The surveys will extend approximately 1 km downstream of Project infrastructure crossings.

- NSDNRR will be consulted if an unexpected flora SAR or SoCC is encountered during construction activities. Mitigation measures based upon consultation will be implemented to reduce the loss of sensitive flora.
- The Proponent will develop and implement surface water management and erosion and sediment control procedures.

8.3.2.3 Habitat Degradation

Terrestrial flora, especially rare species, may face threats from degradation of habitat due to Project activities. During construction, the Project may accelerate natural processes or cause degradation to habitats for terrestrial flora, including erosion of soils, sedimentation of streams, reduced air quality, soil compaction, competition between plant species in disturbed areas and introduction and spread of invasive species.

Soil erosion can be exacerbated on unvegetated soil surfaces that are exposed to rates of rainfall that exceed the rate of infiltration, such as roads and any disturbed areas within the PDA. Erosion can transport sediment away from point sources, resulting in decreases in soil productivity in terrestrial flora habitats (Al-Kaisi, 2000). Sediment generated by erosion can be deposited into wetlands or watercourses, impairing their function, leading to possible impacts to terrestrial flora communities within them (Gleason and Euliss, 1998). Eastern Waterfan is sensitive to habitat disturbances, including siltation in streams (COSEWIC, 2021). Mitigations to reduce effects of soil erosion and siltation include ESC measures such as installing silt fencing and mulching or revegetation of bare soil and the development and implementation of surface water management procedures.

Fragmentation of the terrestrial flora habitat in the Project area may also have a adverse effect. Fragmentation produces edge habitats, which can affect habitat suitability, especially for more sensitive species. Edge habitats are exposed to increased light, dust, and wind (Chen, 1993), causing short-term impacts such as increased susceptibility to windthrow (Esseen, 1994) and disrupting localized moisture and light regimes that may impact sensitive species including lichens (Green and Lange, 1994).

Project activities may pose an increased risk to terrestrial flora habitats due to invasive plant species. Non-native species, introduced intentionally or unintentionally by humans, can become invasive and harm the environment by rapidly reproducing and out-competing native species (Invasive Species Centre, 2024). The introduction or increased abundance of invasive species within the LAA could impact terrestrial flora species and their habitats. Glossy Buckthorn, an invasive species observed within the PDA, is known for outcompeting native vegetation and altering natural habitats by forming dense thickets. It is challenging to control, attributable to prolific seed production and vigorous sprouting in response to stem damage (Invasive Species Centre, 2024). Soil disturbance and construction activities, along with unintentional seed movement during operation and maintenance, may facilitate the introduction or spread of invasive species.

Changes in air quality within the PDA could impact the terrestrial flora community through various pathways. During the construction phase, road development, blasting, and soil disturbance may increase fugitive dust and particulate matter, affecting photosynthesis as they settle on flora surfaces (Farmer, 1993). Accumulation of dust on the soil surface and organic litter can alter soil properties. Airborne contaminants from vehicle exhaust and construction-related products may also affect the terrestrial flora community. They can enter the natural environment by settling on the ground or being absorbed directly from the air. This is of particular concern for non-vascular flora like lichens, which absorb moisture and particles directly from the air rather than through roots (Canters et al., 1991).

The following key measures to mitigate the degradation of terrestrial flora and their habitat will be implemented during Project activities:

- ESC materials such as sediment fencing or mulch will be applied to unvegetated areas to limit sedimentation into adjacent wetlands or watercourses, or other upland habitats. These erosion prevention materials will be maintained as required for the duration of the Project as needed to ensure the transportation and deposition of sediment is minimized.
- During the detailed design phase, Project infrastructure will be oriented to minimize severing or intersecting intact natural habitats to reduce fragmentation and edge habitats.
- Vehicular traffic and the staging of equipment will occur on designated staging/laydown areas or roadways only.
- Alternative road de-icing methods may be employed during winter road maintenance to prevent the impacts of salt on terrestrial flora habitats.
- Invasive species management procedures will be developed and implemented for construction and operation as part of the Vegetation Management Plan.
- Vehicle and equipment emissions will be managed by conducting regular maintenance on machinery and equipment.
- Idling of vehicle engines, equipment, and machinery will be avoided, where practical.
- Haul distances to disposal sites will be reduced where practical.
- Construction-related fugitive road dust will be controlled through measures such as enforced speed limits on access roads and road watering on an as-needed basis.
- Disturbed areas will be revegetated as soon as practical to limit dust emissions and erosion of soils. Temporarily stockpiled materials will be dampened during dry periods.
- Construction during high wind events will be avoided when possible and drop heights will be minimized when unloading trucks to limit fugitive dust.
- The Proponent will develop and implement surface water management and erosion and sediment control procedures.

8.3.3 Residual Effects

While the impacts on both vascular and non-vascular terrestrial flora may vary, the primary concerns involve habitat loss, fragmentation, loss of rare species, and degradation of flora habitat, including the introduction and spread of invasive species. Proposed mitigation and monitoring aim to minimize these effects, which are expected to be of minor magnitude and localized. Residual effects are anticipated to be long-term for habitat and rare species loss, and variable for other impacts.

Certain residual effects related to habitat degradation will be intermittent during construction, operation and maintenance, and decommissioning phases when onsite activities are less frequent, occurring on a short-term basis. The timing of these residual effects, if mitigation measures are followed, is expected to be low. Through proposed mitigation and monitoring, the expected effects on terrestrial fauna will occur once and are projected to be minor, local, seasonally varied, and reversible. With careful detailed design and micrositing of Project infrastructure to avoid sensitive habitats, coupled with active habitat enhancement efforts, effects on terrestrial flora are not anticipated to be significant.

8.4 Monitoring

No monitoring is proposed for this VEC.

9 Wetlands

9.1 Overview

The wetland VEC is composed of all provincially regulated wetlands (greater than 100 m^2 in size) found to intersect with the PDA. The wetland VEC encompasses each wetland habitat type and function within the PDA.

Wetlands are generally defined as habitats with water at or near the surface, with low water flow and saturated (i.e., hydric) soils, and are host to hydrophytic plants that thrive in wet conditions. Wetlands are routinely categorized by form as marshes, swamps, fens, or bogs. Wetland resources support a variety of essential hydrologic, ecological, and socio-economic functions. Wetlands function in the conservation of biodiversity and maintenance of watershed health, including surface water and groundwater quantity and quality. Wetlands are closely related to other VECs assessed in this EA. Impacts to wetlands can affect surface water, groundwater, and essential habitat for terrestrial and aquatic flora and fauna. The potentially interacting VECs are discussed in their respective chapters and include the aquatic environment (Chapter 7), flora (Chapter 8), terrestrial wildlife (Chapter 10), bats (Chapter 11), and birds (Chapter 12).

In response to concerns raised by the public and stakeholders, as well as constraints identified during field assessments, the Proponent has modified the Project roads and turbine layout to avoid or reduce potential for adverse environmental effects on multiple VECs, including wetlands. Turbines were removed from the French River sub-watershed that fall within the French River Watershed Protected Water Area and from select Crown land parcels of the PDA.

It is anticipated that the Project will have direct and indirect impacts on wetlands via loss of wetland habitat and function within the PDA, with the potential to affect wetland function within the LAA and RAA during construction, operation and maintenance, and decommissioning. Site works in the PDA will involve clearing of wetland vegetation and disturbance of wetland soil—both having potential impacts to wetland vegetation communities, hydrology, and wetland function. Changes to the Project layout were implemented to avoid wetlands where possible, and mitigation measures will be used to protect adjacent wetland habitat and function, such as minimizing vegetation clearing to that which is necessary and implementing ESC measures. For wetlands that are temporarily altered, restoration will be conducted to a feasible extent. Wetland compensation, determined through consultation with NSECC, will be completed for wetlands that cannot be avoided.

9.1.1 Regulatory Context

The assessment of wetlands considers the relevant federal and provincial legislation, regulations, and policies in place for wetland protection:

- Nova Scotia *Environment Act*
- Nova Scotia Wetland Conservation Policy
- SARA
- NSESA

9.1.2 Assessment Methodology

The assessment of wetlands focused on all wetland habitat intersecting with the PDA. The NS *Environment Act* defines a wetland as, "Land commonly referred to as a marsh, swamp, fen, or bog that either periodically or permanently has a water table at, near, or above the land's surface or that is saturated with water, and sustains aquatic processes as indicated by the presence of poorly drained soils, hydrophytic vegetation, and biological activities adapted to wet conditions." Existing wetland conditions were assessed through desktop review, predictive wetland modelling, and field surveys. Predictive wetland modelling informed targeted field surveys for wetland delineation and functional assessment. The data collected from this assessment were used to evaluate the impact of the Project on wetland habitat. This information was subsequently used to inform and refine micrositing of Project infrastructure and to develop mitigation measures for adverse Project impacts.

The description of the existing environment is based primarily on data collected through the following resources plus field surveys carried out for this Project:

- NSDNRR wetlands database (NSDLF, 2001)
- NSECC LiDAR Wet areas mapping (which depicts predicted depth to water table)
- NSDNRR Forest Inventory
- Provincial topographic data
- Recent aerial imagery (Pictometry)
- Light Detection and Ranging (LiDAR) imagery and elevation data
- Nova Scotia Geomatics Centre high resolution digital orthoimagery

9.1.2.1 LiDAR Predicted Wetland Mapping

CBCL developed predictive wetland modelling for field surveys. The best available topographic and imagery data from the Nova Scotia Elevation Explorer data portal were compiled and reviewed. A 1 m resolution LiDAR digital elevation model was acquired to identify the landforms and drainage conditions of the site that are conducive to wetland formation. Based on the LiDAR digital elevation model, a depth to water table model was generated, consistent with techniques used by White et al. (2012). The result of this modelling was a theoretical water table position, indicative of wetland hydrology, for the site. The LiDAR depth to water table model was used along with slope and watercourse mapping to generate contours which were compared with provincial wetland mapping and wetlands visible from aerial imagery. Predicted wetland polygons for field maps were then generated from this modelling.

9.1.2.2 Wetland Delineation Surveys

CBCL's qualified wetland assessors conducted formal delineations and functional assessments of wetlands identified within the PDA. Field surveys were conducted between June 12 and November 3, 2023. CBCL did not deviate from the standard delineation protocol save for extending the survey outside of the growing period, which was granted by NSECC, permitting surveys until the end of October (J. Gallop, pers. comm., September 14, 2024). Additional surveys were conducted between November 3 and December 12, 2023, to collect supplementary data to support and clarify desktop mapping with respect to wetland connectivity.

Due to timing and design iterations, several wetlands were not fully assessed within the 2023 seasonal window for wetland delineation; data gaps are noted in Appendix I, Table 1 and Appendix A, Figure 9.1. These wetlands will continue to be assessed during the growing season (June 1 to September 30) in support of the subsequent wetland permitting process.

For efficiency, only the portions of the wetlands within the PDA were delineated, with some exceptions where wetland connectivity needed to be field verified. Wetlands were delineated only if their size was greater than 100 m^2 (i.e., the minimum size for regulated wetlands, according to NSECC regulations). Field data was regularly provided to the Proponent during the wetland surveys to inform modifications to the Project layout with the intent of minimizing wetland alterations. Several wetlands were assessed within the LAA that are not within the proposed PDA. Only wetlands intersecting the PDA have been included in the wetland results.

Individual wetlands were delineated and classified using the US Army Corp of Engineers *Wetlands Delineation Manual* (US Army Corp of Engineers (USACE), 1987) and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region* (USACE, 2012). Wetland boundaries and delineation data were collected using the ArcGIS applications QuickCapture and Survey 123 (at least 3 to 5 m accuracy). Wetland boundaries were walked and mapped. Due to extensive windthrow across the PDA, inaccessible areas for delineation were interpreted upon completion of the field program using a combination of the LiDAR digital elevation model and depth to water table models, as well as aerial photos.

Wetlands were classified using the Canadian Wetland Classification System (National Wetlands Working Group, 1997). Where complexes of multiple wetland types were present, wetland types were named by leading with the dominant class following with the adjoining or subordinate class(es).

Observations on wetland types, water flow path, dominant vegetation communities, fish habitat potential, wetland function, and SAR/SoCC (if present) were recorded. Wetland inflows and outflows were georeferenced where encountered, along with the presence of culverts and ditches. Evidence of wetland disturbance was noted. Hydrologic connections to other wetlands, watercourses, and waterbodies were determined.

The wetland delineation procedure establishes the wetland-upland edge and is based on the presence of the following three environmental parameters:

- Hydrophytic vegetation
- Hydric soils
- Wetland hydrology

To determine a wetland, all three parameters must be present. Sampling points were established at representative locations within the subject wetland, and in the adjacent upland habitat. Subsequently, a wetland edge condition was determined and used to delineate the wetland boundary within the PDA.

Hydrophytic Vegetation

Hydrophytic vegetation refers to plant species that have adapted to living in saturated soils (USACE, 1987). The Nova Scotia Wetland Indicator Plant List (NSECC, 2012) was used to determine the associated wetland indicator status for applicable vegetation. Wetland indicator status can be summarized as the probability or likelihood of a species occurring in wetland versus non-wetland habitat. The percent cover and wetland status indicator of plant species at each sampling location was visually assessed and recorded for varying plot sizes according to the vegetation stratum (10 m for trees, 5 m for shrubs, and 2 m for herbs) to determine if hydrophytic vegetation was dominant within each of the sample locations.

Hydric Soils

Hydric soils are formed as a result of prolonged periods of saturation, flooding, or ponding during the growing season, resulting in anaerobic (oxygen-free) conditions (US Department of Agriculture (USDA) Natural Resources Conservation Service, 1994).

Hydric soil indicators were identified as per the *Field Indicators of Hydric Soils in the United States* (USDA, 2017). Hydric soil is summarized in Appendix I, Table 1, using the field indicator codes (i.e., A1 for Histosol, A2 for Histic Epipedon, etc.). Soil samples were collected using a soil auger to an approximate depth of 50 cm or to the point of refusal, then visually assessed to identify conditions in the wetland and upland soils. Soil horizons were profiled by their texture, thickness, and colour using a Munsell Soil Colour Chart (Kollmorgen Instruments Company, 1990), and the presence of hydric soil indicators (where applicable).

Wetland Hydrology

Wetland hydrology is characterized by periodic inundation or soils that are saturated to the surface at some point during the growing season. Wetland hydrology was observed at determination plots and throughout the entire surveyed wetland area. Wetland hydrology is summarized in Appendix I, Table 1, using the field indicators codes (i.e., A1 for surface water, A2 for high water table, etc.).

9.1.2.3 Wetland Functional Assessment

Wetland functional assessments were completed for each wetland using the Non-tidal *Wetland Ecosystem Services Protocol for Atlantic Canada* (WESP-AC V 3.0) (Adamus, 2018), a functional assessment technique required by NSECC as part of wetland alteration applications. Physical parameters such as pH, TDS, and conductivity were measured when surface water was present. The desktop functional assessment component was conducted after the field portion had been completed.

WESP-AC characterizes and ranks 17 individual ecosystem functions and their associated benefits (Table 9.1) based upon input with upwards of 129 ecological characteristics (indicators) into a logic-based model. The WESP-AC calculator incorporates the responses from desktop, field, and stressor questions to determine whether the functions and associated benefits are Low, Moderate, or High in comparison to baseline wetland scores in Nova Scotia.

Table 9.1 WESP-AC Ecosystem Functions and Benefits

Function	Definition	Potential Benefit
Hydrologic Functions		
Surface Water Storage (WS)	The effectiveness for storing runoff or delaying the downslope movement of surface water for long or short periods.	Flood control and maintaining ecological systems
Stream Flow and Temperature Support (SFTS)	The effectiveness for contributing to streamflow, and to water cooling, especially during the driest part of a growing season.	Supporting fish and other aquatic life
Water Quality Maintenance Functions		
Water Cooling (WC)	The effectiveness for maintaining or reducing temperature of downslope waters.	Supporting cold-water fish and other aquatic life
Sediment and Toxicant Retention & Stabilisation (SR)	The effectiveness for intercepting and filtering suspended inorganic sediments and toxins, thus allowing their deposition; reducing current velocity; resisting erosion; and stabilizing underlying sediments or soil.	Maintaining quality of receiving waters and protecting shoreline structures from erosion.
Phosphorus Retention (PR)	The effectiveness for retaining phosphorus for long periods (>1 growing season).	Maintaining quality of receiving waters
Nitrate Removal & Retention (NR)	The effectiveness for retaining particulate nitrate and converting soluble nitrate and ammonium to nitrogen	Maintaining quality of receiving waters

Function	Definition	Potential Benefit
	gas while generating little or no nitrous oxide (a potent GHG).	
Carbon Stock (CS)	The effectiveness of a wetland both for retaining incoming particulate and dissolved carbon and converting carbon dioxide (CO_2) gas to organic matter (particulate or dissolved) through photosynthesis. The effectiveness to then retain that organic matter on a net annual basis for long periods while emitting little or no methane (a potent GHG).	Maintaining quality of receiving waters
Organic Nutrient Export (OE)	The effectiveness for producing and subsequently exporting organic nutrients (mainly carbon), either particulate or dissolved. It does not include exports of carbon in gaseous form or as animal matter.	Supporting food chains in receiving waters
Ecological (Habitat) Functions		
Aquatic Primary Productivity (APP)	The capacity to support aquatic primary productivity and provide nutrients and energy to higher trophic levels and organisms.	Supporting aquatic food webs and contributing to local biodiversity
Anadromous Fish Habitat (FA)	The capacity to support an abundance and diversity of native anadromous fish for functions other than spawning.	Supporting recreational and ecological values
Resident and Other Fish Habitat (FR)	The capacity to support an abundance and diversity of native non-anadromous fish.	Supporting recreational and ecological values
Amphibian & Reptile Habitat (AM)	The capacity to support or contribute to an abundance and diversity of native amphibians (e.g., frogs, toads, salamanders) and turtles.	Maintaining regional biodiversity
Waterbird Feeding Habitat (WBF)	The capacity to support an abundance and diversity of waterbirds that migrate or winter but do not breed in the region.	Supporting hunting and ecological values; and maintaining regional biodiversity
Waterbird Nesting Habitat (WBN)	The capacity to support an abundance and diversity of waterbirds that nest in the region.	Maintaining regional biodiversity
Raptor & Wetland Songbird Habitat (RSB)	The capacity to support an abundance and diversity of native raptors and wetland songbirds.	Maintaining regional biodiversity
Keystone Mammal Habitat (KMH)	The capacity to support keystone mammals in the region.	Maintaining regional biodiversity
Native Plant Habitat (PH)	The capacity to support a diversity of native vascular and non-vascular species and functional groups, especially those that are most dependent on wetlands and water.	Maintaining regional biodiversity and food chains

Function	Definition	Potential Benefit
Pollinator Habitat (POL)	The capacity to support pollinating insects and birds.	Maintaining regional biodiversity and food chains

9.1.2.4 Wetlands of Special Significance

The *Nova Scotia Wetland Conservation Policy* (Nova Scotia Environment, 2019) stresses the importance of conserving wetlands and their ecological functions, particularly Wetlands of Special Significance (WSS). According to the policy, WSS are defined as the following:

- Salt marshes
- Wetlands within, or partially within, a designated Ramsar site, provincial wildlife management area, 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 Nova Scotia Eastern Habitat Joint Venture
- Wetlands that support SAR that are designated under the SARA or the NSESA
- Wetlands in designated protected water areas as described in the *Environment Act* (Section 106)

Wetlands identified within the PDA were assessed to determine if they meet the criteria of WSS. Additionally, the WESP-AC indicated whether assessed wetlands are WSS, and the NSECC Potential WSS GIS data layer was reviewed to determine whether any potential WSS fall within the PDA.

9.2 Existing Environment

9.2.1 Wetland Identification and Area

The PDA intersects five secondary watersheds flowing toward the Bay of Fundy and the Northumberland Strait:

- Chiganois River
- Debert River
- Folly Lake
- French River
- Wallace River

Wetland identifiers were assigned and numbered sequentially using their sub-watershed (i.e., CHI for Chiganois River, DEB for Debert River, FOL for Folly Lake, FRE for French River, and WAL for Wallace River). Wetland results were mapped according to a grid system and are provided in Appendix I, Figures 9.2 and 9.3.

A total of 365 regulated wetlands were identified within the PDA, of which 354 were formally delineated during the field surveys (Appendix I, Figure 9.3). Seven wetlands were field verified but not formally delineated due to access restrictions. Four wetlands were field verified but are missing determination plot data due to Project layout changes outside of the growing season. Determination forms and functional assessments will be completed in the growing season of 2024 for these four wetlands to support wetland permitting, if required. Wetlands delineated within the PDA are summarized in Appendix I, Table 1. For each field delineated wetland, the total area (in ha) within the PDA and LAA is outlined, including the wetland type, water flow path, landscape position, landform type, hydric soil and hydrology indicators, vegetation communities, and fish presence. The total wetland area within the LAA is also included for the portions of field delineated wetlands that were subsequently desktop delineated in GIS. For the purpose of the detailed wetland delineation summary table, vegetation is displayed based on the highest percentage of cover from each stratum (tree, shrub, and herb). Complete wetland delineation forms and WESP-AC sheets for all WSS are provided in Appendix I. Wetland delineation and WESP-AC forms have not been provided for all other wetlands but will be included in subsequent Wetland Alteration Applications to NSECC. The number and total area of wetland types identified within the PDA are outlined in Table 9.2.

Table 9.2 Summary of Field Verified Wetland Types

Wetland Type	Total Count in PDA	Total Delineated Area in PDA (ha)	Total Wetland Area in LAA (ha)
Treed Swamp	147	25	114
Shrub Swamp	72	12	60
Herbaceous Swamp	2	0.2	0.3
Treed Fen	29	6	37
Shrub Fen	20	6	43
Graminoid Fen	2	0.2	0.2
Treed Bog	3	1	1
Shrub Bog	3	0.2	0.6
Marsh	9	2	13
Complexes	65	17	62

Several wetland types (bog, fen, swamp, and marsh) were encountered within the PDA. Several wetlands encountered consisted of complexes of multiple wetland types.

Of the 365 wetlands within the PDA, 221 are classified as swamps. Swamp wetlands are usually composed of at least 30 percent tall woody vegetation, resulting in wood-rich peat soils, and are typically not as wet as fens and marshes (National Wetlands Working Group, 1997). The majority of the swamps within the PDA were hydrologically connected with some water features flowing through or out of the wetland, ranging from subsurface flow to defined watercourses. Several swamps within the PDA are known, or likely, to support fish, with three swamps (WL-CHI-124, WL-DEB-217, and WL-DEB-354) having confirmed presence of American Eel. The hydric soils within the swamps were indicated by organic layers of varying depths ranging from approximately 10 to 40 cm, underlain by red parent material, or a rock or gravel restricting layer.

Within the PDA, 51 wetlands were classified as fens. Fens are typically characterized by higher rates of groundwater and surface water movement throughout the wetland, resulting in higher concentrations of dissolved minerals. Vegetation cover in fens can vary depending on moisture content and water chemistry. Wetter fens are often dominated by graminoid species, while drier fens are host to more shrub species (National Wetlands Working Group, 1997). Fens within the PDA were predominantly throughflow peatlands with deep peat (greater than 40 cm in depth). Several fens within the PDA are known, or likely, to support fish, with two fens (WL-CHI-061 and WL-CHI-110) having confirmed presence of American Eel.

Within the PDA, six wetlands were classified as bogs. Bogs are raised or level with the surrounding terrain and essentially unaffected by surface water or groundwater originating from surrounding mineral soils. The water table is typically at or just below the bog surface. Surface water within bogs is usually low in dissolved minerals and acidic (National Wetlands Working Group, 1997). Bogs within the PDA were outflow or isolated basin peatlands characterized by deep peat (greater than 40 cm in depth). Most bogs within the PDA are known to likely be fishless, with one bog (WL-CHI-061A) known to be connected to nearby waters likely to contain Atlantic Salmon and American Eel.

Nine of the 365 wetlands within the PDA were classified as marshes. Marshes are characterized by shallow waters that often fluctuate daily, seasonally, or annually due to flooding, groundwater recharge, evapotranspiration, or seepage losses. As a result of fluctuating water input, marshes typically have a high soil nutrient level, supporting predominantly emergent macrophytes (National Wetlands Working Group, 1997). Marshes within the PDA contained standing water and were dominated by herbaceous vegetation.

9.2.2 Wetland Functional Assessment

WESP-AC scores were calculated for 346 wetlands within the PDA and detailed results can be found in Appendix I, Tables 2 and 3. ‘Lower’, ‘Moderate’ and ‘Higher’ scores have been colour-coded (green, yellow, and red, respectively) to illustrate the normalized scores used to determine each function rating, which have been summarized in Appendix I, Table 2. The wetlands within the PDA generally performed lower, moderate, and higher for the following functions, based on the percent of summary of function scores found in Appendix I, Table 2, and summarized by percentage of Project wetlands for each wetland function in Table 9.3.

Table 9.3 Summary of Wetland Function Performance

Summary of Function Scores (Percentage of Project Wetlands)		
Lower	**Moderate**	**Higher**
• Sediment & Toxicant Retention & Stabilization (77%) • Phosphorus Retention (69%) • Organic Nutrient Export (39%) • Anadromous Fish Habitat (97%) • Resident Fish Habitat (86%)	• Surface Water Storage (54%) • Stream Flow & Temperature Support (63%) • Nitrate Removal & Retention (52%) • Carbon Stock (68%) • Aquatic Primary Productivity (68%) • Amphibian & Turtle Habitat (52%) • Waterbird Feeding Habitat (69%) • Waterbird Nesting Habitat (53%) • Raptor & Wetland Songbird Habitat (75%) • Keystone Mammal Habitat (54%)	• Native Plant Habitat (65%) • Pollinator Habitat (77%)

9.2.3 Wetlands of Special Significance

WSS were identified based not only on the confirmed presence of SAR flora (vascular plants or lichens) growing within them, but by the confirmed presence of a mobile SAR species (birds or bats), and by the results of the WESP-AC assessments conducted as part of this program. The results of the WESP-AC interpretive tool and summary ratings for grouped functions for all Project wetlands are provided in Appendix I, Table 3. Project wetlands collectively performed low for the hydrologic, water quality support, aquatic habitat, and transition habitat functions, and high for the aquatic support function.

The process for identifying and defining WSS based on the presence of mobile SAR was discussed with the NSECC Wetland Team (M. Dulmage, pers. comm., January 4, 2024). There is currently no clear definition for WSS based on the presence of mobile SAR, although guidance outlining changes to the policy may be released in 2024. As suggested by NSECC, a wetland is considered a WSS based on the presence of mobile SAR (e.g., birds and bat species that are provincially listed as Threatened or Endangered) if the subject wetland provides or supports life functions for the SAR (e.g., a SAR bird species observed during the breeding period in their preferred habitat). NSECC confirmed that the determination of a WSS based on the presence of a mobile SAR should be based on current observations during field surveys in support of this EA, rather than historical records (e.g., AC CDC records). Further, signs of Mainland Moose do not result in a wetland being identified as a WSS, based on their vast range and transient nature.

Eleven wetlands within the PDA were determined to be WSS based on the results of the WESP-AC assessment (Table 9.4) and three wetlands were determined to be WSS based on CBCL field collected SAR data (Table 9.5). Final determination of WSS designation of these wetlands will be made by NSECC. Table 9.5 outline the potential WSS for consideration based on wetland function or SAR occurrences and rationale for inclusion as WSS. With respect to wetland alteration, WSS will require a higher compensation, to be determined during the Wetland Alteration Application process with NSECC.

Table 9.4 Known WSS Within the PDA, as Determined by the Level of Wetland Function

Wetland ID	Type	Support Supergroup			Habitat Supergroup		WESP-AC WSS Rationale
		Hydrologic	Water Quality Support	Aquatic Support	Aquatic Habitat	Transition Habitat	
WL-CHI-056	Shrub swamp	Moderate	High	High	Low	Low	Support Rule satisfied with two High and one Moderate score
WL-CHI-084D	Shrub swamp-marsh complex	Low	Low	High	High	Moderate	Habitat Rule satisfied with two High and one Moderate score
WL-CHI-110	Treed fen	Moderate	Low	High	High	Moderate	Habitat Rule satisfied with two High and two Moderate scores
WL-DEB-124	Treed swamp	Low	Low	High	High	Moderate	Habitat Rule satisfied with two High and one Moderate score
WL-DEB-144	Treed fen-swamp complex	Low	Low	High	High	High	Habitat Rule satisfied with three High scores
WL-DEB-217	Shrub swamp	Moderate	Low	High	High	Moderate	Habitat Rule satisfied with two High and two Moderate scores
WL-DEB-266	Treed swamp	Moderate	Low	Moderate	Moderate	High	Habitat Rule satisfied with one High score and three Moderate scores
WL-DEB-334	Treed swamp	Low	Moderate	Moderate	High	High	Habitat Rule satisfied with two High and two Moderate scores
WL-FOL-2433	Treed fen-marsh-swamp complex	Low	Low	High	High	Moderate	Habitat Rule was satisfied with two High and one Moderate score
WL-WAL-037	Treed swamp	Low	Low	High	High	Moderate	Habitat Rule was satisfied with two High and one Moderate score
WL-WAL-042	Treed swamp	Low	Low	Moderate	Moderate	High	Habitat Rule was satisfied with one High and two Moderate scores

Table 9.5 Potential WSS Within the PDA, as Determined by the Presence of SAR

Wetland ID	Type	SAR/SoCC Presence	WSS Rationale
WL-DEB-319	Shrub swamp	Black Ash	Threatened, listed under NSESA
WL-FOL-079	Treed fen	Canada Warbler (*Cardellina canadensis)*	Endangered, listed under NSESA Threatened, listed under SARA Two individuals observed on June 16, 2023, during the breeding period, in mixed forested wetland habitat with dense understory. (i.e., suitable nesting habitat for the species). Breeding evidence: Probable
WL-FOL-020	Treed fen-swamp complex	Olive-sided Flycatcher (*Contopus cooperi*)	Endangered, listed under NSESA Special Concern, listed under SARA One individual observed twice (June 13 and 21, 2023) during the breeding period in Red Spruce dominated habitat (i.e., suitable nesting habitat for the species). Breeding evidence: Probable

9.3 Effects Assessment

9.3.1 Boundaries

With respect to the wetland VEC boundaries, the PDA represents the maximum limit of potential direct physical disturbance associated with the Project, and it is an exaggerated or conservative amount to consider potential impacts and allow for avoidance during the detailed design of the Project. The actual impact to wetland resources is expected to be substantially less than the PDA.

A wetland LAA of 500 m was chosen to extend beyond the PDA to a representative distance where potential measurable effects on the wetland VEC may occur. NSECC has defined the wind turbine setback for wetlands to be 30 m from the area of disturbance, which has been considered in the LAA definition. Impact on wetland habitat, hydrology, and function may extend downstream of direct disturbance within the PDA, reaching into the LAA. To accommodate variations among wetlands, a conservative buffer has been applied. Various parameters, including wetland classification, location, topography, watershed hydrology, soil parent material, vegetation species, and community diversity will influence the extent of the potentially affected area. The LAA has been chosen based on the recognition that potential effects on individual wetlands will vary.

The wetland RAA is 1 km surrounding the PDA and was chosen to incorporate the total field and desktop delineated wetland area. The RAA is used to assess potential broader effects of the Project from interaction with other activities, predominantly forestry operations. There is extensive evidence of historical logging within the RAA and many active forestry operations that currently intersect with wetlands in the PDA. The RAA informs the assessment of cumulative effects resulting from activities such as current forestry operations.

9.3.2 Potential Effects and Mitigation

Avoidance is the first step outlined in the process for wetland conservation (Nova Scotia Environment, 2019). Several design changes were generated for the Project to avoid wetland alteration and minimize potential direct and indirect impacts to Project wetlands, where reasonable, while meeting engineering and design constraints. Detailed design of the Project and micrositing of turbines will further avoid wetlands when practicable and will reduce potential interactions between the Project and wetlands. Micrositing involves exact placement of the turbine within the turbine sites as shown in the PDA.

Direct and indirect effects of the Project on the wetland environment could occur through various interconnected pathways. Project construction can result in alteration and loss of wetland habitat via direct disturbance. Impacts to wetland hydrology and wetland function may occur during Project operation and maintenance, and decommissioning. Indirect effects are expected to be lesser in comparison to the anticipated direct loss of wetland area.

The effects can result from short-term activities during the construction phase as well as long-term activities during Project operation and maintenance. Project construction activities, predominantly earthworks, will result in immediate alteration and loss of wetland habitat. Excavation activities can lead to changes in the local groundwater regime with potential indirect effects on wetland hydrology. Project activities can affect the wetland environment as indicated in Table 9.6; these potential effects do not consider the detailed design of the Project and micrositing of turbines that is yet to be completed or the implementation of mitigation measures described herein.

Table 9.6 Potential Environmental Effects of the Project on Wetlands

Project Activity	Potential Environmental Effects		
	Loss of Wetland Habitat	Change in Wetland Hydrology	Change in Wetland Function
Construction			
Site Preparation	X	X	X
Access Roads Construction and Modifications	X	X	X
Material and Equipment Delivery and Storage	-	-	X
Infrastructure Installation	X	X	X
Restoration of Temporary Areas	-	-	-
Testing and Commissioning	-	-	-
Operation and Maintenance			
Turbine Operation and Maintenance	-	-	-
Road Maintenance	X	X	X
Power Line and Substation Maintenance	X	-	X
Vegetation Management	X	X	X
Safety and Security	-	-	-
Decommissioning			
Removal of Infrastructure and Site Restoration	-	-	-

X = Potential Interaction
- = No Interaction

There are specific Project activities that could impact wetland resources:

- Vegetation clearing and grubbing activities during site preparation and maintenance may directly impact wetlands and could lead to changes in vegetation species/community diversity and structure, altered hydrology, or wetland function in downstream wetland areas.
- Site preparation activities involving earthworks (e.g., use of heavy equipment for excavation, grading) may directly impact wetlands by partially or completely infilling wetland area. Direct impacts are expected where access roads cross wetlands, and where wetlands overlap with high potential wind locations, which could make micrositing of the turbine to avoid the wetland more challenging.
- Upgrades to existing roads, new roadbed preparation, and construction of turbine foundations may introduce fill and compact wetland soil, potentially affecting wetland

hydrology and function. Introduction of non-native or invasive plant species may occur as a result of introduced fill material.
- Blasting and foundation construction could disturb local bedrock and potentially impact wetland hydrology and subsequent wetland function through alterations to groundwater flow and nutrient inputs.
- Temporary dewatering activities during construction may lower the water table elevation in surrounding wetland areas, and potentially impact wetland saturation, hydric soil, and available nutrients from groundwater.
- Erosion and sedimentation from road crossings, laydown areas and/or work areas could alter the water quality and/or chemistry of wetlands, potentially affecting the vegetation and wildlife they are able to support. Project-related traffic may contribute to dust and sedimentation.

To minimize effects on wetland habitat, hydrology, and wetland function, mitigation measures outlined in the following subsections will be implemented. Mitigation measures designed to minimize impacts to other VECs, particularly air quality, soil quality, surface water quality, wildlife, wetlands, and the aquatic environment will also aid in minimizing impacts to wetland habitat, hydrology, and function. These mitigation measures are listed in their respective chapters of this EA.

9.3.2.1 Loss of Wetland Habitat

Construction and operation and maintenance activities may result in the direct alteration, degradation, and removal of wetland habitat. The Project may result in the direct loss of wetland habitat within the PDA and indirect loss of surrounding wetland habitat in the nearby LAA. This includes the removal of wetland vegetation, organic matter, and hydric soils. The current PDA is an exaggeration of the anticipated affected areas; detailed micrositing will reduce the PDA to that which is necessary, decreasing the actual area of wetland habitat that will be lost. As described in Section 9.2.1, CBCL has identified 365 wetlands within the PDA. The summary of Project impacts (e.g., partial infilling, or complete infilling) to wetlands is summarized in Appendix I, Table 4. The total wetland area within the LAA and RAA is 329 ha and 346 ha, respectively. The total delineated wetland area within the PDA is 69 ha, therefore the total maximum predicted area of impact is approximately 70 ha, which is an exaggerated area approximately double the likely area of impact after detailed design and micrositing. Table 9.7 presents the likely loss of wetland habitat within the PDA.

Table 9.7 Estimated Area of Wetland Loss Within the PDA

Wetland Type	Total Delineated Area in PDA (ha)	Estimated Area of Wetland to be Lost in PDA (ha)	Estimated Percent Wetland Area (of LAA) to be Lost
Treed Swamp	25	12.5	11
Shrub Swamp	12	6	11
Herbaceous Swamp	0.2	0.1	33

Wetland Type	Total Delineated Area in PDA (ha)	Estimated Area of Wetland to be Lost in PDA (ha)	Estimated Percent Wetland Area (of LAA) to be Lost
Treed Fen	6	3	8
Shrub Fen	6	3	7
Graminoid Fen	0.2	0.1	50
Treed Bog	1	0.5	50
Shrub Bog	0.2	0.1	17
Marsh	2	1	8
Complexes	17	3	5
Total	70	29	9

In areas where permanent Project infrastructure will be constructed (e.g., turbine pads, upgrades to existing roads, creation of new roads), site preparation and construction activities may directly impact wetlands through the removal of vegetation and loss of wetland habitat (change in wetland area or fragmentation of wetland habitat).

Clearing, grubbing, and infilling activities may cause loss of wetland flora and wetland organic matter, peat, and mineral soils. The use of heavy equipment and site vehicle traffic may cause compaction to wetland substrate, impacting vegetation root systems and hydric soil density/porosity, and affecting saturation. These impacts may result in the loss of habitat used by SAR/SoCC and other wildlife and may alter surface water and groundwater hydrology, further discussed under change in wetland hydrology.

In consultation with NSECC wetland specialists (M. Dulmage, pers. comm. January 4, 2024), it was discussed that there may be less impact to WSS where the Project will use pre-existing roads. WSS may be altered by the Project. This may avoid or minimize the impact of constructing completely new infrastructure through potential wetlands. Wetland mapping was used throughout the field surveys to inform the client on design updates to avoid these sensitive features.

Table 9.8 outlines the WSS that may be altered by the Project. The potential for avoidance has been indicated based on whether the WSS is adjacent to the existing infrastructure within the PDA, or currently bisecting it. Through micrositing, the aim will be to avoid WSS that are adjacent to the refined Project footprint and minimize the impact to the WSS that bisect the footprint. If avoidance of impacts cannot be achieved through detailed design, compensation will be required.

Direct impacts to WSS that cannot be avoided (e.g., partial infilling) will require wetland compensation at a higher ratio as agreed upon in consultation with NSECC during the permitting stages.

Table 9.8 Potential Impact to WSS

WSS ID	Type	Total Delineated Wetland Area (ha)	Area of Potential Impact (ha)
WL-CHI-056	Shrub swamp	0.374	0.148
WL-CHI-084D	Shrub swamp-marsh complex	2.364	0.165
WL-CHI-110	Treed fen	0.179	0.105
WL-DEB-124	Treed swamp	0.120	0.068
WL-DEB-144	Treed fen-swamp complex	2.072	1.344
WL-DEB-217	Shrub swamp	34.696	2.187
WL-DEB-266	Treed swamp	0.190	0.095
WL-DEB-334	Treed swamp	0.520	0.172
WL-FOL-2433	Treed fen-marsh-swamp complex	0.603	0.181
WL-WAL-037	Treed swamp	5.266	0.603
WL-WAL-042	Treed swamp	0.176	0.028
WL-DEB-319	Shrub swamp	0.148	0.017
WL-FOL-079	Treed fen	2.480	0.377
WL-FOL-020	Treed fen-swamp complex	1.319	0.254

The Project layout has been designed to avoid and minimize adverse impacts to wetland features to the extent practical. Further wetland avoidance will be achieved through detailed design and micrositing. The following key measures to mitigate the potential effects of the Project on wetland habitat will be further detailed in an EPP and will be implemented prior to construction:

- Turbines will be setback at least 30 m from wetland features whenever feasible.
- Wetlands within the PDA that are to be avoided will be flagged and an appropriate buffer will be established and delimited.
- Wetland organic material and topsoil will be stored separately and reused for site restoration where practicable.
- Where disturbance to wetlands in temporary laydown areas is unavoidable, stabilization of the wetland surface will be conducted using protective layers such as matting, mulch, or biodegradable geotextiles to protect the wetland root layers and seed beds from rutting, admixing, or compaction.
- Where wetland avoidance is not possible, wetland alteration will not proceed without obtaining a wetland alteration permit from NSECC and the Proponent will adhere to all conditions of the wetland alteration permit.
- All wetland removals or alterations will be mitigated via wetland compensation activities, determined in consultation with NSECC and NSDNRR. Wetland compensation

in the form of restoration is the preferred method to compensate for loss of habitat and function (including loss of carbon stores).

9.3.2.2 Change in Wetland Hydrology

Construction and operation and maintenance activities may result in changes to surface water and groundwater hydrology (quality and quantity) directly within the PDA and may extend downstream into the LAA, affecting aquatic receptors.

Earthworks activities may directly impact surface water and groundwater hydrology and increase the potential for run-off and flooding. Wetland hydrology may be impacted through the alteration of the water table and natural flow paths (i.e., saturation, impoundment and/or redirection of water, nutrient input, water storage). Wetland surface water quality may be impacted by sediment-laden runoff. Changes to stream flow quantity and direction may affect wetland area and surface water functions. Impeded drainage may cause wetlands upstream or upgradient of construction activities to flood, or wetlands located downstream of activities could be impacted by a decrease in surface water flow. De-watering and excavation activities may affect the water table within the wetland, affecting hydric soil saturation and the input of nutrients via groundwater, further affecting hydrophytic plant communities and wetland function.

Stormwater flow from roads or other impervious surfaces may enter wetlands in quantities exceeding the natural pre-construction flow. Increased flow velocity may cause increased erosion of wetland soil.

The following key measures to mitigate the potential effects of the Project on wetland hydrology will be further detailed in an EPP and will be implemented during construction:

- Where possible, site clearing will be kept to a minimum.
- Where possible, clearing operations will be conducted during winter months on frozen ground to protect the underlying vegetative mat and to reduce erosion and sedimentation of wetlands.
- Manual clearing will be conducted where ground conditions are not suitable for heavy equipment access.
- Sediment fencing will be erected around construction areas prior to commencement of site preparation and construction.
- ESC measures (i.e., erosion control blankets, hydraulic mulches, turf reinforced mats and/or riprap) will be used to line ditches, swales, drainage channels, and steep banks to avoid erosion and siltation of down-gradient wetlands. These control measures will be installed prior to ground disturbance.
- Mitigation measures for aquatic habitat outlined in Chapter 7 (Aquatic Environment) will also serve to maintain wetland hydrology, saturation, and aquatic habitat that contribute to wetland function.
- Material will be stockpiled in such a way as to prevent erosion and sedimentation to any adjacent wetlands.

- Surface runoff and runoff from stockpiled material will be managed using standard ESC measures.
- Surface water hydrology will be maintained through culvert placement and appropriate structure sizing. Drainage structures will act to dissipate hydraulic energy and maintain flow velocity to reduce erosion.
- The Proponent will develop and implement surface water management procedures.
- Cleared areas within and immediately adjacent to wetlands will be reseeded or otherwise revegetated to reduce erosion. Mitigation measures for vegetation maintenance are outlined in Chapter 8 (Flora).
- Whenever possible, work will be stopped during periods of inclement weather (e.g., high winds, high rainfall).

9.3.2.3 Change in Wetland Function

Impacts to wetland habitat and hydrology may change wetland function. The loss of wetland habitat and vegetation diversity may have indirect effects on SAR/SoCC fauna that depend on wetlands for necessary life functions. Effects on these species are discussed in Chapter 7 (Aquatic Environment), Chapter 8 (Flora), Chapter 10 (Terrestrial Wildlife), Chapter 11 (Bats), and Chapter 12 (Birds). Impacts to ecological habitat functions that support fish, amphibian and reptile, bird, mammal, and pollinator species may occur.

Potential changes to wetland function may result from impacts to wetland habitat and hydrology. Earthworks and ground-disturbing activities may cause soil disturbance, impacting hydric soil saturation, water storage, soil nutrients, and carbon sequestration, as well as changes to vegetation communities and the introduction of non-native and invasive plant species. Wetland function within the LAA and RAA will be considered.

There is potential for the introduction of invasive plant species, impacting the existing wetland vegetation community, particularly in the wetlands adjacent to construction and laydown areas. There is also potential for spread of invasive species within a wetland or introduction to downstream or downgradient wetlands.

Wetlands could be adversely affected by sediment-laden runoff during construction, operation and maintenance, and decommissioning activities. Exposed soil from earthworks like site clearing, grading, and material storage can lead to erosion and sedimentation through surface runoff. This sediment input into wetlands has the potential to smother vegetation and introduce nutrients.

The loss of wetland habitat may impact hydrologic function; subsequent change in wetland function is strongly driven by the alteration of wetland hydrology. This may impact flood control and water temperatures that contribute to the maintenance and support of aquatic life. If cross drainage is maintained where roads exist, hydrological impacts are not expected.

Impacts to water quality maintenance of a wetland may occur. Changes to nutrient storage and release in wetlands may change water quality and plant communities in the wetlands. The effects of nutrient loading may be greatest in low nutrient systems such as treed bogs and shrub bogs. Changes to hydrology and input of nutrients may impact aquatic receptors downstream, affecting ecological habitat.

Loss of wetland area may impact the ability to filter suspended particulate, reduce flow velocity, and stabilize substrate that contributes to erosion control and storm buffering.

Carbon sequestration as a wetland function is defined as the effectiveness of the wetland for retaining incoming carbon, and through the process whereby wetland vegetation converts CO_2 gas into organic matter (New Brunswick Department of Environment and Local Government, 2018). Direct impacts on wetland habitat may result in the loss or disturbance of the associated carbon stores through vegetation removal (i.e., trees as carbon stores), grubbing, or stripping of organic-rich overburden (e.g., conifer needle rich peat as a carbon store) of the wetland surface. Indirect impacts to wetland hydrology may alter the water table and saturation within a wetland, affecting rates of organic matter decomposition that contributes to carbon sequestration. These impacts were incorporated into the GHG emissions calculations for the Project in Chapter 2 (Project Description).

The following key measures to mitigate the potential effects of the Project on wetland function will be further detailed in an EPP and will be implemented during construction:

- Where possible, quarried, crushed material will be used for road building in and near wetlands, with portions to be preserved to minimize the risk of introducing or spreading non-native or invasive plant species into wetland communities.
- Dust suppression measures will be used to avoid sedimentation impacts to wetland habitat and function.
- A Wetland Restoration Plan will be prepared within six months of submitting all wetland alterations for the Project, detailing the selected restoration sites and methods.
- Wetland monitoring programs will be carried out for all impacted wetlands pre- and post-construction, following NSECC wetland alteration approval conditions.
- Organic overburden removed from wetland areas will be reestablished and spread in areas from where it was originally removed. Topsoil will be stabilised and revegetated. These practices will mitigate the release of carbon stores within the organic topsoil layers.
- The Proponent will develop and implement sediment and erosion control and surface water management procedures.

9.3.3 Residual Effects

Residual effects to Project wetlands are expected to be minor but long-term with the possibility of some permanent, direct loss of wetland habitat within the PDA. Wetland alteration approvals will be acquired prior to completing wetland alterations. Residual effects on wetland habitat, hydrology, and function will be minimized within the LAA and

RAA through the implementation of proposed mitigation measures, wetland monitoring, and wetland restoration required as part of the Wetland Alteration Approval. Alterations will be appropriately compensated (following the NSE Policy of No Net Loss) and monitored. Considering the use of existing roads that have already impacted Project wetlands, and the effort to avoid wetland habitat via changes to Project design, the overall effects of the Project on wetland habitat is predicted to be not significant within the LAA and RAA.

9.4 Monitoring

A detailed Wetland Monitoring Plan will be developed as part of the NSECC Wetland Alteration Approval for the Project wetlands. Post-construction, the extent of the actual wetland habitat affected will be verified through monitoring. Monitoring will also document the success of implementation of wetland compensation. Both the monitoring and the compensation will be implemented in accordance with the NSECC Wetland Alteration Approval.

Monitoring is conducted to document pre- and post-construction ecological and hydrological conditions of the Project wetlands. The Wetland Monitoring Plan is intended to monitor the portion of the subject wetlands that will not be altered by the Project (outside the area of direct wetland disturbance) to determine if its ecological character changes after the completion of the Project.

Subject wetlands will be assessed for changes in the proportion of wetland versus upland plant species and for the presence of invasive species. Hydrological monitoring will measure current water levels and responses to rain events, documenting a baseline for comparison to conditions during and after construction.

10 Terrestrial Wildlife

10.1 Overview

The assessment of the Project on terrestrial wildlife encompasses all terrestrial wild fauna with the exception of bats and birds, which are assessed separately in Chapter 11 (Bats) and Chapter 12 (Birds). Interactions of the Project with terrestrial wildlife are closely tied to Project interactions with other VECs that are assessed in the respective chapters, including noise and light disturbance (Chapter 5: Atmospheric Environment), vegetation loss or modification (Chapter 8: Flora), and loss or alteration of wetlands (Chapter 9: Wetlands).

This chapter evaluates the possible implications of the Project on terrestrial wildlife and provides mitigation, construction and operational management practices to minimize these possible effects. The Project has the potential to affect terrestrial wildlife both directly (i.e., increased risk of mortality due to vehicle collisions during construction, operation and maintenance and/or decommission phases), as well as indirectly due to habitat loss, fragmentation, and modification. In addition, wildlife species may exhibit short-term or long-term behavioural changes to avoid habitats subject to disturbance or noise, depending on the species and level of tolerance to disturbance. Strategic site planning will be employed to minimize habitat disturbance and mitigate habitat loss and fragmentation and other possible Project impacts. This includes using existing roads and previously harvested areas, as well as maintaining vegetated buffers around wetlands and watercourses to enhance wildlife connectivity. In addition, the Proponent is committed to enhancing the suitability and quality of Mainland Moose habitat within the LAA and has proposed the concept of a moose corridor to describe a collaborative, large-scale, land conservation effort in the region in which it is prepared to play a coordinating role (see Section 10.3.2.1.1). The focus of this initiative is to prioritize ecological connectivity to intact protected habitats, including the Wentworth Valley Wilderness Area and other high-quality habitat zones. Furthermore, the Proponent is committed to actively participating as a partner in initiatives aimed at preserving and improving connectivity in the broader Colchester/Cumberland region.

In response to concerns raised by the public and stakeholders, as well as constraints identified during field assessments, the Proponent has modified the PDA layout to avoid or reduce potential for adverse environmental effects on multiple VECs, including terrestrial wildlife. Turbines have been removed from wetland areas as well as areas with high wildlife activity and intact, contiguous forested habitats, with a focus on mature forest stands and high conservation value habitats on Crown land.

As discussed in the following subsections, habitat loss and fragmentation will be minimized by using existing roads and previously disturbed areas. Additionally, construction access roads that are not retained will be decommissioned, and vegetation will be gradually restored throughout the Project to mitigate the long-term impacts of habitat loss and fragmentation. All possible effects, mitigation measures, and residual impacts to terrestrial wildlife as a result of the Project are outlined in this chapter and will be further developed in an EPP prior to construction to minimize adverse effects.

10.1.1 Regulatory Context

Assessment of the terrestrial wildlife considers relevant provincial and federal legislation and guidelines:

- SARA
- *Canadian Environmental Protection Act*
- NSESA
- Nova Scotia *Wildlife Act*
- Nova Scotia *Biodiversity Act*
- Nova Scotia *Environment Act*
- Nova Scotia *Wilderness Areas Protection Act*

10.1.2 Assessment Methodology

The assessment of terrestrial wildlife focused on identifying terrestrial fauna species present or likely to be present within or near the LAA, with emphasis on identifying any SAR or SoCC and their habitat. This was achieved though literature review, habitat analysis, and field surveys. The information gathered during the literature review and habitat analysis was used to design and execute field surveys targeting priority species (as outlined in the *Guide to Addressing Wildlife Species and Habitat in an EA Registration Document* (NSECC, 2009)). The data collected from this assessment was used to evaluate the impact of the Project on terrestrial wildlife. This information was then used to inform and refine siting of Project infrastructure and develop measures to minimize adverse effects of Project activities on terrestrial wildlife. The data collected though the assessment process can also serve as a baseline for post-construction monitoring and adaptive management.

The description of the existing environment is based primarily on data collected through the following resources plus field surveys carried out for this Project:

- NSDNRR (2018) Significant Species and Habitat Database
- AC CDC (2023) Data Report
- iNaturalist.ca Observation Database (2023)
- Global Biodiversity Information Facility Occurrence Database (2023)
- Nova Scotia Forestry Inventory
- Nova Scotia Old-Growth Policy and Old-Growth Potential Index

- Ecological Land Classification for Nova Scotia 2015
- Wetlands of Nova Scotia
- Global Forest Watch Tree Cover Loss 2001-2022 (Global Forest Watch, 2023)
- Canada Landsat Disturbance 2017

Records of terrestrial mammal, herpetofauna, and invertebrate SAR and SoCC known to occur within a 100 km radius of the LAA were obtained from the AC CDC and a habitat assessment of the LAA was completed using available habitat information and mapping data (including federal critical habitat and provincial core habitat data layers).

Consultation with NSDNRR was undertaken to identify priority wildlife species for targeted field survey programs. Two terrestrial wildlife species, the mainland Nova Scotia population of moose (*Alces alces americanus*, herein referred to as Mainland Moose) and Wood Turtle (*Glyptemys insculpta*), were identified as priority species and detailed habitat assessments and targeted field surveys for these species were executed within the LAA. Details of the field surveys are presented below in Section 10.1.2.2.

Detailed habitat mapping was developed to identify important areas within the LAA for Mainland Moose throughout its life cycle. The map was used to develop field surveys and inform siting and layout of Project infrastructure. The habitat mapping was also used to evaluate the connectivity of predicted Mainland Moose habitat within the LAA and the surrounding landscape. Details of the habitat mapping are presented below.

10.1.2.1 Mainland Moose Habitat Mapping

A detailed spatial analysis was undertaken to assess and predict the suitability of various habitats within the LAA for Mainland Moose life history stages. The habitat model was built using the biophysical habitat parameters that provide for life cycle requirements for Mainland Moose used in the identification of their core habitat (NSDNRR, 2021). The following datasets were used to extract areas meeting the criteria for biophysical attributes of Mainland Moose habitat in the LAA:

- Nova Scotia Forestry Inventory
- Wetlands and Watercourses of Nova Scotia
- Global Forest Watch Tree Cover Loss 2001-2022
- Global Forest Watch Tree Cover Gain 2000-2020

In Nova Scotia, moose inhabit a diverse range of forest types, favouring mature stands for security and thermal cover, interspersed with foraging resources (young deciduous trees and shrubs). The data layers were analysed to select suitable winter cover, summer cover, winter forage, summer forage, and calving area habitat within the LAA using the criteria defined in the Mainland Moose Recovery Plan (NSDNRR, 2021).

The following stand definition criteria for winter and summer cover were extracted from the Forestry Inventory database:

- Winter cover – Softwood and softwood dominated mixedwood stands at least 5 ha in size meeting the mature stand requirements (60 percent crown closure and at least 12 m in height (or at least 8 m in height with a depth to water table no more than 50 cm).
- Summer cover – Hardwood, mixedwood, and softwood stands at least 5 ha in size meeting the same mature stand requirements above.

After the selection of winter and summer forest cover habitat, the following criteria were used to identify winter/summer forage areas and calving areas:

- Winter forage – Any regenerating forested type within 200 m of winter cover, or mature hardwood or hardwood dominated mixedwood within 200 m of winter cover, or mature softwood dominated mixedwood (no distance requirement from cover).
- Summer forage – Any regenerating forested type within 200 m of cover (summer or winter), or mature mixedwood or hardwood (no distance requirement from cover).
- Calving area – Open water within 40 m of any mature stand, or open water within 40 m of regenerating forage (winter or summer) that is within 200 m of a mature stand, or open water within 40 m of mature forage (winter or summer).

The layers extracted from the forestry inventory layer were then refined to incorporate Global Forest Watch tree cover loss and gain layers to represent the most recent picture of suitable habitat for Mainland Moose within the LAA. The habitat polygons were also compared with the most up to date aerial imagery to analyse any other recent land use changes in the LAA.

10.1.2.2 Field Surveys

The objective of the field surveys was to assess the presence and distribution of terrestrial wildlife across the LAA, focussing on priority terrestrial wildlife species and their habitats identified during the desktop assessment and in consultation with NSDNRR. Surveys to target Mainland Moose included winter tracking, trail camera traps, and pellet group inventory (PGI). Surveys to target Wood Turtle included stream habitat assessments and turtle Visual Encounter Surveys (VES). The survey design targeted areas where priority species were expected to be most active and where their habitat intersected with the PDA, while also covering representative habitat types present across the LAA. Additional observations of terrestrial wildlife were gathered as incidental observations during the biological field programs conducted in the LAA in 2023 and 2024. These incidental observations are included in the assessment of the existing environment.

Winter Tracking

Winter tracking surveys were conducted on foot by two-person teams over two winter seasons (Year 1 – February to March 2023 and Year 2 – February to March 2024). The methods for winter track surveys were developed based on the *Protocol for Mainland Moose Snow Tracking Survey 2022 Update* (NSDNRR, 2022a) and informed by habitat parameters in the Mainland Moose Recovery Plan (NSDNRR, 2021). The goal of these surveys was to target moose in areas where they are expected to be most active in winter

(winter cover and winter forage habitats identified in the Recovery Plan) but were also designed to document signs of wildlife in the winter in representative habitat types present across the LAA.

Year 1 winter tracking surveys were conducted along select survey routes within seven days of a large snowfall event (approximately 10 cm or more). Year 1 surveys focused on accessible trails and roadways through various forested habitats (with emphasis on winter cover and winter forage), open areas, and wetlands. The survey covered a distance of 130 km over eight days between February 16 and March 10, 2023.

Year 2 winter tracking surveys were adjusted to reflect an updated turbine layout as well as habitat information gained during the biological field programs in 2023. Transect surveys were conducted primarily in winter cover and winter forage habitats, two to seven days following a snowfall event of 10 cm or more. Over 23 km of roads and suitable winter moose habitat were surveyed where access was feasible. The survey was conducted over five days between February 12 and March 20, 2024.

Camera Traps

Camera traps using trail cameras were set up in late April 2023 in a variety of habitat types in the PDA along natural corridors for wildlife movement including roadways, wetlands, forest trails, harvested areas, and riparian areas along watercourses and waterbodies. Some of the camera traps were relocated to expand site coverage and in consideration of seasonal wildlife movement and observations from both camera traps and other field programs. Some camera traps were retrieved following the completion of field programs in 2023 (early November) and a subset remained into winter 2024. In total, 13 trail camera trap locations were established; Table 10.1 presents deployment locations, habitat, deployment days, and total survey days for each camera trap.

Table 10.1 Camera Trap Deployment and Retrieval Dates, Total Survey Days and Habitat

Camera Trap Name	Date Deployed	Date Retrieved	No. of Survey Days	Habitat
TC-01	27-Apr-23	06-Jul-23	70	Early successional and regenerating mixedwood forest and shrub swamp
TC-02	27-Apr-23	06-Jul-23	70	Open bog with ericaceous shrubs and coniferous swamp
TC-03	27-Apr-23	16-Nov-23	203	Early successional softwood forest
TC-04	27-Apr-23	12-Feb-24	291	Shrub and graminoid stream meadow
TC-05	27-Apr-23	12-Feb-24	291	Poor sedge fen and spruce bog complex with mixedwood forest along road
TC-06	28-Apr-23	12-Feb-24	290	Mid-successional softwood forest with scattered birch
TC-07	28-Apr-23	20-Nov-23	206	Open shrub meadow along intermittent stream

Camera Trap Name	Date Deployed	Date Retrieved	No. of Survey Days	Habitat
TC-08	28-Apr-23	23-Aug-23	117	Tall graminoid beaver meadow along stream
TC-09	28-Apr-23	31-Jul-23	94	Early successional softwood forest
TC-10	28-Apr-23	20-Nov-23	206	Early successional mixedwood forest and swamp matrix
TC-11	31-Jul-23	20-Nov-23	112	Stream crossing with graminoid meadow and open water pools
TC-12	06-Jul-23	16-Nov-23	133	Lake shallow with emergent vegetation
TC-13	06-Jul-23	12-Feb-24	221	Open shallow water pond along road edge

Pellet Group Inventory

PGI surveys were conducted on foot by two-person teams in the LAA to understand the distribution, suitable habitats, and movement corridors of Mainland Moose and White-tailed Deer (*Odocoileus virginianus*). The PGI surveys generally followed the Pellet Group Inventory Data Collection Protocol (NSDNRR, 2022b), which involves walking transects and recording winter pellet groups and other evidence of moose and deer. Transect routes were selected to encompass representative habitats in the LAA, with a specific emphasis on areas where Mainland Moose are anticipated to be active, including winter cover and foraging habitats. Certain transect routes extended beyond the PDA (up to 5 km) to assess moose proximity to Project infrastructure and evaluate moose activity in the broader area. The design of the PGI survey routes allows for integration into a post-construction monitoring program to assess any impact the Project may have had on moose behaviour.

PGI transects were surveyed over eight days between April 27 and May 9, 2023. In total, 18 transects (between 5 and 10 km in length) were surveyed, representing 168 km of total distance surveyed. Survey teams recorded winter pellet groups of moose and deer along the transect routes. All suspected Mainland Moose activity was recorded (i.e., browse, bedding, tracks) and signs of other animal activity, if observed, were also documented during the PGI surveys.

In 2012, CBCL conducted PGI surveys in the northwestern portion of the current Project LAA and this data is incorporated into the existing environment section below. Methodology of the 2012 surveys followed provincial methods of the time, which were designed to estimate population sizes of White-tailed Deer and Mainland Moose.

Turtle Habitat Assessment and Visual Encounter Surveys

Targeted turtle habitat assessments and VES were designed based on survey protocols for Wood Turtle in Nova Scotia (NSDLF, 2021) but were adapted for all turtle species. The turtle habitat assessments were conducted at watercourses which intersected with the PDA with priority given to watercourses connected to identified Wood Turtle critical habitat, watercourses within the Wallace and Chiganois watersheds, and large permanent watercourses (especially clear, meandering watercourses with moderate flow). Additional assessments were conducted within the LAA where suitable habitat was encountered.

Following habitat assessments, VES were carried out in suitable turtle habitat, with surveyors walking a minimum of 200 m up- and downstream of watercourse crossings or suitable habitat areas parallel to proposed Project infrastructure. Habitat features of each watercourse and surrounding riparian area were evaluated to determine the habitat quality of the watercourse, overwintering sites, nesting sites, and food availability for turtle species. Incidental observations of other herpetofauna (e.g., snakes, salamanders) were recorded if encountered.

Turtle habitat assessments and VES were conducted over 22 days between May 24 and July 1, 2023, when conditions were suitable as per the NSDNRR protocol. Additional habitat assessments were performed outside of this period during the detailed watercourse and wetland assessments if suitable turtle habitat was encountered. Further habitat assessments and VES are currently being conducted (May 2024) to address survey gaps due to updates in the turbine layout since the initial surveys were completed.

10.2 Existing Environment

10.2.1 Mammals

The NSDNRR Significant Species and Habitat Database contains 120 records of species and/or habitat records that relate to terrestrial mammals (excluding bats) within a 100 km radius of the PDA. These records include Deer Wintering (117 records), Other Habitat (1 record), Species at Risk (1 record), and Species of Concern (1 record). Only three of the records occur within 5 km of the PDA (all Deer Wintering).

The Deer Wintering records refer to sites important for overwintering White-tailed Deer. The closest important deer wintering area includes the forests of the southern slopes of the Cobequid Slopes Ecodistrict, which overlaps with the southwestern-most portions of the LAA and intersects with a small portion of the PDA.

The AC CDC (2023) Data Report reports observations of eight terrestrial mammal SAR and SoCC (excluding bats) that have been recorded within a 100 km radius of the LAA. None of the identified SAR or SoCC have been observed within the LAA, with the exception of Mainland Moose, which has been recorded within 5 km of the LAA (AC CDC, 2023).

Mainland Moose are expected in the PDA since the Project overlaps with the Core Habitat outlined in the Recovery Plan (which spans much of Cumberland and Colchester counties) and the two counties are known to host the largest of the three localized population groups of Mainland Moose in the Province (NSDNRR, 2021; Parker, 2003). Historical provincial data show that moose have been regularly detected in the vicinity of the Project area (Basquill, 2011). Mainland Moose have been observed in the PDA and LAA during field surveys carried out by CBCL in 2012, 2023, and 2024. The results of the surveys carried out by CBCL in 2023 and 2024 are summarized in Section 10.2.1.2.

In 2012, CBCL conducted fieldwork that confirmed the presence of Mainland Moose in an area that overlaps with the northwestern section of the LAA (CBCL, 2012). The 2012 surveys aimed to determine moose presence, identify habitats of importance to moose, and estimate their abundance within a 55 km^2 study area. The primary habitats with moose pellet group observations included harvested areas adjacent to mature forest, as well as young mixedwood and hardwood habitats. The survey estimated a moose population density of 0.08 moose per km^2, suggesting the possible presence of four to five individuals in the study area in 2012.

Mainland Moose is the only species among the eight terrestrial mammal SAR and SoCC recorded within a 100 km radius by the AC CDC. However, due to the broad ranges and greater mobility of mammal species in general, the remaining seven species are discussed in detail below.

Lynx (*Lynx canadensis*) in Nova Scotia predominantly inhabit the Cape Breton Highlands, with occasional sightings in mainland Nova Scotia (McAlpine and Smith, 2010). The population experiences cyclical abundance, favouring habitats rich in their primary prey, the Snowshoe Hare (*Lepus americanus*), and is influenced by competition with Bobcats (*Lynx rufus*). It is not likely that Lynx are present in the LAA as a breeding population. Lynx is only known to exist on Cape Breton Island (Nova Scotia Lynx Recovery Team, 2006). The nearest record of Lynx is approximately 97 km from the LAA in the province of New Brunswick (AC CDC, 2023).

Long-tailed Shrew (*Sorex dispar*) has a limited range in Nova Scotia but can be found in the wooded talus slopes of the Cobequid Mountains and this species is typically associated with moss-covered rocks along forest streams (McAlpine and Smith, 2010). According to the NSDNRR Significant Species and Habitat Database, significant areas containing talus are present northwest of Folly Lake and Smith Brook, which are 300 m and 4,000 m outside of the LAA, respectively, west of Trunk 4. No talus slopes were observed in the LAA, but the rocky river or stream banks along watercourses may provide suitable habitat for Long-tailed Shrew. The nearest record of Long-tailed Shrew is approximately 25 km from the LAA (AC CDC, 2023).

The Maritime Shrew (*Sorex maritimensis*) is endemic to Canada and are associated with scrub and grass-dominated wet–dry meadow habitat adjacent to water from central New Brunswick through mainland Nova Scotia. American Water Shrew (*Sorex palustris*) is found in the forested ecozones of Canada and the northern US in association with waterways, in marshes, along the stream banks, in adjacent floodplain forest or meadow, and around beaver dams (McAlpine and Smith, 2010). The open meadow wetlands present along watercourses within the LAA may provide suitable habitat for Maritime Shew and American

Water Shrew. The nearest record of Maritime Shrew and American Water Shrew is approximately 81 km and 78 km from the LAA, respectively (AC CDC, 2023).

In Nova Scotia, Fisher (*Pekania pennanti*) occurs in mature conifer, hardwood, and mixed-wood forest habitats on the mainland and Cape Breton, where their mammalian prey (Snowshoe Hare, Red Squirrel (*Tamiasciurus hudsonicus*), and Porcupine (*Erethizon dorsata*)) are abundant (Milton et al., 2022). The nearest record of Fisher is approximately 28 km from the LAA (AC CDC, 2023). Southern Flying Squirrel (*Glaucomys volans*) is a species which also relies on the presence of mature forest habitat. The mature forest habitats within the LAA may provide suitable habitat for Fisher and Southern Flying Squirrel, though the Project is approximately 70 km outside of the known range of Southern Flying Squirrel (COSEWIC, 2006). The Forest Inventory layer and Old-Growth Potential Index show that the majority of the mature forest habitats occur within the Crown land parcels in the central and eastern portions of the LAA and along the major watercourses where steep topography limits timber harvesting.

Southern Bog Lemmings (*Synaptomys cooperi*) are common in wet areas of recent forest clearcuts and meadows, as well as grassy bogs and in hardwood forests on rocky or talus substrates in Nova Scotia (McAlpine and Smith, 2010). The recent forest clearcut, meadows, and hardwood forest may provide suitable habitat for Southern Bog Lemming in the LAA. The nearest record of Southern Bog Lemming is approximately 83 km from the LAA (AC CDC, 2023).

10.2.1.1 Mainland Moose Suitable Habitat

In general, the LAA encompasses regions that meet the criteria used to identify core habitat for Mainland Moose in the Recovery Plan. Of the total land area evaluated within the LAA, 52 percent meets one or more of the biophysical components essential for optimal habitat. Table 10.2 presents the breakdown of area habitat components identified within the LAA and PDA (note: these estimates are conservative as they do not consider unvegetated areas such as roads currently present in the LAA and PDA). The results of the Mainland Moose habitat mapping are presented in Appendix A, Figure 10.1.

Table 10.2 Summary of Mainland Moose Habitat Components Identified Within in the LAA and PDA

Habitat Component	Total Area (ha)	
	LAA	PDA
Winter cover	15,171	16.7
Summer cover	9,284	149.1
Summer forage	14,116	570.8
Winter forage	6,850	288.7
Calving area	375	0.7

10.2.1.2 Winter Tracking, PGI Surveys, and Camera Trap Results

A total of nine species were identified across all field surveys (including incidental observations) conducted within the LAA (Table 10.3). Of these species, five were captured by camera traps (Table 10.4). Locations of winter tracking, PGI surveys, and camera traps are presented in Appendix A, Figure 10.2.

Table 10.3 Summary of Mammal Species Observed

Scientific Name	Common Name	NSESA	SARA	COSEWIC	AC CDC
Alces alces americana	Mainland Moose	Endangered	-	-	S1
Ursus americanus	American Black Bear	-	-	Not at Risk	S5
Lynx rufus	Bobcat	-	-	-	S5
Canis latrans	Eastern Coyote	-	-	-	S5
Tamiasciurus hudsonicus	Red Squirrel	-	-	-	S5
Lepus americanus	Snowshoe Hare	-	-	-	S5
Odocoileus virginianus	White-tailed Deer	-	-	-	S5
Pekania pennanti	Fisher	-	-	-	S3
Castor canadensis	North American Beaver	-	-	-	S5

Table 10.4 Summary of Mammal Observations via Camera Traps

Camera Trap Name	Animals Observed	Number of Observations
TC-01	White-tailed Deer	2
TC-02	Eastern Coyote	3
TC-03	Bobcat	3
	Eastern Coyote	2
	White-tailed Deer	17
	American Black Bear	1
TC-04	White-tailed Deer	10
	Mainland Moose	1
TC-05	White-tailed Deer	4
	American Black Bear	4
TC-06	Mainland Moose	2
	White-tailed Deer	2
	American Black Bear	3
	Eastern Coyote	1
TC-07	White-tailed Deer	3
TC-08	White-tailed Deer	7
	Mainland Moose	1

Camera Trap Name	Animals Observed	Number of Observations
TC-09	White-tailed Deer	2
	American Black Bear	7
	Eastern Coyote	1

As evident by the observations made during the field programs, Mainland Moose are using habitats within the LAA year-round, though the habitats where moose are present vary seasonally. Signs of Mainland Moose observed included individuals, pellets, beds, tracks, and browse. No moose observations were made during the Year 1 or Year 2 winter tracking surveys. Evidence of Mainland Moose was observed during the PGI surveys, on the trail camera traps, and incidentally during other field programs.

Direct observation of Mainland Moose by field personnel was recorded four times over the field survey period from February to November 2023. A juvenile bull was observed crossing the road during a bird survey in June and another bull was observed during wetland surveys in October. The observations of these animals were only 1.3 km apart, which suggests they may represent the same individual. Two observations of an individual cow were made; one in September and one in October during wetland and fall bird surveys, respectively. These observations were approximately 4 km apart.

Signs of moose were detected on nine of the 18 PGI transect routes. Seven routes had moose pellet observations and the remaining two routes had observations of moose tracks and browse. The majority of the pellet group observations (58 percent) were in softwood-dominant forest habitat, while the rest were observed in hardwood-dominant forests (30 percent) and unforested habitat (12 percent).

Observations of Mainland Moose were captured on three of the 13 trail camera trap locations. Two of the trail camera moose observations were in wet meadow habitats associated with watercourses and the third was along an existing road through a softwood forest stand.

As Mainland Moose are a location-sensitive species, the location observations are not provided in this EA but will be provided to NSDNRR under separate cover.

In general, the LAA seems to support a year-round moose population, with several forest, open, and wetland habitat types providing suitable cover and forage areas.

10.2.2 Turtles and Other Herpetofauna

The NSDNRR Significant Species and Habitat Database contains 230 records of species and/or habitat records that relate to turtles and other herpetofauna within a 100 km radius of the PDA. These records include Species at Risk (229 records) and Species of Concern (1 record). The Species at Risk record refers to Wood Turtle (139 records) and Snapping

Turtle (91 records). The Species of Concern refers to Painted Turtle (presumably Eastern Painted Turtle (*Chrysemys picta picta*)).

Only one of the NSDNRR Significant Species and Habitat Database records occurs within 5 km of the PDA—a section of the Chiganois River identified as Wood Turtle habitat is present 1.5 km from the southeast of the PDA.

The AC CDC (2023) Data Report lists observations of four terrestrial herpetofauna SAR and SoCC that have been recorded within a 100 km radius of the LAA (see Appendix B). Table 10.5 summarizes the Herpetofauna observed within a 5 km radius of the LAA.

Table 10.5 Herpetofauna SAR and SoCC Observed within a 5 km Radius of the LAA (Source: AC CDC, 2023)

Scientific Name	Common Name	NSESA	SARA	COSEWIC	AC CDC
Glyptemys insculpta	Wood Turtle	Threatened	Threatened	Threatened	S2
Chelydra serpentina	Snapping Turtle	Vulnerable	Special Concern	Special Concern	S3
Chrysemys picta picta	Eastern Painted Turtle	-	Special Concern	Special Concern	S4

The Wood Turtle and Snapping Turtle records are associated with the Wallace and Chiganois Rivers and both watersheds overlap the PDA. The observations of Eastern Painted Turtle are associated with ponds and marshes along the Debert River, 5 km south of the PDA.

10.2.2.1 Turtle Habitat Assessments and Visual Encounter Survey Results

No turtle individuals or signs of turtles were observed during the habitat assessments or VES, nor were any incidental observations made during the field programs. The Wallace and Chiganois River watersheds, which overlap the LAA, are known to contain habitat for Wood Turtles and some areas of possible habitat were observed along watercourses in these watersheds. The lack of turtles seen during of the visual surveys does not indicate the absence of turtles in the LAA. The poor success rate of VES is well known due to Wood Turtles tendency to hide in dense vegetation or retreat to water upon sensing an approaching threat (Flanagan et al., 2013).

A total of 59 watercourse and possible habitat locations were assessed for turtle habitat suitability and a subsection of those (38) were subject to a targeted turtle survey (VES). The surveys were distributed amongst the five watersheds that overlap the PDA: in Chiganois (15 VES), Debert (14), Wallace (5), Folly (3), and French (1). Locations of the turtle habitat assessments and VES are presented in Appendix A, Figure 10.3. The majority of the watercourses assessed were of high velocity with minimal sand or gravel substrate. Suitable habitat for Wood Turtle is clear watercourses, with a moderate flow, and hard bottoms of sand or gravel, typically ranging from 2 to 30 m in width (MacGregor & Elderkin, 2003). Although there is little evidence that suitable habitat for breeding Wood Turtles exists in the sections of watercourses assessed, it is likely that dispersing turtles could travel through the LAA from suitable habitat further downstream (especially in the Chiganois and Wallace watersheds).

A total of six species of herpetofauna were identified (all incidental observations) over the course of the field survey programs conducted within the LAA (Table 10.6).

Table 10.6 Summary of Herpetofauna Observations Recorded during the Field Survey Programs

Scientific Name	Common Name	NSESA	SARA	COSEWIC	AC CDC
Thamnophis sirtalis	Common Gartersnake	-	-	-	S5
Opheodrys vernalis	Smooth Greensnake	-	-	-	S4
Pseudacris crucifer	Spring Peeper	-	-	-	S5
Lithobates pipiens	Northern Leopard Frog	-	-	-	S5
Lithobates clamitans	Green Frog	-	-	-	S5
Lithobates sylvaticus	Wood Frog	-	-	-	S5

10.2.3 Invertebrates

The AC CDC (2023) data report contains records of 64 invertebrate SAR and SoCC within a 100 km radius of the LAA. Table 10.7 summarizes the 12 invertebrate species observed within a 5 km radius of the LAA.

Table 10.7 Terrestrial Invertebrate SAR and SoCC Observed within a 5 km Radius of the LAA (Source: AC CDC, 2023)

Scientific Name	Common Name	NSESA	SARA	COSEWIC	AC CDC
Bombus bohemicus	Ashton Cuckoo Bumble Bee	Endangered	Endangered	Endangered	S1
Bombus terricola	Yellow-banded Bumble Bee	Vulnerable	Special Concern	Special Concern	S3
Boloria chariclea	Arctic Fritillary	-	-	-	S1S2
Satyrium acadica	Acadian Hairstreak	-	-	-	S2
Aglais milberti	Milbert's Tortoiseshell	-	-	-	S2S3

Scientific Name	Common Name	NSESA	SARA	COSEWIC	AC CDC
Satyrium calanus	Banded Hairstreak	-	-	-	S3
Polygonia interrogationis	Question Mark	-	-	-	S3B
Cecropterus pylades	Northern Cloudywing	-	-	-	S3S4
Amblyscirtes hegon	Pepper and Salt Skipper	-	-	-	S3S4
Cupido comyntas	Eastern Tailed Blue	-	-	-	S3S4
Argynnis aphrodite	Aphrodite Fritillary	-	-	-	S3S4
Polygonia faunus	Green Comma	-	-	-	S3S4

10.3 Effects Assessment

10.3.1 Boundaries

For the purpose of this assessment, the LAA for terrestrial wildlife includes the PDA and a 2 km buffer. The RAA for terrestrial wildlife incorporates the concentration area occupied by the Cumberland/Colchester subgroup of Mainland Moose.

10.3.2 Potential Effects and Mitigation

Several changes were implemented for the Project to minimize potential direct and indirect impacts on terrestrial wildlife, where reasonable, while meeting engineering and design constraints. Detailed design of the Project and micrositing of turbines will further avoid terrestrial wildlife habitat when practicable and will reduce potential interactions between the Project and terrestrial wildlife. Micrositing involves exact placement of the turbine within the turbine sites as shown in the PDA.

Direct and indirect effects of the Project on terrestrial wildlife could occur through various interconnected pathways. During construction, activities like earthworks and vegetation clearing may lead to habitat loss, alteration, and disruptions in movement patterns, as well as changes in food availability. The Project will require approximately 150 km of access roads, 116 km (77 percent) of which are existing gravel roads, that will require upgrades in sections. New gravel road sections will be required where turbines branch from the existing roads, and alternate access routes are proposed, resulting in approximately 34 km (23 percent) of new linear disturbance. Increased road width and density may fragment habitat and affect wildlife movement. The rise in Project-related vehicle traffic poses a risk of mortality and injury due to collisions. Additionally, sensory disturbance from light and noise during construction, operation and maintenance, and decommissioning could impact wildlife behaviour.

Project activities may pose increased threats specific to Mainland Moose. Forest clearing and road construction activities could increase White-tailed Deer access to moose habitat, heightening the risk of disease transmission. Additionally, the updated road infrastructure may facilitate non-Project related human access, potentially attracting individuals engaged in illegal moose poaching.

Project activities can affect terrestrial fauna as indicated in Table 10.8; these potential effects do not consider the detailed design of the Project and micrositing of turbines that is yet to be completed or the implementation of mitigation measures described herein.

Table 10.8 Potential Environmental Effects of the Project on Terrestrial Wildlife

Project Activity	Potential Environmental Effects			
	Habitat Loss/ Fragmentation	Collision Risk	Disruption of Life History	Other Threats (Poaching/ Disease)
Construction				
Site Preparation	X	X	X	-
Access Roads Construction and Modifications	X	X	X	X
Material and Equipment Delivery and Storage	-	X	X	-
Infrastructure Installation		X	X	-
Restoration of Temporary Areas	-	-	X	-
Testing and Commissioning	-	X	X	-
Operation and Maintenance				
Turbine Operation and Maintenance	-	X	X	-
Road Maintenance	-	X	X	-
Power Line and Substation Maintenance	-	X	X	-
Vegetation Management	-	X	X	-
Safety and Security	-	-	-	-
Decommissioning				
Removal of Infrastructure and Site Restoration	-	X	X	-

X = Potential Interaction
- = No Interaction

10.3.2.1 Habitat Loss and Fragmentation

The Project may result in habitat degradation and fragmentation for terrestrial wildlife species within the LAA.

Project is within the Cumberland/Colchester Mainland Moose subgroup concentration area and area identified as Core Habitat by the Mainland Moose Recovery Plan (NSDNRR, 2021). The Recovery Plan recognizes renewable energy projects and road construction as activities likely to cause adverse effects, including the destruction of important moose habitat, through habitat loss, conversion, degradation, and fragmentation. Construction activities within the PDA may lead to the clearance of up to 1.3 km^2 of mature forest cover habitat and 5.2 km^2 of forage habitat that meet the biophysical parameters for Mainland Moose Core Habitat. As described in Section 2.1, after detailed design, the area to be cleared is expected to be approximately half this amount or less. The clearing activities of the Project may result in both short-term and long-term loss of suitable moose habitat within the PDA. Forest clearing may reduce cover habitat for thermoregulation and shelter, but the area of foraging habitat may increase post-construction as most of the vegetation around the turbine base and road edges will naturally regenerate, which will minimize the loss of foraging habitat following construction. Currently, the majority of the LAA is subject to industrial timber harvesting activities, with only the old-growth forest stands on Crown land protected from harvest under the Old-Growth Forest Policy. The Proponent has committed to mitigation measures to offset the limited increase in habitat fragmentation. In addition, the Proponent has proposed the concept of a moose corridor to describe a collaborative, large-scale, land conservation effort in the region in which it is prepared to play a coordinating role (see Section 10.3.2.1.1).

The estimate of habitat loss or alteration is based on the PDA, which is an exaggeration of the final Project Footprint. Further, some of the habitat slated for clearing is directly adjacent to existing roads, and the total cleared areas will be less than estimated because these calculations include the areas currently occupied by roads. The layout of the PDA utilizes habitats along existing roads and lower-quality habitat to minimize habitat loss impacts. Additionally, throughout the iterative design process of the Project, areas of particularly high-quality habitat were avoided (e.g., old growth, wetlands, and concentrations of moose observations, see Figure 2.2). With micrositing of turbines and other Project infrastructure, the amount of clearing required will be substantially less than that estimated for the purpose of this EA.

The Cumberland/Colchester region currently has the highest concentration of Mainland Moose in the province, making protection of habitat in the area important for recovery of this species (NSDNRR, 2021). Habitat within this region, and especially areas meeting the biophysical requirements for Core Habitat, play a pivotal role in ecological connectivity for moose. Ongoing work to enhance the suitability and quality of habitat within the LAA are underway and include the concept of creating a moose corridor to increase ecological connectivity (see Section 10.3.2.1.1).

Historical and current land use, including forestry and off-road recreational activities, has considerably fragmented the habitat within the LAA due to degraded forest habitat and abundant road and trail networks. Fragmentation affects the quality and connectivity of habitat for both individual wildlife and populations. Moose in the LAA could be impacted by both further fragmentation of the forests and vegetation removals in foraging areas resulting from turbine, road construction, and road widening. Design considerations to place turbines in previously disturbed areas were incorporated to minimize additional habitat fragmentation, for example, 74 percent of the access roads will be using existing roads in the PDA and the Global Forest Watch Tree Cover Loss (2001 to 2022) data indicates that 34 percent of the PDA has experienced forest loss in this period. In addition, vegetated buffers around wetlands and watercourses will be maintained to support connectivity and cleared areas will be replanted progressively to mitigate fragmentation effects.

Herpetofauna use terrestrial habitats like wetlands, riparian areas, forested areas near water, and rocky/gravelly areas such as roadsides. The Project layout is designed to minimize impacts on intact habitat, especially in riparian areas and surrounding forests. Most watercourses in the PDA were not observed to support turtle habitat. However, turtles move across the landscape, especially between wetlands and watercourses, and may be present in the LAA. The Project design minimizes habitat alteration of watercourses and adjacent habitat by prioritizing pre-existing roads and watercourse crossings. The construction of new roads may create small gravel roadside habitats suitable for nesting turtles. Given the lack of quality turtle habitat and lack of observations of SoCC in the LAA, impacts from habitat loss and fragmentation to herpetofauna are expected to be low.

Other non-priority species use various habitats in the LAA; the Project construction and operation and maintenance phases may result in habitat loss and fragmentation for non-priority species. Project construction may remove refugia, increase predation risks, and disrupt ecological balance. Forest interior species, such as Fisher and Southern Flying Squirrel, are more sensitive to habitat loss and fragmentation, but the Project layout, which involves using existing roads and avoiding old-growth habitat, is designed to minimize bisecting intact forested areas with substantial unsuitable habitat. In general, it is expected that movement patterns may be affected in the short-term as alternate habitats are sought, but terrestrial wildlife will likely continue using habitats (including new and existing roads) post-construction. Presently, industrial timber harvesting activities are prevalent threats to wildlife habitat loss within the LAA, with the exception of the old-growth forest stands on Crown land.

It is anticipated that direct impacts of habitat loss and fragmentation to non-priority species in the LAA will be low and can be mitigated through strategies to reduce these effects. Careful site planning has been implemented to minimize habitat disturbance and to reduce habitat loss and fragmentation, use existing roads and areas that have been previously altered, such as clearcuts and harvested areas. Habitat modelling, field survey results, and NSDNRR guidance have been considered during Project layout design. The iterative Project design process has prioritized avoidance and minimization of interactions with important wildlife habitat such as wetlands and mature forest (see Figure 2.2).

The following key measures to mitigate the potential effects of the Project on terrestrial wildlife habitat will be further detailed in an EPP and will be implemented prior to and during construction:

- Mainland Moose habitat mapping was considered in the design of the Project layout to create wildlife corridors or buffer zones to facilitate species movement. During the detailed design, turbines will be oriented to avoid severing or intersecting intact forest or natural habitat linkages wherever possible.
- Vegetated buffers around wetlands and watercourses will be maintained to support connectivity for wildlife where possible.
- Habitat restoration and revegetation programs after construction will be implemented, ensuring that critical habitat components are preserved or replaced.
- Vegetation management practices that benefit Mainland Moose will be implemented, such as maintaining natural browse areas and creating new foraging opportunities.
- Roads will be decommissioned where possible to reduce long-term effects of habitat loss and fragmentation. Temporary areas within the PDA will be progressively restored during the course of Project construction with the revegetation of roadsides and cleared areas prioritized.
- To minimize the impacts of habitat loss during operation and maintenance, particularly for Mainland Moose, compatible vegetation will be maintained in cleared areas (i.e., cutting tree species while preserving low shrub species that do not interfere with Project infrastructure or site access).
- The Proponent is committed to enhancing the suitability and quality of Mainland Moose habitat within the LAA and has proposed the concept of a moose corridor to describe a collaborative, large-scale, land conservation effort in the region in which it is prepared to play a coordinating role (see Section 10.3.2.1.1). A moose corridor would provide ecological connectivity between protected areas and foster improvements in land use practices, such as reduction in forest harvesting. considerations for connectivity to intact protected habitats, such as the Wentworth Valley Wilderness Area and other high-quality habitat zones.
- Based on the final engineering design, variances from the assessed PDA layout may necessitate additional turtle habitat surveys and VES. Additional surveys will be completed as required to target any proposed new or upgraded infrastructure on watercourses.
- Alternative road de-icing methods will be employed during road maintenance as practicable to prevent the impacts of salt on wildlife and their habitats.
- Measures will be implemented to control and prevent the spread of invasive species.
- NSDNRR Mainland Moose and Wood Turtle monitoring plans will be implemented on Crown land and other parcels if possible.
- NSDNRR will be consulted in the final Project design to minimize road length, avoid sensitive features, and reduce water crossings.
- The Proponent will develop and implement a Wildlife Management Plan.

10.3.2.1.1 **Proposed Moose Corridor**

Recognizing the need for the implementation of the Mainland Moose Recovery Plan (2021) and the Collaborative Protected Areas Strategy (2023), the Proponent is proposing the concept of a moose corridor to protect moose habitat on Project lands and enhance ecological connectivity between protected habitat across the broader landscape and region.

It is estimated that up to approximately four percent of the Project lands (PIDs) will be used for wind farm infrastructure, which leaves a considerable area available for conservation purposes. Moose habitat and other ecologically valuable lands could be protected from high-production forestry and potentially receive some level of protected status.

Mainland Moose and other wildlife move between habitats based on seasonal and life cycle needs; therefore, the Proponent acknowledges the importance of protecting these habitats and the corridors between them.

The Proponent's proposed moose corridor concept describes a collaborative, large-scale, land conservation effort in the region in which it is prepared to play a coordinating role. A moose corridor would provide ecological connectivity between Protected Areas and foster improvements in land use practices in corridors, such as a reduction or changes to forest harvesting. The focus of this initiative is to prioritize ecological connectivity to intact protected habitats, including the Wentworth Valley Wilderness Area, the Cook Conservation Lands, and other high-quality habitat. Options for protection could include provincial wilderness areas, Indigenous Protected and Conserved Areas, and conservation or working land easements.

At a community meeting in Debert on February 12, 2024, the Proponent proposed the formation of a working group composed of scientists, Rights holders, provincial and municipal governments, landowners, the forest industry, conservation groups and other interested parties to operationalize the Mainland Moose Recovery Plan. The Proponent has had preliminary conversations with some potential members of the working group and is waiting for Project approval to proceed further.

10.3.2.2 Collision Risk

Due to an increase in road traffic in the PDA, predominantly during the construction phase, the Project will increase the risk of collision with wildlife using the roadways. Currently the LAA is used by local residents, recreational users (particularly snowmobiles and ATVs), and for industrial forestry operations.

Surveys conducted within the LAA (particularly trail camera trap data) show current year-round use of roads by a variety of animals including Mainland Moose, White-tailed Deer, Bobcat, and Eastern Coyote. These species may be at increased risk of injury and death due to collisions through all phases of the Project, but particularly during construction when increases in vehicular traffic will be greatest.

Herpetofauna are particularly vulnerable to increased exposure to road traffic due to their slow movement. During seasonal migrations from their overwintering areas, they often cross roads to reach breeding sites. Wood Turtles, in particular, frequently nest in human-made habitats such as road embankments. Turtle species are highly sensitive to increased mortality among adults and older juveniles due to their delayed sexual maturity and slow reproductive rate. Mortality and injury from road networks (including new road construction, road widening and increased traffic volume and speed) are identified as high-level concerns for the recovery of Wood Turtle (ECCC, 2020). The construction phase of the Project poses the greatest increase in risk of collision injury and mortality due to the increased traffic levels on the roads, but impacts can be mitigated by avoiding construction activities during peak seasonal activity and movement patterns of individual species.

The threat of wildlife vehicle collisions will be local in the medium-term and with the highest likelihood of occurring during the construction phase. It is expected that traffic associated with the Project's operational phase (maintenance of equipment and vegetation) will have minimal impact on the potential for wildlife collisions. Considering existing traffic load and the expected minimal impact from the Project beyond the construction phase, the impact of collisions on terrestrial fauna in the LAA due to road traffic is anticipated to be low.

Flying invertebrates are at risk of mortality due to collisions with operating turbine structures, particularly those exhibiting hill-topping, swarming, and migrating behaviours (Voigt, 2021). A potential influencing factor contributing to the collision risk is the attraction of some insect species to wind turbines, with turbine colour identified as a potential influencing factor (Long et al., 2010; Crawford et al., 2023). However, gaps in the literature persist regarding how attraction to wind turbines influences insect mortality rates and whether turbine-induced fatalities contribute to overall insect population declines (Voigt, 2021). Based on this limited knowledge, the Project's impact on invertebrates in the LAA is uncertain.

The following key measures to mitigate the potential effects of the Project on terrestrial wildlife collision risk will be further detailed in an EPP and will be implemented prior to and during construction:

- Wildlife-friendly turbine designs will be considered, such as specialized lighting to minimize wildlife from approaching turbines.
- Strategic design will be employed to minimize road density, using existing roads as much as possible.
- Project staff will be briefed on wildlife dangers and hotspots, aiming to minimize traffic and associated stress to wildlife.
- Vehicle speeds will be reduced, especially in key areas during sensitive seasonal windows for wildlife. Signage will be posted in sensitive habitat during sensitive periods for wildlife to caution drivers.
- Traffic signs (speed limit and wildlife warning signs) will be installed to reduce speed and alert road users to presence of wildlife.

- Project related traffic will be minimized to reduce wildlife vehicle collisions.
- The amount of road that parallels a watercourse will be minimized where possible.
- Permanent and temporary road and water crossings will be planned in advance to prevent turtle mortality and protect water quality.
- Onsite monitoring for all wildlife species, including Mainland Moose, will be conducted during site preparation and construction activities.
- Onsite monitoring for turtles will be conducted during site preparation and construction activities in areas identified as suitable turtle habitat (for any species). Wood Turtle VES should be considered immediately prior to site preparation and construction activities.
- If a turtle or nest is encountered during construction activities, work will cease, and the local regional biologist contacted for direction.
- Vegetation management practices to enhance visibility for wildlife and reduce the risk of collisions will be implemented.
- The Proponent will develop and implement a Wildlife Management Plan.

10.3.2.3 Disruption of Life History

The Project activities may cause habitat disturbance, disrupting the life history of terrestrial wildlife in an area already influenced by human activities such as forestry operations and recreational use. During the Project construction period, disturbance levels are expected to be comparable to active forestry operations, but extended over a longer duration (excluding short-term, isolated activities like blasting). Wildlife may exhibit behavioural changes as a result of the Project and seek out alternate habitats outside of the LAA due to sensory disturbance and stress. In the operation and maintenance phase, sporadic increases in lighting, traffic, and human presence may occur, potentially prompting wildlife to avoid or abandon suitable habitats over the longer term. The greatest difference in the disturbance regime within the LAA as a result of the Project may arise from the noise (and possibly vibration) generated by the operating turbines.

Mainland Moose could be especially sensitive to disruptions in their life history caused by Project roads during construction, operation and maintenance, and decommissioning. Moose experience disturbances from road construction, maintenance, and traffic, with even low-intensity roads such as recreational trails prompting some degree of habitat avoidance (Beazley et al., 2004). Studies on the impacts of road density on moose individuals and populations have been conducted, revealing direct and indirect influences (Yost and Wright, 2001; Beazley et al., 2004; Shanley and Pyare, 2011). However, the magnitude of influence can vary depending on factors such as road type, use, and density. Areas within the Colchester-Cumberland region surpass the road density threshold considered detrimental to Mainland Moose yet host the province's highest concentration of individuals (NSDNRR, 2021).

Moose could exhibit altered behaviour and movement patterns in response to Project activities that cause loss of habitat, increased vehicular traffic, increased human presence, and noise. Some studies have looked at the impact of operational wind turbines on moose, but the impacts to their behaviour and habitat selection remains unclear (Bernt, 2021). The Mainland Moose Recovery Plan recognizes stress from renewable energy infrastructure, specifically citing artificial lighting sources and the flicker effect as a potential threat to the Mainland Moose (NSDNRR, 2021).

While there is limited research on the response of moose to wind turbines, studies on other large mammals like deer, reindeer, and elk show behavioural changes during construction and operation (Łopucki et al., 2017; Skarin et al., 2015; Skarin and Alam, 2017; Skarin et al., 2018), with some studies indicating no significant impact on behaviour during operation (Walter et al., 2006; Colman et al., 2013; Tsegaye et al., 2017; Taylor et al., 2016). Studies on carnivores (including martens) indicate that wind farms can influence habitat use and abundance, especially during construction (Sirén et al., 2016; Łopucki et al., 2017; Sirén et al., 2017). To reduce disruptions to wildlife life history, seasonality will be considered when planning construction, maintenance, and decommissioning activities. The field studies and habitat mapping indicate where Mainland Moose presence is likely the highest and avoiding these areas during sensitive seasonal windows will help reduce the impacts.

Despite existing noise from forestry and recreational activities, including recreational snowmobiling, ATV use, hunting, and fishing, various mammal species were observed in the LAA. This suggests wildlife, including Mainland Moose, are tolerant or habituated to sensory disruptions from existing human activities.

Small-mammal (e.g., rodent and shrew) populations are not likely impacted by wind energy development (De Lucas et al., 2005; Łopucki and Mróz, 2016). Due to lack of studies on the impacts of wind turbines on local small mammal populations it is unclear what impacts the Project may have, if any, on small mammals in the LAA.

Sensitive periods for herpetofauna, related to migration or nesting periods, may be disrupted by Project activities, impacting migratory or breeding behaviours and potentially creating barriers to important habitat due to habitat removal or fragmentation. It is expected that impacts on life history of herpetofauna will be negligible considering the Project's use of existing roads and previously disturbed habitats, especially if construction, maintenance, and decommissioning activities are conducted outside of sensitive periods for these species.

The following key measures to mitigate the potential effects of the Project on life history of terrestrial wildlife will be further detailed in an EPP and will be implemented prior to and during construction:

- Micrositing and detailed design will be employed strategically to minimize loss of vital habitat for priority species' reproduction events:
  - Mainland Moose (wetlands, isolated islands/peninsulas)
  - Wood Turtle (clear, meandering streams with gravel shores, gravel roadsides)

- Micrositing and detailed design will be employed to minimize clearing areas to maintain refugia and cover for protection from predators.
- Blasting will be undertaken in accordance with regulatory requirements and will only be conducted by qualified blasting professionals.
- Pre-blast wildlife searches will be completed.
- Blasting will be monitored and will be planned to occur on days where weather conditions are less likely to cause excessive noise levels.
- Noise-reducing technologies will be used to minimize the impact of construction noise on wildlife.
- Onsite lighting will be designed to minimize disturbance.
- Project personnel will be prohibited from harassment and feeding of wildlife.
- A comprehensive post-construction monitoring program will be implemented in consultation with NSDNRR to assess the ongoing impact of wind turbines on wildlife.
- Adaptive management strategies will be employed to adjust operations based on monitoring results.
- The Proponent will develop and implement a Wildlife Management Plan.

10.3.2.4 Other Threats (Disease/Poaching)

Project activities including forest clearing and road construction may increase White-tailed Deer access to moose habitat, potentially increasing the risk of disease transmission, including Brainworm (*Parelaphostrongylus tenuis*) and Winter Tick (*Dermacentor albipictus*). The evidence from the field surveys shows prominent use of the LAA by deer and existing roads connecting the known deer over-wintering area to the PDA. It is anticipated that the increased impact from the Project on Mainland Moose disease will be small.

Poaching is recognized as a potential threat to Mainland Moose in the Recovery Plan (NSDNRR, 2021). Although increased human access, including local hunters and recreational users, may elevate the risk, the LAA is already highly accessible. Upgrades to existing roads may allow for more types of vehicles accessing moose habitat which could increase the poaching risk. However, the heightened presence of operational and maintenance staff may serve as a deterrent to moose poaching.

Project construction may enhance non-Project-related human access to the LAA, potentially attracting increased use by ATV users, hikers, and hunters, including those engaging in illegal moose poaching—a significant threat to Mainland Moose (NSDNRR, 2021). These users might exploit the newly constructed or upgraded access roads. To mitigate this effect, plans for decommissioning and revegetating access roads will be implemented.

Establishment or spread of invasive weed populations through Project construction, operation and maintenance, and decommissioning activities may impact wildlife in the LAA. The Recovery Plan for Mainland Moose lists invasive plant species as a concern for Mainland Moose due to their impact on available food sources. This includes plant species such as Glossy Buckthorn (*Rhamnus frangula*), which was observed in the LAA (Chapter 8:

Flora). Best management practices will be implemented during Project activities to limit the spread of invasive species. Additionally, invasive species management procedures will be adopted within the PDA to identify, prevent, control, and mitigate the impact of invasive species.

It is anticipated that impacts of disease, poaching and other threats to priority and non-priority species in the LAA will be low and can be mitigated through strategies to reduce these effects.

The following key measures to mitigate the potential effects of the Project on terrestrial wildlife will be further detailed in an EPP and implemented prior to and during construction:

- To discourage deer from areas of regenerating vegetation, native seed sources with plant species unpalatable to deer will be used in the revegetation process.
- As much natural cover as possible will be retained to favour moose habitat over deer habitat to minimize incursion of brainworm and winter tick.
- Invasive species management procedures will be developed and implemented as part of the Vegetation Management Plan.
- Access roads for construction will be decommissioned and revegetated where possible.
- Decommissioning of existing roads in strategic areas or the use of barriers to limit human presence will be considered.
- The Proponent will develop and implement a Wildlife Management Plan.

10.3.3 Residual Effects

Although effects on mammals, herpetofauna, and invertebrates vary, primary concerns include habitat loss, fragmentation, and vehicle collision and the associated disruptions to life history. The magnitude of residual effects is expected to be moderate to large on an immediate scale based on the loss of core habitat for Mainland Moose. Magnitude of the effects of habitat fragmentation is expected to be minor on a local scale. Residual effects are predicted to be long-term for habitat loss and fragmentation but variable for individual species. Habitat disruption and avoidance will most likely occur during periods of construction and may be more intermittent during periods of operation and maintenance when onsite human activities are less frequent and would occur on a short-term basis. This will return to baseline during inactive periods and after the decommissioning of the Project. Timing of residual effects, if the mitigation measures are followed, should be low to moderate. Through proposed mitigation and monitoring, anticipated effects on terrestrial fauna are expected to be minor and local. These effects are continuous but seasonally varied and reversible. Through careful detailed design and micrositing of Project infrastructure to avoid Core Habitat, in addition to actively seeking ecological connectivity and habitat enhancement opportunities such as the proposed moose corridor, potential significant effects can be avoided.

10.4 Monitoring

An environmental monitoring program will be developed prior to Project construction. Additional surveys or mitigations may be identified in consultation with regulators following review of the monitoring program.

A post-construction monitoring program for Mainland Moose will be developed in consultation with NSDNRR and implemented for a minimum of two years post-construction to assess effects of the Project. The results of the post-construction monitoring program will be submitted to NSDNRR as required.

11 Bats

11.1 Overview

The assessment of the Project on bats includes migratory and resident bat species and their habitat. Wind energy projects can adversely affect bats, and turbines represent a risk of increased mortality. Indirect impacts such as habitat loss and fragmentation and sensory disturbance also present risks to bats. Iterative Project layout adjustments—including the removal of turbines from old-growth and mature forests—have reduced potential impacts on bats and their habitat (see Figure 2.2). The ongoing detailed design process seeks to further minimize the Project's impact on bat habitats through careful infrastructure placement.

Interactions of the Project with bats are closely tied to Project interactions with other VECs that are assessed in more detail in the respective chapters, including noise and light disturbance (Chapter 5: Atmospheric Environment), vegetation loss or modification (Chapter 8: Flora), and loss or alteration of wetlands (Chapter 9: Wetlands).

For this assessment, studies were completed to examine the existing environment including bat presence and activity and maternity roosting habitat within the LAA, and other features such as hibernacula within proximity to the LAA. The information gathered from pre-construction surveys helps to assess site risk, inform siting of infrastructure, develop mitigation measures, and provide baseline information to support post-construction monitoring and adaptive management (NSDNRR, 2022). Mitigation measures have been outlined in this chapter and will be further developed in a Project-specific EPP prior to construction to minimize adverse effects on bat populations.

11.1.1 Regulatory Context

Assessment of bats considers the existing environment and measures effects using relevant provincial and federal legislation:

- Nova Scotia *Wildlife Act*
- NSESA
- SARA
- *Canadian Environmental Protection Act*
- Nova Scotia *Biodiversity Act*
- Nova Scotia *Environment Act*

- Nova Scotia *Wilderness Areas Protection Act*

11.1.2 Assessment Methodology

The assessment of bats focused on identifying migratory and resident bat species present on or near the LAA and activity on site. Data was collected through literature review, online databases and reports, habitat analysis, and field surveys conducted during migratory and breeding periods.

The information gathered during the literature review and habitat analysis was used to inform the design of baseline field surveys and reflective of the protocols outlined in *Guidance for Bird and Bat Surveys Pre- and Post-Construction Surveys and Monitoring – Wind Energy* (NSDNRR, 2022), *Bats and Wind Turbines. Pre-siting and preconstruction survey protocols* (Lausen et al., 2010), *Pre-Construction Bat Survey Guidelines for Wind Farm Development in NB* (New Brunswick Department of Fish and Wildlife, 2009), and to a lesser extent, *Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds* (ECCC, 2007b), and *Wind Energy & Birds Environmental Assessment Guidance Update* (ECCC, 2022).

Baseline field surveys were designed to determine the presence and diversity of bat species, activity on site, and to identify suitable maternity roost habitats within the LAA. This information was then used to inform and refine siting of Project infrastructure, develop measures to minimize adverse effects of Project construction and operation on bats, and evaluate impacts of the Project. The data collected through the assessment process will also serve as a baseline for post-construction monitoring and adaptive management.

The description of the existing environment is based primarily on data collected through the following resources plus field surveys carried out for this Project:

- Karst Risk Map of Nova Scotia (Drange and McKinnon, 2019)
- Locations of Known Bat Hibernacula in Nova Scotia (Moseley, 2007)
- Nova Scotia Geoscience Atlas—Abandoned Mine Openings (GeoNOVA, 2024)
- Nova Scotia Significant Species and Habitats Database (GeoNOVA, 2024)
- AC CDC Data Report (AC CDC, 2023)
- Global Forest Watch Tree Cover Loss 2001-2022 (Global Forest Watch, 2023)
- Nova Scotia Forest Inventory (GeoNOVA, 2024)
- Nova Scotia LiDAR Point Cloud (GeoNOVA, 2024)
- Nova Scotia Hydrographic Network (GeoNOVA, 2024)
- Nova Scotia Wetlands Inventory (NSDNRR, 2021)

A habitat assessment of bats and important habitat features (e.g., critical habitat) known to occur within a 100 km radius of the LAA was completed using available habitat information and mapping data.

A SAR biologist with NSDNRR, the Environmental Protection Operations Directorate – Atlantic, ECCC, and the Environmental Stewardship Branch of ECCC were consulted regarding proposed bat survey methodology. Comments received from reviewers (M. McGarrigle, pers. comm., April 20, 2023; M. Hingston, pers. comm., May 17, 2023; S. Wade, pers. comm., June 7, 2023), were incorporated into the survey methodology. Details of these surveys are presented below in subsection 11.1.4.

Detailed habitat suitability modelling was developed to identify possible suitable bat maternity roost habitat for Little Brown Myotis (*Myotis lucifugus*) and Northern Myotis (*Myotis septentrionalis*) that may occur within the LAA. These maps were used to inform field survey design and evaluate Project impacts. Details of the habitat suitability modelling for these SAR bats are presented below.

11.1.2.1 SAR Bat Habitat Modelling

Habitat suitability modelling was conducted to assess the quality and quantity of possible suitable maternity roosting habitat for Northern Myotis and Little Brown Myotis. Since the summer range of Tri-colored Bat (*Perimyotis subflavus*) is thought to be restricted to southwest Nova Scotia and does not overlap with the PDA (Quinn and Broders, 2007), habitat modelling to identify possible suitable maternity roost habitat was not completed.

Spatial parameters representing biophysical attributes of maternity roost habitat were assigned based on peer-reviewed literature and expert knowledge. The spatial layers used to represent and measure suitable roosting habitat were retrieved from the following datasets:

- Nova Scotia Forest Inventory (GeoNOVA, 2024)
- Global Forest Watch Tree Cover Loss 2001-2022 (Global Forest Watch, 2023)
- Nova Scotia LiDAR Point Cloud (GeoNOVA, 2024)
- Nova Scotia Hydrographic Network (GeoNOVA, 2024)
- Nova Scotia Wetlands Inventory (NSDNRR, 2021)

Where available, field-verified spatial wetland data obtained through the wetland survey program (Chapter 9: Wetlands) was included in the analysis. Wetland data from the Nova Scotia Wetlands Inventory (NSDNRR, 2021) was used to supplement the areas within the LAA that were not field verified during the surveys in 2023.

Northern Myotis

Maternity roosts of the Northern Myotis are closely linked to the presence of forest cover, streams, and specific tree attributes (ECCC, 2018). In Atlantic Canada, Northern Myotis will typically select maternity roosts within stands of mature, deciduous trees with a high and relatively open canopy near water and trails (Forbes, 2012; Garroway and Broders, 2015; Henderson and Broders, 2008). Areas that include high levels of disturbance, such as timber harvesting areas, do not provide suitable habitat for Northern Myotis (Broders and Forbes, 2010).

In Nova Scotia, Northern Myotis shows a preference for Sugar Maple, Yellow Birch, American Beech, Red Maple, and Eastern Hemlock (Patriquin and Leonard, 2011; Broders et al., 2006; Broders and Forbes, 2004); particularly trees with a diameter at breast height ranging from 25 to 44 cm and stands with a higher density of trees in mid-stages of decay (Patriquin and Leonard, 2011; COSEWIC, 2013; Fabianek et al., 2015). The biophysical attributes used to model possible suitable Northern Myotis maternity roosting habitat are:

- Diameter at Breast Height – Any stand classified as having an average total diameter of 20 cm or greater
- Cover Type – Any stand classified as deciduous in the Nova Scotia Forest Inventory
- Forest Type – Any stand classified as having not been treated silviculturally and does not qualify as clearcut, partial cut, burn, old field, wind throw, alders, brush, or dead, and any stand classified as containing dead trees greater than 5 m
- Canopy Height – Any stand with a canopy height of 15 m or greater (Henderson and Broders, 2008)
- Canopy Cover – Any stand with 10 to 100 percent canopy cover (Henderson and Broders, 2008)
- Forest Cover Change – Any site where tree cover loss was not present in the past 21 years

Little Brown Myotis

Little Brown Myotis often use buildings as maternity habitat; however, natural roost sites are also known to provide maternity habitat (COSEWIC, 2013; Balzer et al., 2022). Few human-made structures that may support roosting bats occur within the LAA, and these structures include small bridges installed for forestry. As a forest-dwelling species, natural roosting sites for Little Brown Myotis are typically tall, large-diameter trees in older stands with open canopies (Kalcounis-Ruppel et al., 2005; Barclay and Brigham, 1996). Little Brown Myotis has been recorded in both coniferous and deciduous forest stands; however, evidence suggests a preference for deciduous and mixedwood forests (Broders et al., 2006; Kalcounis et al., 1999). Generally, stand age is more important than forest type for Little Brown Myotis, likely due to increased snag availability for roosting (COSEWIC, 2013).

The biophysical attributes used to model possible suitable maternity roosting habitat for Little Brown Myotis are:

- Diameter at Breast Height – Any stand classified as having an average total diameter of 20 cm or greater
- Canopy Height – Any stand with a canopy height of 15 m or greater
- Cover Type – Any stand classified as deciduous or mixedwood in the Nova Scotia Forest Inventory
- Forest Type – Any stand classified as having not been treated silviculturally and does not qualify as clearcut, partial cut, burn, old field, wind throw, alders, brush, or dead, and any stand classified as containing dead trees greater than 5 m
- Distance to Wetland – Area within 500 m of an open wetland

11.1.3 Field Surveys

The objective of the field surveys was to gather baseline information on bats that use and move through the LAA. Following the *Guidance for Bird and Bat Surveys Pre- and Post-Construction Surveys and Monitoring – Wind Energy* (NSDNRR, 2022), other accepted survey protocols and guidance documents, and consultation with regulators, baseline survey protocols were developed. Passive and active methods for acoustic monitoring were used.

The *Guidance for Bird and Bat Surveys Pre- and Post-Construction Surveys and Monitoring – Wind Energy* (NSDNRR, 2022) states a minimum of two to three survey stations are required for wind energy projects with less than 10 turbines, with an additional survey station for every five turbines beyond this amount. To align with this guidance and provide survey coverage across the LAA, CBCL deployed 14 detectors (Figure 11.1) between late April and early November. Active survey methods involved the use of a handheld bat detector at different survey locations and in transit when travelling between survey locations during nightjar surveys. The acoustic monitoring surveys were designed to target areas of potential impact (e.g., PDA) and associated airspace around the proposed turbine locations.

Autonomous recording units (ARUs) (Wildlife Acoustics Song Meter Mini Bat) were used to passively sample echolocation calls of bats within the LAA continuously between April 28 and November 1, 2023. This survey period overlaps the key active periods: breeding, migratory periods, and movement by resident species.

Survey locations were selected to target areas where bats are likely to congregate (e.g., wetlands for foraging) and along natural corridors (e.g., valleys, streams, and ridges) where migratory bat movements are likely to occur (Lausen et al., 2010) to maximize recordings of bats foraging or commuting in the area. A desktop assessment to identify suitable locations was conducted prior to the execution of the field program and final locations were selected in the field based on suitable conditions (Table 11.1). Based on an initial desktop level assessment using various forms of aerial imagery (e.g., GIS, Google Earth, Pictometry), Project details (e.g., Project layout and the proposed 49 turbines), and provincial guidance documents, 14 detectors were deployed to provide representative coverage of the LAA (Figure 11.1).

Table 11.1 Deployment Locations, Habitats, Deployment and Retrieval Dates for each Autonomous Recording Unit (ARU)

ARU ID	Deployed	Retrieved	Habitat
WR01	27-Apr-23	16-Nov-23	Early successional and regenerating mixedwood forest and shrub swamp
WR02	27-Apr-23	16-Nov-23	Open bog with ericaceous shrubs and coniferous swamp
WR03	27-Apr-23	16-Nov-23	Early successional softwood forest

ARU ID	Deployed	Retrieved	Habitat
WR04	27-Apr-23	20-Nov-23	Mid-successional hardwood dominated by Yellow Birch near stream crossing
WR05	27-Apr-22	16-Nov-23	Regenerating clearcut
WR06	28-Apr-23	16-Nov-23	Poor sedge fen and spruce bog complex with mixedwood forest along road
WR07	28-Apr-23	16-Nov-23	Tall shrub fen and early successional softwood forest
WR08	28-Apr-23	16-Nov-23	Mid-successional softwood forest with scattered birch
WR09	28-Apr-23	20-Nov-23	Regenerating clearcut and mid successional softwood forest
WR10	28-Apr-23	20-Nov-23	Tall graminoid beaver meadow along stream
WR11	28-Apr-23	20-Nov-23	Early successional mixedwood forest
WR12	28-Apr-23	20-Nov-23	Regenerating clearcut
WR13	28-Apr-23	20-Nov-23	Early successional softwood forest
WR14	28-Apr-23	20-Nov-23	Early successional mixedwood forest and swamp matrix

Each ARU was programmed to record full spectrum data 30 minutes before sunset to 30 minutes after sunrise. Detector settings (e.g., trigger frequency, recording length, etc.) were selected following the North American Bat Monitoring Program (NABat) and Acoustic Guide for Bat Monitoring in Atlantic Canada (McBurney and Segers, 2020). Bat detectors were deployed at ground level (approximately 2 to 3 m from the ground) and were mounted directly to tree trunks. Detectors were deployed on April 27 and April 28, 2023, and the units were programmed to record until they were retrieved in November 2023.

Data was downloaded from the units every two to three weeks, at which time batteries were replaced. At these times, units were checked to ensure they were functioning properly and had not been interfered with by animals or humans.

Active sampling using an Echo Meter Touch II Pro (Wildlife Acoustics) occurred during two rounds of nightjar surveys in June and July 2023. Twenty-one locations were surveyed twice over the span of seven nights (Figure 12.7 – Nightjar Survey). When driving between survey locations, methodology similar to Mobile Acoustic Transect Surveys (NABat; Loeb et al., 2015) were followed. Surveys occurred between 30 minutes before sunset and midnight in suitable weather conditions (e.g., clear weather, low wind speed, no precipitation). Analytical software (Kaleidoscope Pro Version 5.6.2) was used to interpret and analyze bat calls recorded during passive and active surveys. All recordings were processed using Kaleidoscope Pro's auto-analysis software tool. This process screens out non-bat files (noise) and the remaining files are considered possible bat calls. Bat calls were manually verified using Kaleidoscope. Portions of the non-bat calls were manually vetted to assess whether any bat calls were mislabelled as noise.

When possible, recorded bat passes were identified to species. Where bat calls could not be identified to species with confidence, these calls were classified into groupings of bats with similar or overlapping call characteristics (Table 11.2). *Myotis* calls (Little Brown Myotis and Northern Myotis) were generally classified into one common group, *Myotis*.

Table 11.2 Species and Groupings used during Analysis of Data Recorded in the Project Area

Species	Code
Little Brown Myotis (*Myotis lucifugus*)	MYLU
Northern Myotis (*Myotis septentrionalis*)	MYSE
Tri-colored Bat (*Perimyotis subflavus*)	PESU
Eastern Red Bat (*Lasiurus borealis*)	LABO
Hoary Bat (*Lasiurus cinereus*)	LACI
Silver-haired Bat (*Lasionycteris noctivagans*)	LANO
Big Brown Bat (*Eptesicus fuscus*)	EPFU
Groupings	**Code**
Little Brown Myotis/Northern Myotis	*Myotis*
Eastern Red Bat/ Tri-colored Bat/Little Brown Myotis/Northern Myotis	HighF
Big Brown Bat/Silver-haired Bat	EPFULANO
Hoary Bat/Big Brown Bat/Silver-haired Bat	LowF

After identification, bat passes were analysed to determine seasonal and temporal activity patterns within the LAA. Subsequent analysis was carried out to assess activity of migratory species—those at a higher risk of mortality.

11.2 Existing Environment

Seven species of bats have been recorded in Nova Scotia (Broders et al., 2003) and are protected under Nova Scotia's *Wildlife Act*. Of these, three species are listed as Endangered at both the provincial (NSESA) and federal (Schedule 1 of SARA) levels (Table 11.3).

Table 11.3 Bat Species of Nova Scotia and Conservation Status

Scientific Name	Common Name	NSESA	SARA	COSEWIC	AC CDC
Myotis lucifugus	Little Brown Myotis	Endangered	Endangered	Endangered	S1
Myotis septentrionalis	Northern Myotis	Endangered	Endangered	Endangered	S1
Perimyotis subflavus	Tri-colored Bat	Endangered	Endangered	Endangered	S1

Scientific Name	Common Name	NSESA	SARA	COSEWIC	AC CDC
Lasiurus cinereus	Hoary Bat	--	--	Endangered	SUB, S1M
Lasiurus borealis	Eastern Red Bat	--	--	Endangered	SUB, S1M
Lasionycteris noctivagans	Silver-haired Bat	--	--	Endangered	SUB, S1M
Eptesicus fuscus	Big Brown Bat	--	--	--	SNA

In Nova Scotia, three non-migratory bat species—Little Brown Myotis, Northern Myotis, and Tri-colored Bat—over-winter in caves and abandoned mines (Moseley, 2007). However, the Tri-colored Bat is primarily found in southern Nova Scotia and the Fundy coast of New Brunswick (Broders et al., 2003).

White-nose Syndrome (WNS) poses the most significant threat to the survival of three bat species. WNS is caused by the fungus *Pseudogymnoascus destructans*, which thrives in cold, humid underground environments typical of bat hibernacula and results in bats waking frequently during hibernation, depleting their energy reserves prematurely and often leading to death (ECCC, 2018; NSDLF, 2020). This disease has led to severe population declines, with mortality rates exceeding 90 percent in many hibernacula in eastern Canada, including Nova Scotia (COSEWIC, 2013; ECCC, 2018; US Fish and Wildlife, 2019).

The other four bat species known to occur in Nova Scotia are long-distance migratory species, three of which were assessed by COSEWIC in May 2023 as Endangered: Hoary Bat, Eastern Red Bat, and Silver-haired Bat. The fourth migratory species is Big Brown Bat. While the range and population of Big Brown Bat is largely unknown, there have been a few occurrence records for Nova Scotia (Broders et al., 2003).

The NSDNRR Significant Species and Habitat Database contains 38 records of species and/or habitat records which relate to bats within a 100 km radius of the PDA (GeoNOVA, 2024). These records include Species at Risk (33 records) and Species of Concern (5 records). None of the records overlap, or are within, 5 km of the PDA. The details of these records include the following:

- Species at Risk – Records relate to Little Brown Bat (30), Tri-colored Bat (1), Northern Myotis (1), and Bat (unclassified) (1)
- Species of Conservation Concern – Records relate to significant areas (mines)

The AC CDC (2023) Data Report indicates that no bat species occurrences or hibernacula have been reported within the LAA or within 5 km. All three SAR bat species are known from within a 100 km radius of the LAA, with the nearest observations being Little Brown Myotis 17.6 km away from the LAA (AC CDC, 2023). No occurrences of the migratory bat species are reported within 100 km of the LAA.

11.2.1 Bat Detections

Migratory bats and *Myotis* species were recorded within the LAA. There are low levels of bat activity within the LAA, with total of 105 bat passes recorded between April 27 and November 1, 2023. The majority of bat passes are attributed to *Myotis* species (83 passes; 79 percent), with migratory bats contributing to the remaining 21 percent (11 passes classified as EPFULANO (Big Brown Bat/Silver-haired Bat), 7 as LowF, and 4 as Hoary Bat) (Table 11.4). While surveying commenced in late April and ran until early November, bats were recorded only during the fall migration period (i.e., between August 23 and October 26, 2023). These results suggest that bats are not using the LAA during the breeding period.

Table 11.4 Summary of Acoustic Bat Passes Recorded Between April 27 and November 1, 2023

ARU Location	*Myotis*	EPFULANO*	LowF*	Hoary Bat *	Total	No. of nights bats were detected
WR01	-	-	-	-	0	0
WR02	-	-	-	-	0	0
WR03	-	-	-	-	0	0
WR04	-	-	-	-	0	0
WR05	12	2	-	-	14	11
WR06	1	3	-	1	5	4
WR07	4	2	-	-	6	5
WR08	1	-	-	2	3	3
WR09	3	1	-	-	4	4
WR10	42	-	4	-	46	17
WR11	14	1	3	-	18	11
WR12	1	-	-	-	1	1
WR13	1	-	-	1	2	2
WR14	3	2	-	-	5	5
WR 15	1	-	-	-	1	1
Total (% of total bat calls)	83 (79%)	11 (10.5%)	7 (6.6%)	4 (3.8%)	105	64

*Migratory bat species

EPFULANO = Big Brown Bat/Silver-haired Bat

LowF = Hoary Bat/Big Brown Bat/Silver-haired Bat

Approximately half of the *Myotis* passes were recorded from a single ARU that was deployed in the northeast portion of the LAA (approximately 40 m outside the PDA) within a large wetland. Based on the number of calls and the surrounding habitat, it is suspected that this area is used as a foraging site during the fall migration period. All migratory bat files were recorded during fall migration (i.e., August 27 to October 10, 2023) suggesting that some migratory bats may traverse through the LAA during fall migration. However, the relatively low number of passes suggests that the LAA does not appear to be serving as a migration corridor for bats.

The average total passes per detector night for the LAA throughout the survey period, encompassing all species, was 0.04. Additionally, the average migratory passes per detector night within the Project area were observed to be 0.006 overall, and 0.03 for *Myotis* species.

Similarly low bat activity levels were recorded at the proposed Higgins Mountain Wind Farm and Kmtnuk Wind Power projects, which are located west and east of the LAA, respectively (Strum Consulting, 2023a, 2023b). Forestry practices on site may contribute to these low activity levels, as many bat species avoid large clearcuts and open areas (e.g., Henderson and Broders, 2008).

No bats were recorded or observed during the seven nights of active surveys.

11.2.2 Bat Habitat

Regions with limestone karst topography can yield features such as caves and sinkholes, which can be used by bats for roosting and hibernation. The LAA primarily occurs in areas of low relative risk of encountering karst with smaller areas of medium karst risk occurring along the southern and eastern portions of the PDA (Figure 11.2) (Drange and McKinnon, 2019). Several abandoned mine openings occur within and adjacent to the LAA but no known hibernaculum occur within the LAA. The two closest known hibernacula include the Lear Shaft (7.5 km west of PDA) and Hayes Cave (29 km south of PDA) (Moseley, 2007).

The closest critical habitat for SAR bat species (10 x 10 km standardized Universal Transverse Mercator (UTM) grid squares where the description of critical habitat is met (i.e., hibernacula have been identified)) (Environment Canada, 2015) is the Lear Shaft, which is located approximately 7.5 km west of the PDA. This hibernaculum is located within the abandoned mines in the Londonderry area. There are records of Little Brown Myotis and Northern Myotis and this hibernaculum was classified as a significant site as it was suspected to support between 50 and 1,000 bats over winter (Moseley, 2007). A recent study was conducted at the Lear Shaft as part of an EA for an adjacent wind project, Higgins Mountain Wind Farm. During fall monitoring between September 4 and November 24, 2020, and spring surveys between May 18 and June 30, 2021, one *Myotis* call was recorded on June 16, 2021 (Strum Consulting, 2023). Nevertheless, WNS-affected hibernacula are still considered critical habitat.

Hayes Cave is located approximately 29 km south of the PDA. Hayes Cave is the largest known hibernaculum in Nova Scotia with a count of over 9,000 bats (Taylor, 1997, as cited in Moseley, 2007). All seven bat species were recorded at this site with the majority being Nova Scotia's three Endangered bat species (Moseley, 2007). However, preliminary results from 2012 studies suggest that WNS has reduced this hibernating population to approximately 250 individuals (M. Elderkin, pers. comm., June 13, 2012, as cited in Strum, 2022).

Fifty-four abandoned mine openings occur within 5 km of the PDA. Of the 54 mine openings, 23 occur within the LAA. The Abandoned Mine Openings database (GeoNOVA, 2024) indicates that two of these abandoned mines have existing depths of 10 m and 20 m. These two mine openings were visited in June and both were deemed not suitable for bat hibernacula. Refuse was observed covering a large portion of the opening and surrounding areas. Additionally, there did not appear to be any tunnels or suitable hibernating conditions as the opening was large and partially filled with rock and soil. However, due to health and safety concerns, an inspection of the interior of the mine openings was not attempted.

Many bat species prefer roosting in older forest stands over younger ones. Older forests offer increased snag availability for roosting and provide foraging habitat with a relatively closed canopy (Barclay and Brigham, 1996; Crampton and Barclay, 1996; Krusic et al., 1996; Jung et al., 1999; as cited in ECCC, 2018). One of the forest stands classified as old growth minimally overlaps with the LAA for bats by 20 m (Figure 8.2).

Based on habitat modelling, the LAA provides limited habitat (19.46 ha; 0.14 percent) that may serve as possible maternity roost habitat for Little Brown Myotis or Northern Myotis (Figure 11.3). The PDA contains only a very small amount of possible suitable maternity roosting habitat (0.12 ha; 0.008 percent), owing to the lack of mature forest stands.

Foraging Little Brown Myotis are commonly found in open habitats, including ponds, roads, and open forests, whereas Northern Myotis foraging sites include small ponds, forest canopies, and along paths and roadways (ECCC, 2018). Migratory species such as the Hoary Bat and Silver-haired Bat generally forage high above clearings, treetops, or over water. Therefore, a large portion of the LAA can serve as possible foraging habitats for resident and migratory bat species.

11.3 Effects Assessment

11.3.1 Boundaries

For the purposes of this assessment, the LAA for bats includes the PDA, a 500 m buffer, and associated airspace. The RAA is a 5 km buffer around the PDA.

11.3.2 Potential Effects and Mitigation

Several measures were implemented to mitigate potential direct and indirect impacts on bats, considering engineering and design constraints. Additionally, the detailed design of the Project and the micrositing of turbines aim to minimize disruption to bat habitats (e.g., foraging and roosting) whenever feasible and reduce potential interactions between the Project and bats.

Potential impacts on bats through multiple interconnected pathways, both direct and indirect, may arise. Construction activities such as earthworks and vegetation clearance have the potential to cause habitat loss and modification. If these activities occur during critical periods, such as migratory or breeding seasons, they could result in mortality, injury, or displacement of bats.

Provincial and federal recovery strategies (NSDLF, 2020; ECCC, 2018) recognize anthropogenic disruptions as being additive effects to the challenges of WNS. Bats could be adversely affected, directly or indirectly, through various Project activities during construction, operation and maintenance, and/or decommissioning. Collision of individuals with turbines and power lines can directly result in injury and fatality, as can barotrauma[4]. Indirectly, the installation of a wind project can result in habitat loss and fragmentation that can adversely affect long-term survival and reproductive success (Lemaitre et al., 2017). Removal of trees containing cavities or peeling bark could displace bats or directly injure roosting bats if removal occurs during their active period. The proximity of known hibernacula to the Project is a concern since there may be migration pathways that traverse the PDA. Project activities can affect bats as indicated in Table 11.5; these potential effects do not consider the detailed design of the Project and micrositing of turbines that is yet to be completed or the implementation of mitigation measures described herein.

Table 11.5 Potential Environmental Effects of the Project on Bats

Project Activity	Potential Environmental Effects		
	Habitat Loss/ Fragmentation	Direct Mortality and Injury	Sensory Disturbance
Construction			
Site Preparation	X	X	X
Access Roads Construction and Modifications	-	X	X
Material and Equipment Delivery and Storage	-	-	X
Infrastructure Installation	-	-	X
Restoration of Temporary Areas	-	-	X
Testing and Commissioning	-	X	X
Operation and Maintenance			
Turbine Operation and Maintenance	-	X	X

[4] Barotrauma is injury resulting from a change in air pressure.

Project Activity	Potential Environmental Effects		
	Habitat Loss/ Fragmentation	Direct Mortality and Injury	Sensory Disturbance
Road Maintenance	-	X	X
Power Line and Substation Maintenance	-	X	X
Vegetation Management	-	X	X
Safety and Security	-	-	X
Decommissioning			
Removal of Infrastructure and Site Restoration	-	X	X

X = Potential Interaction
- = No Interaction

11.3.2.1 Habitat Loss and Fragmentation

The Project activities that result in removal of trees may affect roosting habitat for bats, and changes to riparian habitat or wetlands has the potential to impact foraging and drinking habitat for bats.

Construction activities such as vegetation/forest clearing and grubbing will result in a short-term and long-term loss of habitat. Vegetation clearing will occur within the PDA for access roads, turbines, transmission lines, and other Project infrastructure. Forest clearing will result in the loss of possible tree roost habitat, and to a lesser extent, possible maternity roost trees. Tree removal or land clearing can also affect the suitability of cave or mine roosts. For the purposes of the assessment, a conservative estimate of habitat including possible foraging and roosting that will be removed or altered is approximately 1,468 ha (PDA). However, only 0.12 ha of the 1,468 ha (0.008 percent) was identified as possible suitable maternity roost habitat for Little Brown and Northern Myotis. Foraging habitat within the LAA generally includes riparian areas, forests, and wetlands and impacts to these areas are generally covered in Chapter 7 (Aquatic Environment), Chapter 8 (Flora), and Chapter 9 (Wetlands), respectively. The estimate of habitat loss is greater than the final Project Footprint (see Section 2.1: Potential Development Area and Footprint). Therefore, the amount of clearing required for the Project will be less than what has been estimated for the purpose of this EA.

The iterative Project design process has prioritized avoidance and minimization of interactions with high-quality habitat (see Figure 2.2). During this process, several turbines and roads were removed or relocated from areas deemed high-quality bat habitat and turbines were positioned to target areas previously affected by forestry activities. These adjustments were made to mitigate the loss of areas identified as suitable maternity roost habitat for SAR bats (e.g., old-growth and mature forests), whose habitat is limited on site due to industrial forestry activities (Figure 1.3). Activities causing degradation or loss of wetlands can adversely affect foraging habitat. Therefore, Project layout adjustments were made to mitigate impacts on wetlands and riparian areas, with detailed designs aimed at further minimizing these potential impacts. Hibernacula do not occur within the LAA and given the distance to the closest known hibernaculum (7.5 km from the PDA), no impacts to critical habitat are anticipated.

Although numerous bat species tend to avoid extensive clearcuts and open spaces, forested and vegetated edges have been observed to offer foraging opportunities for certain bats. These edges may additionally serve as protective zones against predators and wind, and they may concentrate prey (Krusic et al., 1996; Grindal and Brigham, 1998; Swystun et al., 2001; Henderson and Broders, 2008; as cited in ECCC, 2018).

The following key measures to mitigate the potential effects of the Project on bat habitat will be further detailed in a Project-specific EPP and will be implemented prior to and during construction:

- Careful site planning will be implemented to minimize habitat disturbance, mitigate habitat loss and fragmentation, and make use of existing roads and areas previously affected, such as clearcuts and harvested areas. The detailed design phase will involve a review of SAR bat maternity roost habitat models and survey findings (e.g., location of large diameter (greater than 25 cm) snags field).
- Existing gravel roads will be used as access roads, to the extent possible.
- Vegetated buffers around wetlands and watercourses will be maintained to support connectivity and foraging habitat where possible.
- Avoidance of suitable maternity roosting habitat.
- Habitat will be restored and revegetated after construction.
- Measures will be implemented to control and prevent the spread of invasive species.
- Work crews will recognize the working limits of the PDA and will refrain from entering surrounding habitat.

11.3.2.2 Direct Injury or Fatality

The Project presents risks of direct bat mortality and injury during construction, primarily due to vegetation clearing and increased traffic. Once operational, most bat deaths at turbines are due to blunt force trauma from collisions, with a smaller component of deaths related to barotrauma due to rapid change in air pressure (Baerwald et al., 2008; Rollins et al., 2012). As per COSEWIC (2013), any additional mortality of SARA-listed bat species in WNS affected regions, including fatalities at wind turbines, could adversely affect local population survival, hinder recovery efforts, and potentially impede the development of resistance to the WNS-causing fungus.

Construction activities, such as tree clearing and grubbing, pose a risk for bats. Although the amount of possible suitable maternity roost habitat is small (0.037 ha; 0.002 percent of the PDA) and there is little evidence of maternity roosting in the PDA, without mitigation measures, there is a potential for destruction of maternity roosts and subsequent mortality of female bats and their pups. Clearing extensive forest areas during the breeding season can also disrupt bats, potentially hindering their reproductive capabilities for the year. To address these risks, vegetation clearing will be scheduled outside of the sensitive periods for bats (e.g., outside the bat maternity season).

Zimmerling and Francis (2016) examined bat mortality across 64 Canadian wind farms. Their findings revealed an average mortality rate of 15.5 ± 3.8 (95 percent confidence interval) bats per turbine per year, with a wide range observed from 0 to 103 bats per turbine per year at individual wind farms. In contrast, data collected specifically from wind farms in Nova Scotia was lowest of any province in the country with a mortality rate of 0.5 bats per turbine per year. Similarly, a study conducted by Birds Canada in 2016, focusing on data from wind farms in Atlantic Canada, estimated an average annual bat mortality rate within 50 m of the turbine base (from May 1st to October 31st) to be 0.26 ± 0.11 bats per turbine. These findings emphasize the variability in bat mortality rates across different regions and highlight the importance of localized studies for accurate assessment.

Bat mortality levels from wind turbines have varied based on species, location, season (Kunz et al., 2007b; Arnett et al., 2008; Baerwald and Barclay, 2011), turbine height (Barclay et al., 2007; Anderson et al., 2022), wind speeds (Arnett et al., 2008; Horn et al., 2008), speed of turbine, and weather (Arnett et al., 2008). A recent study found that fewer Little Brown Myotis fatalities occurred at taller turbines than shorter (turbines ranged from 119 to 186 m (hub height plus blade length) but fatalities of migratory bats increased with increased turbine heights (Anderson et al., 2022). Given *Myotis* species accounted for the majority (79 percent) of bat passes within the LAA, this study suggests the proposed turbine height (hub height plus blade length = 199.5 m) may help to mitigate potential collisions with most bats that occur in the PDA, specifically *Myotis* species.

The reasons why bats do not avoid turbines remain largely unknown. Behaviour such as breeding, swarming, and foraging can involve repeated passes around wind turbines and increase the risk of collision (Cryan and Brown, 2007; Arnett et al., 2008; Rydell et al., 2010a; Roeleke et al., 2016). A few studies have demonstrated that the number of insects present around wind turbines is influenced by the location and arrangement of the turbines (e.g., creation of an opening in the forest, aviation warning lights, roads, turbine colour, and air currents created by movement of the blades) (Horn et al., 2008; Rydell et al., 2010b).

One goal of baseline surveys is to estimate the relative risk of fatality to bats from wind turbines at proposed sites via a representative sampling of bat activity across a proposed project area. To assess this risk, the Wildlife Branch of Alberta Environment and Sustainable Resource Development uses a precautionary principle where the risk is calculated based on the number of migratory bat passes per detector-night. Since an equivalent comparison for Nova Scotia is not available, this model is generally being used for the purposes of assessing potential mortality risks. The number of bat passes per detector-night collected within the LAA throughout the survey period, encompassing all species, was 0.04, of which 0.006 were for migratory bat passes only, and 0.03 for *Myotis* species. All values would be considered a potentially acceptable risk (lowest risk) (Government of Alberta, 2013).

Nevertheless, annual fluctuations in bat activity and the potential alteration of activity patterns in the vicinity of turbines (Barclay et al., 2007; Kunz et al., 2007; Horn et al., 2008; Cryan and Brown, 2007) imply that predicting project risk is challenging because pre-construction data might not accurately predict fatality rates (Hein et al., 2013). Hence, post-construction monitoring of fatalities is essential to monitor and assess bat mortalities.

The second year of the two-year baseline study and a minimum two-year post-construction monitoring program will further inform and identify potential Project impacts, assess effectiveness of mitigations, and inform adaptive management programs to reduce the risk to bats within the LAA. This is particularly important because any additional mortality of SAR bats in affected WNS areas has the potential to impact the survival of local populations, their recovery, and possibly the development of resistance to the fungus causing WNS (ECCC, 2018).

A post-construction monitoring program will be developed in consultation with ECCC-CWS and NSDNRR and implemented for a minimum of two years. Carcass searches will be conducted during the spring (minimum of 6 to 8 weeks) and fall (minimum of 8 to10 weeks), regardless of the weather. The *Guidance for Bird and Bat Surveys Pre- and Post-Construction Surveys and Monitoring – Wind Energy* (NSDNRR, 2022), *Wind Energy & Birds Environmental Assessment Guidance Update* (ECCC-CWS, 2022), and other accepted guidelines will be referenced when developing the monitoring program.

Ongoing monitoring and adaptive management strategies will be implemented to assess and mitigate potential impacts on bats during the construction, operation and maintenance, and decommissioning phases of the Project.

The following key measures to mitigate the potential risks of bat collision will be further detailed in a Project-specific EPP and will be implemented prior to and during Project activities:

- Vegetation clearing, specifically tree clearing, will be completed outside of the bat maternity season when females and their pups are present (typically June 1 to September 1) to reduce bat fatality risk due to removal of roost trees. Tree clearing will be done, to the extent feasible, outside the active period for bats to avoid accidental injury or mortality of any bat, not only maternity roosting bats.
- During construction and operation, install appropriate drainage around turbines to prevent formations of wetted areas or pooled water that might increase insect populations and attract bats.
- Vehicle speed will be reduced, especially in key areas during sensitive seasonal windows for wildlife.
- The Proponent will develop and implement wildlife management procedures.
- Site lighting will be reduced to the extent practicable, reducing insect attraction and subsequent attraction to infrastructure by bats.
- Environmental personnel responsible for site monitoring during construction will receive training to recognize concerns related to bats that may be present in PDA.

- Guidance specific to minimizing impacts to bats will be captured within a Wildlife Management Plan. The plan will include guidelines to avoid harm to bats, actions/steps to take should a roosting bat be discovered, and appropriate buffers based on disturbance activities.
- A comprehensive post-construction monitoring program will be developed and implemented in consultation with NSDNRR and ECCC-CWS to assess the ongoing impact of wind turbines on wildlife, particularly bats, and inform adaptive management strategies.
- Adaptive management strategies will be employed throughout the lifespan of the Project, if required based on the findings of the post-construction mortality monitoring program.

11.3.2.3 Sensory Disturbance

Sensory disturbances from noise and lighting at wind projects are considered to pose lower risks than collisions. However, as outlined in the Recovery Strategy (ECCC, 2015), activities that cause excessive disturbance (e.g., light, noise, vibrations) could result in the arousal of bats from torpor. Noise can have an indirect effect on bats through disturbance and light pollution at night has the potential to attract bats to lit project infrastructure due to the potential of increased prey availability and potentially increasing the mortality risk (e.g., collision and barotrauma).

Noise will be generated throughout all phases of the Project. Heavy equipment during construction, operation and maintenance, and decommissioning will contribute to noise generation. Additionally, turbines will produce noise during operation. Because the closest known hibernaculum is 7.5 km from the PDA, disturbance to hibernating bats during construction and operations are not anticipated. Construction and decommissioning activities will primarily occur during daylight hours, limiting sensory disturbance to roosting bats.

Wind turbines during operation generate noise that may impact the ability of bats to carry out a wide range of behaviours such as communication, foraging, and predator avoidance (Oerlemans et al., 2007). Consequently, bats may avoid wind turbines—particularly forest-dwelling species like *Myotis*—and the operation of wind turbines erected at forested sites could represent indirect habitat loss (Ellerbrok et al., 2022). However, other sensory disturbances may be attracting bats to wind turbines (Cryan et al., 2014; Horn et al., 2010). Evidence suggests that wind turbines disrupt various sensory cues such as vision, vibration, pressure, temperature, and olfactory cues, at both the scale of individual turbines and wind farms as a whole (Jonasson et al., 2024). Bats may be attracted to wind turbines because these structures have characteristics similar to favourable roost trees (Cryan et al., 2014; Guest et al., 2022). Transmission corridors and roads resemble natural linear features typically used by bats during commuting and migration (Jameson & Willis, 2014; Jonasson et al., 2024). Together, these cues can interrupt bat navigation and movement, especially in forested habitats.

The following key measures to mitigate the potential effects that Project lighting and noise may have on bats will be further detailed in a Project-specific EPP and will be implemented prior to and during Project activities:

- Specialized lighting systems (e.g., ADLS) is being considered to minimize impacts to wildlife.
- Onsite lighting will be minimized to the extent possible to prevent insect congregation that may attract bats to turbines while maintaining Transport Canada requirements.
- Turbine lighting will not exceed the minimum standards in the Canadian Aviation Regulations (i.e., Standard 621, Section 12.2 and Figure 5-3).
- Movement detection lighting will be used on office structures, doors to turbines, gates, etc., which will turn off when not in use.
- Construction will occur during daytime hours and will be restricted at night, when possible, to avoid illuminating the habitat unnaturally.
- Noise-reducing technologies may be considered to minimize the impact of construction noise on bats.
- Intense sound operations (i.e., blasting) will be scheduled to avoid maternity roost windows, when possible.
- Blasting will be undertaken in accordance with regulatory requirements and will only be conducted by qualified blasting professionals.
- Pre-blast wildlife searches will be completed.
- Blasting will be monitored and will be planned to occur on days where weather conditions are less likely to cause excessive noise levels.
- The Proponent will develop and implement a Wildlife Management Plan.

11.3.3 Residual Effects

Activities associated with the Project may induce short to long-term impacts on bats within the PDA and LAA, primarily due to vegetation clearing and cutting, collisions with wind turbines, and sensory disturbance.

The residual effects stemming from habitat loss during construction are forecasted to be long-term and of minor magnitude. Suitable bat habitat within the LAA is generally low and possible suitable bat maternity roost habitat within the PDA is low (0.037 ha; 0.002 percent). The extent of the effect will be local and is scheduled to occur once during a period of low sensitivity.

The residual effects related to bat mortality during the operation and maintenance phase are expected to be minor in magnitude (lowest level of mortality risk (per Government of Alberta, 2013)), restricted to the PDA, and occur during times of moderate to high sensitivity. Based on the low numbers of bats observed within the LAA, the period of observations, and the low numbers of bat fatalities that have been reported in Atlantic Canada from wind turbines, bat fatalities are anticipated to be intermittent.

Careful detailed design, micrositing of Project infrastructure to avoid high quality habitat, and avoidance of creating areas around turbines that bats may be attracted to will further mitigate potential risks. Through these steps and the implementation of post-construction monitoring and adaptive management planning, potential significant effects can be mitigated, and are therefore not anticipated. The residual effects of Project activities on the bats (i.e., change in habitat and change in mortality rate) are predicted to be not significant.

11.4 Monitoring

Onsite monitoring for all wildlife species will be conducted during site preparation and construction activities.

As outlined in Section 11.3.4, a post-construction mortality monitoring program will be developed in consultation with ECCC-CWS and NSDNRR and implemented for a minimum of two years post-construction. Carcass searches will be conducted during the spring (minimum of 6 to 8 weeks) and fall (minimum of 8 to 10 weeks), regardless of the weather. The *Guidance for Bird and Bat Surveys Pre- and Post-Construction Surveys and Monitoring – Wind Energy* (NSDNRR, 2022), *Wind Energy & Birds Environmental Assessment Guidance Update* (ECCC-CWS, 2022), and other accepted guidelines will be referenced when developing the monitoring program.

The results of the post-construction mortality monitoring program will be submitted to the appropriate regulatory agencies as required. Additional surveys or mitigations may be identified in consultation with regulators following review of the results. An Adaptive Management Plan will be prepared in consultation with NSDNRR and ECCC-CWS detailing acceptable bat mortality thresholds and appropriate operational responses should mortality records exceed those thresholds.

Data from post-construction mortality surveys may also be shared with the AC CDC and *The Wind Energy Bird and Bat Monitoring Database* (NatureCounts - Wind Energy Bird & Bat Monitoring Database) (Birds Canada, 2022).

12 Birds

12.1 Overview

The assessment of the Project on birds includes migratory and resident birds and their habitats. Wind energy projects have the potential to adversely affect birds. A primary concern associated with wind power is the direct impact on birds, such as collisions with wind turbines and the associated infrastructure that can lead to fatalities. Indirect impacts such as habitat loss and fragmentation and sensory disturbance also present risks to birds. Iterative Project layout adjustments—including the removal of turbines from old-growth and mature forests, interior forest habitat, and wetlands—have reduced potential impacts on birds and their habitat. The ongoing detailed design process seeks to further minimize the Project's potential impact on bird habitats through careful infrastructure placement.

Interactions of the Project with birds are closely tied to Project interactions with other VECs that are assessed in more detail in the respective chapters, including noise and light disturbance (Chapter 5: Atmospheric Environment), vegetation loss or modification (Chapter 8: Flora), and loss or alteration of wetlands (Chapter 9: Wetlands).

For this assessment, studies were completed across four seasons to examine the presence of birds and their habitats within the LAA. Understanding the presence of birds and bird habitat from pre-construction surveys was used to inform siting of infrastructure, the effects assessment, and the development of mitigation measures to minimize effects to birds and their habitat during the construction, operation and maintenance, and decommissioning phases of the Project. Survey results also provide baseline information to support post-construction mortality monitoring and adaptive management plans (NSDNRR, 2022; Environment Canada, 2007a). Mitigation measures have been outlined in this chapter and will be further developed in a Project-specific EPP prior to construction to minimize adverse effects to birds.

12.1.1 Regulatory Context

Assessment of birds considers the following relevant provincial and federal legislation and guidelines:

- *Migratory Birds Convention Act, 1994*
- SARA
- *Canadian Environmental Protection Act*

- NSESA
- Nova Scotia *Wildlife Act*
- Nova Scotia *Biodiversity Act*
- Nova Scotia *Environment Act*
- Nova Scotia *Wilderness Areas Protection Act*

12.1.2 Assessment Methodology

The assessment of birds focused on identifying migratory and resident bird species present or likely to be present within or near the LAA, with emphasis on identifying any SAR or SoCC and their habitat. Data was collected through literature review, online databases and reports, habitat analysis, and field surveys conducted across all seasons.

The information gathered during the literature review and habitat analysis was used to inform the design of baseline field surveys that are reflective of the Project's site sensitivity and risk (Category 4 per *Wind Energy & Birds Environmental Assessment Guidance Update* (ECCC, 2022), *Wind Turbines and Birds: A Guidance Document for Environmental Assessment* (ECCC, 2007a) and *The Guide to Preparing an EA Registration Document for Wind Power Projects in Nova Scotia* (NSDNRR, 2022) and protocols outlined in *Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds* (ECCC, 2007b), *Wind Energy & Birds Environmental Assessment Guidance Update* (ECCC, 2022), and *Guidance for Bird and Bat Surveys Pre- and Post-Construction Surveys and Monitoring – Wind Energy* (NSDNRR, 2022).

Baseline field surveys were designed to determine the presence, diversity, and abundance of bird species and their habitats within the LAA and evaluate the impact of the Project. This information was then used to inform and refine siting of Project infrastructure and develop measures to minimize adverse effects of Project activities on birds. The data collected through the assessment process will also serve as a baseline for post-construction mortality monitoring and adaptive management.

The description of the existing environment is based primarily on data collected through the following resources plus field surveys carried out for this Project:

- Critical Habitat for Species at Risk National Dataset – Canada (ECCC, 2022)
- NSDNRR (2018) Significant Species and Habitat Database
- Important Bird Areas (IBAs) (Bird Canada & Nature Canada, 2023)
- Migratory Bird Areas and National Wildlife Areas (NWAs)
- Species at Risk Public Registry documents for federal SAR
- AC CDC (2023) Data Report
- Second Atlas of Breeding Birds of the Maritime Provinces (Maritimes Breeding Bird Atlas (MBBA)) (Stewart et al., 2015)
- eBird (2024)
- Global Forest Watch Tree Cover Loss 2001-2022 (Global Forest Watch, 2024)
- NSDNRR Nova Scotia Old Growth Policy and Old Growth Potential Index

- Nova Scotia Forest Inventory (GeoNOVA, 2024)
- Nova Scotia Hydrographic Network (GeoNOVA, 2024)
- Nova Scotia Wet Areas Mapping and Flow Accumulation Channel (GeoNOVA, 2024)
- Nova Scotia Wetlands Inventory (NSDNRR, 2021)
- Nova Scotia LiDAR Point Cloud (GeoNOVA, 2024)

A habitat assessment of SAR and SoCC birds known to occur within a 100 km radius of the LAA was completed using available habitat information and mapping data (including federal critical habitat and provincial core habitat data layers).

A SAR biologist with NSDNRR, the Environmental Protection Operations Directorate – Atlantic, ECCC, and the Environmental Stewardship Branch of ECCC were consulted regarding proposed bird survey methodology. Comments received from reviewers (M. McGarrigle, pers. comm., April 20, 2023; M. Hingston, pers. comm., May 17, 2023; S. Wade, pers. comm., June 7, 2023), were incorporated into the survey methodology. Details of these surveys are presented below in subsection 12.1.2.2.

Landcover within the LAA was analyzed through the Nova Scotia Forest Inventory layer (Figure 8.1). The Nova Scotia Forest Inventory layer categorizes the majority of the landcover of the LAA as forested stands with hardwood, softwood, and mixedwood stands comprising approximately 15 percent, 47 percent, and 22 percent, respectively. Other land cover types include clearcut (8 percent) and wetland (2 percent), while the remaining cover types collectively make up 5 percent of the total land cover. However, this outdated layer does not reflect current site conditions as approximately 35 percent of the LAA has been harvested between 2001 and 2022 (Global Forest Watch, 2024).

Detailed habitat suitability mapping was developed to identify suitable breeding habitat for eight SAR birds within the LAA (Table 12.1). These maps were used to inform field survey design and evaluate Project impacts. Details of the habitat suitability mapping for SAR birds are presented in the subsections that follow.

Table 12.1 SAR Birds for which Habitat Suitability was Modelled within the Windy Ridge LAA.

Scientific Name	Common Name	Status			
		NSESA	SARA	COSEWIC	AC CDC
Cardellina canadensis	Canada Warbler	E	T	SC	S3B
Chaetura pelagica	Chimney Swift	E	T	T	S2S3B,S1M
Chordeiles minor	Common Nighthawk	T	SC	SC	S3B
*Coccothraustes vespertinus**	Evening Grosbeak	V	SC	SC	S3B,S3N,S3M
Contopus cooperi	Olive-sided Flycatcher	T	SC	SC	S3B
Contopus virens	Eastern Wood-pewee	V	SC	SC	S3S4B

Scientific Name	Common Name	Status			
		NSESA	SARA	COSEWIC	AC CDC
Euphagus carolinus	Rusty Blackbird	E	SC	SC	S2B
Hylocichla mustelina	Wood Thrush	-	T	T	SUB

E – Endangered, T – Threatened, V – Vulnerable, SC – Special Concern, NAR – Not at Risk

12.1.2.1 SAR Bird Habitat Modelling

GIS-based habitat suitability models were developed to assess the quantity of potential suitable breeding habitat for at-risk birds identified within the LAA. Spatial parameters representing biophysical attributes of breeding habitat were chosen based on peer-reviewed literature and expert knowledge. The spatial layers used to build the suitable breeding habitat models were retrieved from the following datasets:

- Nova Scotia Forest Inventory (GeoNOVA, 2024)
- Nova Scotia Hydrographic Network (GeoNOVA, 2024)
- Nova Scotia Wet Areas Mapping and Flow Accumulation Channel (GeoNOVA, 2024)
- Nova Scotia Wetlands Inventory (NSDNRR, 2021)
- NSDNRR Nova Scotia Old Growth Policy and Old Growth Potential Index
- Global Forest Watch Tree Cover Loss 2001-2022 (Global Forest Watch, 2024)
- Nova Scotia LiDAR Point Cloud (GeoNOVA, 2024)

Where available, field-verified spatial wetland data obtained through the wetland survey program (Chapter 9: Wetlands) was included in the analysis. Wetland data from the Nova Scotia Wetlands Inventory (NSDNRR, 2021) was used to supplement the areas within the LAA that were not field verified during the surveys in 2023.

Canada Warbler

Canada Warbler generally breeds in wet, deciduous, or mixedwood forests, with a dense understory and high canopy (Haché et al., 2014; NSDLF, 2021; COSEWIC, 2020). In Nova Scotia, Westwood (2016) found that Canada Warbler habitat was correlated with mixedwood forests composed of Black Spruce and Red Maple, with lesser quantities of Red Spruce and Balsam Fir. However, forest structural diversity generally appears to be more important than tree species composition (Stewart et al., 2015).

The following parameters were chosen to model possible suitable Canada Warbler breeding habitat within the LAA:

- Depth to water table – Sites with a depth to water table less than or equal to 2 m (Several studies have demonstrated depth to water as a more accurate predictor of habitat suitability for species associated with forested wetlands such as Canada Warbler (Westwood, 2016; Westwood et al., 2019))
- Stand Cover Type – Any stand classified as mixedwood or deciduous forest
- Canopy closure – Any stand with a canopy closure of 5 to 85 percent (Westwood et al., 2017)

Chimney Swift

Chimney Swift primarily nests within artificial structures like chimneys, silos, air shafts, wells, and barns. However, this species is known to nest in natural habitats within large hollow trees and tree cavities found in mature and old-growth forests (COSEWIC, 2018; Zanchetta et al., 2014).

The following parameters were chosen to model possible suitable Chimney Swift breeding habitat within the LAA:

- Old-Growth Potential Index (values 10 and 11)
- Tree Cover Loss – Any site where tree cover loss has not occurred within the last 21 years

Common Nighthawk

Common Nighthawk nests on open ground and in clearings. Numerous habitats meet the requirements for breeding habitat including open forests (especially those with cuts, burns or rocky outcrops); grasslands; wetlands; rocky areas such as quarries, gravel pits and railway margins; and cultivated areas including orchards and blueberry fields (COSEWIC, 2018; ECCC, 2016).

The following parameters were chosen to model possible suitable Common Nighthawk breeding habitat within the LAA:

- Stand Cover Type – Any area classified as old field, clearcut, rock barren, barren, agriculture, blueberries, gravel pit, destroyed by fire, or rail corridor
- Tree Cover Loss – Any site where tree cover loss occurred within the last two years

Eastern Wood-pewee

Eastern Wood-pewee primarily inhabits open deciduous and mixedwood forests with high canopies as well as forest edges and clearings (ECCC, 2023c). In Nova Scotia, both treed swamps as well as mature, upland forests are important habitats for the species (Brazner & MacKinnon, 2020). Eastern Wood-pewee tends to avoid human-occupied areas and regenerating forests (NSDNRR, 2022; COSEWIC, 2012).

The following parameters were chosen to model possible suitable Eastern Wood-pewee breeding habitat within the LAA:

- Stand Cover Type – Any stand classified as deciduous or mixedwood forest
- Tree Cover Loss – Any site where tree cover loss has not occurred within the last 21 years

Evening Grosbeak

Evening Grosbeak prefers to breed in mature, old coniferous and mixedwood stands, often dominated by fir, spruce, Tamarack, pine, and aspen with relatively low canopy cover (COSEWIC, 2016; ECCC, 2022b). Nests are predominantly found within trees that are greater than 40 m in height (Bekoff et al., 1987).

The following parameters were chosen to model possible suitable Evening Grosbeak breeding habitat within the LAA:

- Old-Growth Potential Index (all values)
- Stand Cover Type – Any stand classified as a coniferous or mixedwood forest
- Tree Cover Loss – Any site where tree cover loss has not occurred within the last 21 years

Olive-sided Flycatcher

Olive-sided Flycatcher prefers to breed in moist, coniferous, or mixedwood forest, and is often associated with wetlands, forest edges (especially alongside wetlands), and gaps created by recent burns and clearcuts (NSDLF, 2021b). In Nova Scotia, this species is associated with stands dominated by spruce, Balsam Fir, and Red Maple and to a lesser extent pine and Tamarack (Staicer et al., 2015). While the species prefers forested areas, Olive-sided Flycatcher requires open areas or clearings within their breeding habitat to forage for insects on the wing. The species also nests in tall trees, typically 5 to 20 m above ground level, with snags nearby (COSEWIC, 2018b). Studies in Nova Scotia have confirmed that Olive-sided Flycatcher prefers stands with lower canopy cover and greater canopy height (Staicer et al., 2015).

The following parameters were chosen to model possible suitable Olive-sided Flycatcher breeding habitat within the LAA:

- Canopy Height – Any site with a canopy height of 5 m or greater
- Stand Cover Type – Any stand classified as coniferous or mixedwood forest
- Tree Cover Loss – Any site where tree cover loss has not occurred within the last 21 years

Rusty Blackbird

An obligate wetland species, Rusty Blackbird requires wetland habitats for nesting, foraging, and shelter (ECCC, 2015). In Nova Scotia, Rusty Blackbird is known to nest in coniferous and mixedwood forested wetlands, bogs, beaver ponds, marshes, and within riparian zones (COSEWIC, 2006). Breeding habitat within forested wetlands are characterized by short (0.5 to 6 m), dense canopies consisting mainly of Black Spruce, Balsam Fir, Tamarack, White Cedar, and Red Maple (Stacier et al., 2015; COSEWIC, 2006). Rusty Blackbird will breed in disturbed wetland habitats in Nova Scotia, including wetlands surrounded by regenerating clearcuts and forest plantations (COSEWIC, 2006).

The following parameters were used to model possible suitable Rusty Blackbird breeding habitat:

- Stand Cover Type – Any site classified as coniferous or mixedwood forest
- Depth to Water Table – Any site where the depth to water table is 50 cm or less
- Riparian Zones – Any site within 20 m of a watercourse or waterbody (Whitaker and Montevecchi, 1999)

Wood Thrush

Wood Thrush prefers to breed in moist, deciduous or mixedwood forest stands with trees greater than 16 m in height and a dense canopy (greater than 70 percent) (COSEWIC, 2012; Roth, 1987; Robbins et al., 1989). In the Maritimes, Wood Thrush is associated with poplar and Red Maple, and to a lesser extent immature spruce, sapling Pin Cherry, ash, and alder (Stewart et al., 2015).

The following parameters were used to model possible suitable Wood Thrush breeding habitat:

- Canopy Height – Any site with a canopy height of 10 m or greater
- Stand Cover Type – Any site classified as deciduous or mixedwood forest
- Crown Closure – Any site with a canopy closure of 70 percent or greater
- Depth to Water Table – Any site with a depth to water table of 10 cm to 2 m

12.1.2.2 Field Surveys

The objective of the field surveys was to gather baseline information on the birds that use and move through the LAA year-round. Seasonally appropriate survey protocols were developed following the *Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds* (ECCC, 2007b), *Wind Energy & Birds Environmental Assessment Guidance Update* (ECCC, 2022), and *Guidance for Bird and Bat Surveys Pre- and Post-Construction Surveys and Monitoring – Wind Energy* (NSDNRR, 2022), other standard survey protocols and guidance documents, and consultation with regulators. Winter surveys were conducted to determine which bird species use the LAA during the winter season; breeding bird surveys (including nocturnal owl surveys) were conducted to assess the diversity and abundance of species using the LAA for nesting, foraging, and raising young during the breeding season; and migration surveys were conducted during the spring and fall migration periods to determine which species may be at higher risk of colliding with turbines during this period. Surveys were designed to target areas of potential impact (e.g., PDA) and associated airspace in the vicinity of the proposed turbine locations.

Winter Bird Surveys

Winter bird surveys were generally conducted within the LAA from February 16 to March 10, 2023 (Year 1) and February 9 to February 29, 2024 (Year 2) using area searches. Area searches are systematic surveys with the aim of documenting the presence and abundance of bird species within a specific survey area. Areas surveyed during winter bird surveys included access roads and areas near known proposed turbine locations at the time of the surveys. In addition, survey routes were selected to provide representative coverage of various habitat types within the PDA.

The Year 1 field program was executed by a two-person team over eight days, with a total of 37 hours of survey effort covering approximately 140 km on foot (see Figure 12.1).

Nocturnal Owl Surveys

Nocturnal owl surveys were generally conducted within the LAA between April 24 and April 27, 2023, under suitable weather conditions (e.g., minimal wind and precipitation). Surveys generally followed the protocols described in *Guidelines for Nocturnal Owl Monitoring in North America* (Takats et al., 2001) and *Nova Scotia Nocturnal Owl Survey: Guide for Volunteers* (Birds Canada, 2019).

Twenty-two survey stations were placed across the LAA in various habitat types (see Figure 12.2). Nova Scotia owl playback recordings (provided by Birds Canada) were broadcasted at each survey station. The focus of these surveys was to target owls; however, all detected species were recorded, including species that sing or display at dusk (e.g., American Woodcock (*Scolopax minor*)).

Nocturnal surveys for breeding owl species and nightjars were conducted by CBCL at eight survey stations within the northern portion of the current Project LAA in 2012, and this data is incorporated into the existing environment section below (Figure 12.3). These surveys were conducted on May 7, 2012, and June 11, 2012, in suitable weather generally following *Guidelines for Nocturnal Owl Monitoring in North America* (Takats et al., 2001).

Migration Surveys

Comprehensive migration monitoring, including point count surveys, passage migration surveys, as well as radar and acoustic monitoring, was completed to assess the presence, abundance, and movement of birds within the LAA during migration.

Migration Point Count Surveys

Ten-minute, unlimited radius point count surveys were conducted between dawn (one half hour before sunrise) and approximately 10:00 a.m. in suitable weather conditions (e.g., minimal wind and precipitation). Point count surveys were conducted at each survey location (typically spaced apart 250 m or more) within the PDA. Survey locations were located to cover each major habitat type to provide representative coverage of the PDA. Point count survey locations were generally placed along existing roads (i.e., proposed access roads) as songbirds are readily detected along the edges of habitats. Survey locations were also placed at or near prospective turbine locations. The eastern portion of the LAA was difficult to access; therefore, ARUs (Wildlife Acoustics Inc® Song Meter Micro) were deployed to complement migration surveys. While ARUs provide an efficient and accurate alternative, there are limitations when quantifying the number of individuals. Because quantifying the abundance of birds present within and adjacent to the PDA is important to determine potential Project effects, CBCL opted to survey most locations with surveyors in the field using a standard point count methodology.

At each survey location, all species seen or heard were recorded as well as an estimate of the number of individuals of each species during the survey period. The distance to each bird was estimated using fixed distance categories (0 to 50 m, 51 to 100 m, and further than 100 m) and individuals were monitored throughout the duration of each point count to limit double counting. General observations including date, time, and weather conditions (temperature, wind speed, presence of any precipitation) were also recorded. Point counts were also completed by listening to the audio data captured on the ARUs (referred to as Microphone Point Counts in ECCC, 2007). These point counts consisted of locating a 10-minute segment of the recording that was collected under suitable conditions (i.e., low wind and low/no precipitation). All species identified within the 10-minute period were noted.

Spring migration point count surveys were conducted between April 20 and May 24, 2023. Three rounds of point count surveys were completed at 81 survey locations, totaling approximately 240 point count surveys (Figure 12.4).

In 2012, two transects approximately 1.5 km in length were surveyed during spring migration. Seven point count survey locations were placed along each transect, totaling 14 point count survey locations (Figure 12.5). These transects were situated within the northern portion of the current LAA. Ten survey locations were visited five times between April 26 and June 1, and four point count survey locations were surveyed four times due to the presence of coyotes during one round of surveys. In total, 66 point count surveys were completed during the 2012 spring migration surveys.

Fall migration point count surveys were conducted between August 15 and November 3, 2023. Four rounds of point count surveys were completed at 80 survey locations during the fall migration period for a total of approximately 320 point count surveys (Figure 12.6).

Passage Migration Counts

Passage migration counts were conducted during the spring and fall migration periods to assess the number of birds flying through the LAA, particularly where turbines are proposed to be built.

Surveys were conducted at three suitable observation points within the LAA (Figures 12.4 and 12.6). Observation points were placed in locations that provided a clear view of multiple proposed turbine locations. The species, number of individuals, and the direction and height of passing birds were recorded.

Passage migration counts started as early as 9 a.m. and continued for 1 to 6 hours. Some surveys were terminated early due to weather conditions (e.g., rain or heavy fog). During spring migration, four rounds of passage migration surveys were completed at each observation point for a total of 20 hours of survey effort. During fall migration, six rounds of passage migration surveys were completed at each observation point for a total of 77 hours of survey effort.

Radar Monitoring

Nocturnal migration monitoring uses radar technology to detect the volume (i.e., passage rate) and flight height of nocturnal migrants that traverse the LAA. The radar unit detects all organisms using the airspace, which may include birds, bats, and insects; those detected are therefore generically referred to as targets (Appendix J).

An automated radar unit was deployed within the LAA and monitored by Ausenco (Appendix J) during the 2023 spring and fall migration season:

- April 14 through June 15, 2023, for a total of 62 nights
- July 15 through November 10, 2023, for a total of 111 nights

The late spring start was due to impassable snow on the roads. The radar functioned properly throughout the spring migration monitoring period and for approximately 94 percent of the fall migration monitoring period. The radar unit was programmed to begin operation approximately 30 minutes before sunset and operation ended approximately 30 minutes after sunrise during each night to align with the acoustic recordings. The location of the radar unit was selected to maximize detection of nocturnal migrants that pass through the LAA at the height of the rotor-swept zone (RSZ).

Determining the location of the unit relied on the availability of participating landowners to host the radar, site accessibility, site security, and clear sight lines with minimal clutter. The radar was oriented perpendicular to the anticipated flight direction to maximize the likelihood of target detection. Refer to Appendix J for more information.

Acoustic Monitoring

Acoustic monitoring was used to record birdsong at night to discern species and species groups that migrate through the LAA. The monitoring was completed concurrently with the radar monitoring, coordinated to record during the same days and time period by Ausenco (Appendix J). Acoustic recorders (AudioMoth™ full spectrum) were deployed at 11 locations across the LAA in areas that were free of overhead obstruction. The recording units have a maximum detection range of approximately 200 m, which is within the RSZ for the proposed Project turbines. Recordings were interpreted using bioacoustics data software that identified bird species and species groups by bird calls (Appendix J).

Weather variables (e.g., wind speed, wind direction, and precipitation) were selected to quantify weather effects on the radar and acoustic data. Refer to Appendix J for more information.

Breeding Bird Surveys

Breeding bird surveys were conducted within and directly adjacent to the PDA to determine which species regularly use the area for nesting, for foraging during the breeding season, or for raising their young.

Breeding Bird Point Count Surveys

Following the point count methodology used during migration surveys, 10-minute, unlimited radius point counts were conducted between dawn (one half hour before sunrise) and approximately 10:00 a.m. in suitable weather conditions (e.g., minimal wind and precipitation). Observed breeding evidence was recorded using standard MBBA breeding bird codes.

Ninety-five survey locations were generally distributed across the LAA (e.g., at or near turbine pads and access roads) to target the different habitat types and within suitable breeding habitat for SAR birds that may breed within the PDA (refer to Section 12.1.2.1) (Figure 12.7). Like migratory surveys, ARUs were deployed at two survey locations that were difficult to access and audio recordings were analyzed. Each survey location was surveyed twice with the aim to detect both early and late breeders. A total of 190 point count surveys were conducted between June 7 and July 7, 2023. Forty-five point count survey locations occur more than 500 m from proposed turbines.

Nightjar Surveys

Common Nighthawk is listed under the federal SARA as Special Concern and Eastern Whip-poor-will (*Antrostomus vociferus)* is listed under the federal SARA as Threatened; both are listed under the provincial NSESA as Threatened. Because Common Nighthawk are crepuscular and Eastern Whip-poor-will are nocturnal, these species are not typically detected during standard breeding bird surveys (as outlined above) and targeted surveys are required to determine the presence of these species within a particular geographical area.

Following the general methodology outlined in the *Canadian Nightjar Survey Protocol* (Birds Canada, 2022), 21 survey stations were spread across the LAA (Figure 12.8). Two rounds of nightjar surveys were conducted 30 minutes before sunset and extended until approximately two hours after sunset to capture the Eastern Whip-poor-will window. The first round was completed between June 15 and June 22, 2023, and the second round was completed between June 27 and July 6, 2023. Because there is potential for Eastern Whip-poor-will within the PDA, the second round of surveys were timed to coincide with the full moon which occurred on July 3, 2023. At each survey station, the surveyor listened for six minutes, recording all species identified by sight or sound. Attention was also given to other species that sing or display at dusk (e.g., American Woodcock).

Nocturnal surveys for nightjars were also conducted in 2012. Methodology for these surveys is outlined above under Nocturnal Owl Surveys and results are presented within the Nocturnal Owl Survey section below.

Pileated Woodpecker and Great Blue Heron

Targeted surveys were carried out for Pileated Woodpecker and Great Blue Heron. The nests of these species are protected year-round under the Migratory Birds Regulations, 2022, and there is suitable nesting habitat in the PDA. Evidence of current or historical nesting was recorded during the execution of bird surveys and other biological field programs conducted in the LAA in 2023 and 2024. These incidental observations are included in the assessment of the existing environment.

12.2 Existing Environment

Bird conservation areas occur in proximity to the LAA are shown on Figure 12.9. The Important Bird Area (IBA) nearest the PDA is Cobequid Bay IBA (NS019), located approximately 12 km southwest, as measured from the closest turbine. Cobequid Bay is recognized as a Hemispheric Shorebird Reserve under the Western Hemisphere Shorebird Reserve Network. The eastern arm of the Bay of Fundy can be divided into the lower Minas Basin (IBA # NS020) and the upper Cobequid Bay. At low tide, areas of mud and sand flats and salt marshes are exposed and between 1 and 2 million shorebirds use the mud flats of the head of the Bay of Fundy in the fall for staging before southern migration. Due to this IBA's food supply, it attracts 50 to 95 percent of the world total Semipalmated Sandpiper (*Calidris pusilla*) population.

The Boot Island NWA is a 107 ha parcel of federally protected land situated within the Minas Basin. The boundaries of the protected area are located northeast of Gaspereau, Nova Scotia, approximately 67 km southwest of the PDA. The protected area covers the entirety of Boot Island and its associated saltmarsh extending to the southwest. Boot Island NWA is also a Ramsar Wetland of International Importance (ECCC, 2021). As a result of continuous erosion by tidal forces, the site became an island when a channel split it from the mainland.

The Amherst Point Migratory Bird Sanctuary is a 433 ha parcel of federally protected land located 5 km southwest of Amherst, Nova Scotia. The boundaries of the protected area are located between Highway 104 and Maccan River, approximately 61.5 km northwest of the PDA. The sanctuary overlaps in location and boundaries with the Chignecto NWA, a 432 ha parcel of federally protected land. The sanctuary is also designated as an IBA called the Upper Cumberland Basin by BirdLife International (ECCC, 2023). Chignecto NWA is also designated as Class VI under the International Union for Conservation of Nature (ECCC, 2023).

The Wallace Bay NWA is a 580.5 ha parcel of federally protected land located at the upper limit of Wallace Harbour on the Northumberland Strait, approximately 22.6 km north of the PDA. The protected area covers the western portion of Wallace Bay and portions of the surrounding land (ECCC, 2023b). Wallace Bay NWA is also designated as Class VI under the International Union for Conservation of Nature (ECCC, 2018).

Based on the Critical Habitat for Species at Risk National Dataset (ECCC, 2022), no critical habitat for SAR birds occurs within the LAA. The closest proposed critical habitat has been identified for Bobolink (*Dolichonyx oryzivorus*) in Tatamagouche, Nova Scotia (Site ID: 20TMR76), approximately 11 km from the PDA.

The NSDNRR Significant Species and Habitat Database contains 563 historical records of species and/or habitat records which relate to birds within a 100 km radius of the PDA. These records include Migratory Bird (82 records); Species at Risk (110 records); Species of

Concern (170 records); and Other Habitat (201 records). None of the records overlap or are within 5 km of the PDA. Some of the records within this database do not reflect current species status (e.g., Common Loon).

The details of these records include the following:

- Migratory Bird – Most records relate to shorebirds (unclassified) (38), Double-crested Cormorant (*Phalacrocorax auritus*) (9), Great Blue Heron (*Ardea herodias*) (6), American Black Duck (*Anas rubripes*) (6), and Common Eider (*Somateria mollissima*) (6)
- Species at Risk – Most records relate to Common Loon (*Gavia immer*) (46), Piping Plover (*Charadrius melodus*) (33), and Peregrine Falcon (*Falco peregrinus*) (9)
- Species of Concern – Most relate to Common Loon (*Gavia immer*) (118), Nelson's Sharp-tailed Sparrow (*Ammospiza nelson*) (17), Common Tern (*Sterna hirundo*) (9), and Tern (unclassified) (9)
- Other Habitat – Most records relate to Bald Eagle (*Haliaeetus leucocephalus*) (189) and Osprey (*Pandion haliaetus*) (6)

Different bird groups demonstrate differences in potential sensitivity to wind turbines (Kingsley and Whittam, 2004). Based on the species observed within the LAA, Project-specific functional groups were selected (Table 12.2). Common Nighthawks may be susceptible to collision with turbines and associated blades due to foraging and breeding behaviour. Common Nighthawk is an aerial insectivore known to occupy open habitat areas in search of flying insects at various heights and defend their territories by aerial displays (wing booms). Due to these factors, Nightjars are presented as a Functional Group for further assessment. Songbirds (passerines) are the bird group reported to be most affected by wind energy facilities in North America (Zimmerling et al., 2013); as such, this group is also separate from Other Landbirds.

Table 12.2 Project-specific Functional Groups

Functional Group	Description
Waterfowl	Order Anseriformes (e.g., Ducks, Geese, and Swans), Order Suliformes (Cormorants)
Waterbirds	Includes seabirds (i.e., marine birds), Order Podicipediformes (e.g., Grebes), Order Gaviiformes (e.g., Loons), Order Pelicaniformes (e.g., Herons), Order Coraciiformes (e.g., Kingfishers), Order Guriformes (e.g., Rails, Gallinules, Coot)
Shorebirds	Order Charadriiformes (Sandpipers, Plovers, Snipes, Woodcocks)
Diurnal Raptors	Eagles, buteos, accipiters, Northern Harrier, Osprey and falcons. Turkey Vultures were included in this group due to their similarity to many soaring raptors
Nocturnal Raptors	Order Stringiformes (i.e., Owls)
Nightjars	Order Caprimulgiformes (e.g., Nighthawks and Whip-poor-wills).
Passerines	Order Passeriform (songbirds)

Functional Group	Description
Other Landbirds	Orders Apodiformes (e.g., Swifts, Hummingbirds), Order Columbiformes (e.g., Pigeons), Order Cuculiformes (i.e., Cuckoos), Order Galliformes (e.g., Grouse, Pheasants), Order Piciformes (e.g. Woodpecker, Flicker, Sapsucker)

The desktop habitat assessment identified mostly forested landcover types within the LAA. The key landcover types include hardwood, softwood, and mixedwood forests; wetlands; and clearcuts. As outlined above and in Chapter 8 (Flora), much of the forested lands are subject to industrial forestry operations with 35 percent of forest lost in the LAA between 2001 and 2022. Remnant forests are generally dominated by Acadian Forest species. One of the forest stands classified as old-growth minimally overlaps with the LAA by 20 m (Figure 8.2).

Based on historical records, 148 species of birds across nine functional groups were observed within 5 km of the LAA (Appendix J, Table 12.1). These species may currently use the LAA during their life cycle. Majority of species observed within the LAA include passerines.

Table 12.3 Functional Groups and Species Diversity Known to Occur within 5 km of the LAA

Functional Group	Total Species	Percent of Total
Diurnal Raptors	13	9
Nightjars	1	1
Nocturnal Raptors	4	3
Other Landbirds	12	8
Passerines	92	62
Shorebirds	8	5
Waterbirds	8	5
Waterfowl	10	7
Total	148	100

The following historical records of bird species within or in proximity to the LAA have been documented:

- AC CDC (2023) Data Report – 113 SAR and SoCC bird species within a 100 km radius of the LAA and 44 were observed within 5 km of the LAA (Appendix J, Table 12.2).
- eBird – 513 records representing 86 species within 1 km of the LAA (Appendix J, Table 12.3).
- MBBA – LAA intersects or occurs directly adjacent to eight MBBA squares. Of the 128 species recorded, 103 were classified as confirmed breeders in one or more atlas squares (Appendix J, Table 12.4). Nine of the species categorized as confirmed breeders are listed federally or provincially at risk.

The PDA and LAA contain potential suitable breeding habitat for eight SAR birds, although suitable habitat for most SAR is limited (Table 12.3; Figures 12.10 to 12.17). The most abundant potential suitable SAR habitat present is that of the Olive-sided Flycatcher, Eastern Wood-pewee, and Common Nighthawk.

Table 12.4 Summary of Possible Suitable Breeding Bird Habitat within the PDA and LAA

Species	PDA (ha)	Percent of PDA	LAA (ha)	Percent of LAA
Canada Warbler*	70.94	4.83	848.42	6.56
Chimney Swift	38.19	2.60	612.3	4.48
Common Nighthawk*	228.65	15.57	1602.79	12.39
Eastern Wood-pewee	254.50	17.33	2864.74	20.94
Evening Grosbeak	87.05	5.92	1250.22	9.14
Olive-sided Flycatcher*	297.50	20.19	3347.94	24.47
Rusty Blackbird*	90.82	6.18	1288.64	9.42
Wood Thrush	4.34	0.003	91.31	0.71

*Observed during breeding bird surveys.

In 2023, a total of 13,547 individuals, representing 119 species and five unidentified taxa (falcon species, woodpecker species, passerine species, swallow species, warbler species) were observed (Appendix J, Table 12.5). Of the 119 species identified, 25 SoCC and nine SAR were observed (Table 12.4). The most abundant species observed include Pine Siskin (*Spinus pinus*; 1149 observations), White-throated Sparrow (*Zonotrichia albicollis*; 981 observations), American Robin (*Turdus migratorius*; 963 observations), and Dark-eyed Junco (*Junco hyemalis*; 778 observations). Five of the eight SAR species listed in Table 12.4 have been categorized in the MBBA as confirmed breeders within the LAA.

Survey information and weather conditions at the time of each survey are outlined in Table 12.6 in Appendix J.

Table 12.5 Summary of SAR and SoCC Recorded Across all Bird Surveys Completed at Windy Ridge in 2023

Functional Group	Scientific Name	Common Name	Status				Numbers of Observations Recorded during 2023 Field Surveys								Total
			NSESA	SARA	COSEWIC	AC CDC	Nocturnal Owls	Winter Residency	Spring Migration		Fall Migration		Breeding Birds	Nightjar	
									Point Counts	Passage Migration	Point Counts	Passage Migration			
Diurnal Raptors	*Accipiter cooperii*	Cooper's Hawk			NAR	S1?B,SUN,SUM			1	1					2
Diurnal Raptors	*Accipiter atricapillus*	American Goshawk			NAR	S3S4						4			4
Diurnal Raptors	*Buteo lagopus*	Rough-legged Hawk			NAR	S3N						1			1
Diurnal Raptors	*Cathartes aura*	Turkey Vulture				S2S3B,S4S5M				1		3			4
Diurnal Raptors	*Falco sparverius*	American Kestrel				S3B,S4S5M			3	1	4	1			9
Nightjars	*Chordeiles minor*	Common Nighthawk	T	SC	SC	S3B					4		4	20	28
Other Landbirds	*Coccyzus erythropthalmus*	Black-billed Cuckoo				S3B					1				1
Other Landbirds	*Picoides arcticus*	Black-backed Woodpecker				S3S4			1				4		5
Passerines	*Cardellina canadensis*	Canada Warbler	E	T	SC	S3B					2		9		11
Passerines	*Coccothraustes vespertinus*	Evening Grosbeak	V	SC	SC	S3B,S3N,S3M			13		16				29
Passerines	*Contopus cooperi*	Olive-sided Flycatcher	T	SC	SC	S3B							15	1	16
Passerines	*Contopus virens*	Eastern Wood-Pewee	V	SC	SC	S3S4B			1						1
Passerines	*Dolichonyx oryzivorus*	Bobolink	V	T	SC	S3B					1				1
Passerines	*Euphagus carolinus*	Rusty Blackbird	E	SC	SC	S2B							2		2
Passerines	*Hirundo rustica*	Barn Swallow	E	T	SC	S3B					18				18
Passerines	*Lanius borealis*	Northern Shrike				S3S4N					1				1
Passerines	*Loxia curvirostra*	Red Crossbill				S3S4					10		4		14
Passerines	*Myiarchus crinitus*	Great Crested Flycatcher				S1B					1				1
Passerines	*Passerella iliaca*	Fox Sparrow				S3S4B,S5M			1						1
Passerines	*Perisoreus canadensis*	Canada Jay				S3		2	4	2	39	21	5		73
Passerines	*Pinicola enucleator*	Pine Grosbeak				S3B,S5N,S5M		23	9		1				33
Passerines	*Poecile hudsonicus*	Boreal Chickadee				S3		11	15	1	43	10	7		87
Passerines	*Riparia riparia*	Bank Swallow	E	T	T	S2B			2						2

Functional Group	Scientific Name	Common Name	Status				Numbers of Observations Recorded during 2023 Field Surveys									Total
			NSESA	SARA	COSEWIC	AC CDC	Nocturnal Owls	Winter Residency	Spring Migration		Fall Migration		Breeding Birds	Nightjar	
									Point Counts	Passage Migration	Point Counts	Passage Migration			
Passerines	*Setophaga castanea*	Bay-breasted Warbler				S3S4B,S4S5M			2		9	2	37		50
Passerines	*Setophaga striata*	Blackpoll Warbler				S3B,S5M			2		44	28	5		79
Passerines	*Setophaga tigrina*	Cape May Warbler				S3B,SUM					1		2		3
Passerines	*Spinus pinus*	Pine Siskin				S3			3		713	433			1149
Shorebirds	*Actitis macularius*	Spotted Sandpiper				S3S4B,S5M					1				1
Shorebirds	*Charadrius semipalmatus*	Semipalmated Plover				S1B,S4M					1				1
Shorebirds	*Gallinago delicata*	Wilson's Snipe				S3B,S5M	6		1						7
Shorebirds	*Pluvialis squatarola*	Black-bellied Plover				S3M						1			1

E – Endangered, T – Threatened, V – Vulnerable, SC – Special Concern, NAR – Not at Risk

12.2.1 Winter Birds

A total of 233 individuals, consisting of 18 species and one unidentified taxa of woodpecker, were recorded during the winter bird surveys in 2023. Of the 18 species, three SoCC were recorded: Boreal Chickadee (*Poecile hudsonicus*; 11 observations), Canada Jay (*Perisoreus canadensis*; 2 observations), and Pine Grosbeak (*Pinicola enucleator*; 23 observations). The most abundant species included Black-capped Chickadee (*Poecile atricapillus*; 50 observations), Golden-crowned Kinglet (*Regulus satrapa*; 47 observations), and Pine Grosbeak (*Pinicola enucleator*; 23 observations) (Appendix J, Table 12.5).

12.2.2 Owls

During the 2023 nocturnal owl surveys, four species were recorded, including two owl species: the Great Horned Owl (*Bubo virginianus*) and Barred Owl (*Strix varia*). The other two species recorded included Wilson's Snipe (*Gallinago delicata*) and American Woodcock (*Scolopax minor*)—both species with aerial flight displays (Appendix J, Table 12.5).

In 2012, a total of 16 individuals across five species were recorded. Species detected included Great Horned Owl, Barred Owl, Northern Saw-whet Owl (*Aegolius acadicus),* American Woodcock (*Scolopax minor*) and Ruffed Grouse (*Bonasa umbellus*).

12.2.3 Migration

12.2.3.1 Spring Migration

A total of 3,848 individuals, consisting of 81 species and one unidentified taxa of woodpecker, were recorded during the spring migration point count surveys within the LAA in 2023 (Appendix J, Table 12.5). Of these 81 species, 12 are SoCC and three are SAR (Table 12.4). Passerines (92 percent) and Other Landbirds (5.8 percent) represent most species detected.

A total of 251 individuals, representing 47 species and three unidentified taxa (falcon species, passerine species, and warbler species) were observed during spring passage migration surveys conducted within the LAA in 2023 (Appendix J, Table 12.5). Of the 47 species identified, five are SoCC (Table 12.4). No SAR were identified during spring passage migration surveys. Passerine (82.7 percent), Diurnal Raptors (9.6 percent), and Other Landbirds (5.2 percent) were the three most abundant functional groups detected.

The largest flocks observed during spring migration included a flock of White-throated Sparrows (seven individuals) and another flock of Yellow-rumped Warblers (seven individuals). When altitude of flight was noted, most individuals (53 percent) were recorded 0 to 50 m above ground level and the remaining were recorded between 51 and 100 m (24 percent) and greater than 100 m (22 percent) above ground level. These results suggest that more than half of the individuals recorded were within the RSZ; the area between the lowest and highest rotor tip height or where the blades are moving (i.e., approximately 40 to 200 m above ground level).

No concentrations of raptors were observed during spring migration point counts or passage migration surveys.

12.2.3.2 Fall Migration

Eighty-four species and two unidentified taxa (passerine species, warbler species), totalling 4,156 individuals, were recorded within the LAA during the fall migration point count surveys in 2023 (Appendix J, Table 12.5). Of the 84 species (95 percent Passerines), five are SAR and 14 are SoCC. The SAR include Barn Swallow, Bobolink, Canada Warbler, Common Nighthawk, and Evening Grosbeak. A summary of the SAR and SoCC observed during the fall migration point counts are provided in Table 12.4.

A total of 1,523 individuals, representing 62 species and three unidentified taxa (passerine species, warbler species, swallow species), were observed during fall passage migration surveys conducted within the LAA in 2023 (Appendix J, Table 12.5). Of the 62 species identified, 10 SoCC were observed (Table 12.5). No SAR were identified during the fall passage migration survey. The most abundant functional bird groups detected include Passerine (92.4 percent), Diurnal Raptors (4.1 percent), and Other Landbirds (2.4 percent).

The most abundant species observed during fall passage migration surveys were migratory finches (e.g., Pine Siskins, White-winged Crossbill, and Purple Finch) and 92 percent of these individuals were flying through the LAA at 0 to 50 m above ground level. The largest flocks observed during fall migration included flocks of Common Grackles (70 individuals), Pine Siskins (50 individuals), and White-winged Crossbills (30 individuals). Most individuals (77.6 percent) were observed at a height of 0 to 50 m above ground level, 16 percent of individuals were observed between 51 and 100 m above ground level, and 6.4 percent were observed at heights greater than 100 m above ground level. These observations suggest that most individuals may fly outside the RSZ of the turbines.

No concentrations of raptors were observed during point counts or migration surveys. While shorebirds concentrate nearby in the Minas Basin, there was no indication that shorebirds migrate at low altitudes near the site.

12.2.3.3 Radar Monitoring

During the spring migration monitoring period, the highest target volumes were observed in late April, with the highest proportion of target volume within the RSZ observed in early May (refer to Appendix J – Windy Ridge 2023 Radar and Acoustic Monitoring Baseline Report). Flight volumes on May 6 occurred after a period of unfavourable conditions (e.g., rain and strong north and easterly winds), forcing birds to fly at a lower altitude. Although the proportion of targets within the RSZ increases with increasing headwinds, the total number of targets decrease. Cumulatively, most targets in the spring were detected above the RSZ.

Throughout the fall migration monitoring period, the highest target volumes were observed in late September and early October, with the highest proportion of flights within the RSZ observed in early October. In contrast to the spring monitoring results, the fall flight volumes were greatest within the RSZ most nights during fall migration. This suggests that some migrant flight altitudes (above ground level) are lower as they traverse the Cobequid mountains, particularly during fall migration in unfavourable weather conditions.

Target flight height extends to 800 m above ground level, suggesting that nocturnally migrating birds use a large airspace within the LAA.

12.2.3.4 Acoustic Monitoring

During spring migration, 13 distinct species and four species groups were identified. The species most commonly detected included:

- Common Nighthawk – 68.2 percent of total detections
- White-throated Sparrow – 3.8 percent of total detections
- Swainson's Thrush (*Catharus ustulatus*) – 3.8 percent of total detections

The single-banded down sweep species group, which includes Pine Warbler (*Setophaga pinus*), Northern Parula (*Setophaga americana*), Yellow-throated Warbler (*Setophaga dominica*), and Prairie Warbler (*Setophaga discolor*), represented 6.5 percent of calls detected during spring migration.

The high detection rate of Common Nighthawk in the LAA during the breeding season suggests that this species is likely foraging and breeding in the area. Clearcut areas, common within the LAA, provide suitable habitat for both breeding and foraging.

Canada Warbler, the other SAR detected during acoustic monitoring, was detected six times in the spring and 115 in the fall, representing 2.7 and 2.8 percent of the total spring and fall detections, respectively. Since Canada Warbler are diurnal, these detections likely reflect individuals migrating through the LAA.

During fall migration, 14 distinct species and one species group were identified from the recordings. The three most commonly detected species included:

- Ovenbird (*Seiurus aurocapilla*) – 18 percent
- Veery (*Catgarus fuscescens*) – 13.7 percent
- Black-and-white Warbler (*Mniotilta varia*) – 10.3 percent

The species group of warblers (zeep), which includes Bay-breasted Warbler, Blackburnian Warbler (*Setophaga fusca*), Blackpoll Warbler, Cape May Warbler (*Setophaga tigrine*), Magnolia Warbler (*Setophaga magnolia*), Northern Waterthrush (*Parkesia noveboracensis*), and Yellow Warbler (*Setophaga petechia*), represented 23.5 percent of the calls detected during fall migration.

12.2.4 Breeding Birds

In 2023, 73 species, totalling 3,394 individuals, were recorded within the LAA during the breeding bird point count surveys (Appendix J, Table 12.5). Of these 73 species (98 percent Passerines), four are SAR and eight are SoCC. A summary of SAR and SoCC and associated breeding evidence codes are provided in Table 12.5. The most abundant species included White-throated Sparrow (317 individuals), Black-throated Green Warbler (301 individuals), Red-eyed Vireo (202 individuals), and Common Yellowthroat (202 individuals). There was no evidence of colonial breeding or roosting birds observed within the LAA.

Olive-sided Flycatcher is the only SAR confirmed to be breeding within the LAA that was observed. Three Olive-sided Flycatcher fledglings were observed within the LAA on August 14, 2023. However, confirmed breeding evidence is often difficult to obtain so CBCL conservatively assumes additional species are likely breeding within the LAA. Common Nighthawk were categorized as possible breeder during the breeding bird program however, based on the frequency of Common Nighthawk recordings during the acoustic monitoring program and availability of suitable nesting habitat within the LAA (Figure 12.10), this species is likely to be breeding within the LAA. Rusty Blackbird was categorized as possible breeder as this species was observed calling in suitable nesting habitat on June 7 and 10, 2023. Canada Warbler was also considered a probable breeder within the LAA because a pair was observed together during the breeding season on June 21, 2023.

Five SoCC have been categorized as probable breeders within the LAA (Table 12.6). Pairs of Blackpoll Warbler, Boreal Chickadee, and Cape-May Warblers were categorized as possible breeders as pairs of each species were observed within suitable nesting habitat in the LAA during the breeding season.

A pair of White-throated Sparrows were observed within the LAA on June 7, 2023, acting very agitated and territorial, suggesting probable nesting in the vicinity. Several other species would be categorized as possible breeders within the LAA as they were observed singing in suitable habitat during the breeding season.

Table 12.6 Summary of SAR and SoCC Recorded during the Breeding Bird Point Count Surveys in 2023

Scientific Name	Common Name	NSESA	SARA	COSEWIC	S-Rank	No. of records	Breeding Evidence Category
Cardellina canadensis	Canada Warbler	E	T	SC	S3B	9	Probable
Chordeiles minor	Common Nighthawk	T	SC	SC	S3B	4	Probable

Scientific Name	Common Name	NSESA	SARA	COSEWIC	S-Rank	No. of records	Breeding Evidence Category
Contopus cooperi	Olive-sided Flycatcher	T	SC	SC	S3B	15	Confirmed
Euphagus carolinus	Rusty Blackbird	E	SC	SC	S2B	2	Possible
Setophaga castanea	Bay-breasted Warbler	-	-	-	S3S4B, S4S5M	37	Probable
Picoides arcticus	Black-backed Woodpecker	-	-	-	S3S4	4	Probable
Setophaga striata	Blackpoll Warbler	-	-	-	S3B,S5M	5	Possible
Poecile hudsonicus	Boreal Chickadee	-	-	-	S3	7	Possible
Perisoreus canadensis	Canada Jay	-	-	-	S3	5	Probable
Setophaga tigrina	Cape May Warbler	-	-	-	S3B,SUM	2	Possible
Haemorhous purpureus	Purple Finch	-	-	-	S3S4	25	Probable
Loxia curvirostra	Red Crossbill	-	-	-	S2B	4	Probable

E – Endangered, T – Threatened, SC – Special Concern

12.2.5 Nightjar Surveys

A total of 23 species, totalling 126 individual observations, were recorded during nightjar surveys conducted within the LAA in 2023 (Appendix J, Table 12.5). Of the 23 species identified, two SAR were observed. Common Nighthawks were recorded at 11 of the survey locations and Olive-sided Flycatcher was incidentally recorded at one location.

12.2.6 Pileated Woodpecker and Great Blue Heron

No Great Blue Herons were observed, nor was any evidence of current or historical nesting observed within the LAA.

One Pileated Woodpecker nesting cavity was observed during the winter bird surveys on March 9, 2023. The nest was monitored during the execution of other field programs in 2024 and no evidence of activity was observed. During breeding bird surveys, one individual Pileated Woodpecker was recorded on June 20, 2023. Twenty individuals were recorded during migration surveys (spring and fall combined) at 19 different locations.

12.3 Effects Assessment

12.3.1 Boundaries

For the purposes of this assessment, the LAA for birds includes the PDA, a 500 m buffer, and associated airspace. The RAA is a 5 km buffer around the PDA.

12.3.2 Potential Effects and Mitigation

Several measures were undertaken in the Project design to minimize potential direct and indirect impacts on birds within engineering and design constraints (see Figure 2.2). Detailed design of the Project and micrositing of turbines will further avoid bird habitat, when practicable, and reduce potential interactions between the Project and birds.

The Project could potentially impact birds through various interconnected pathways, both directly and indirectly. During construction, activities such as earthworks and vegetation clearing can lead to habitat loss and alteration. If these activities occur during the nesting season, these activities could kill, injure, or displace nesting birds.

Project related vehicle traffic poses a risk of mortality and injury due to collisions with birds. Collisions with turbine blades, towers, and transmission lines are possible during the operation and maintenance phase of the Project. Project activities can affect birds as indicated in Table 12.7; these potential effects do not consider the detailed design of the Project and micrositing of turbines that is yet to be completed or the implementation of mitigation measures described herein.

Table 12.7 Potential Environmental Effects of the Project on Birds

Project Activity	Potential Environmental Effects		
	Habitat Loss/ Fragmentation	Direct Mortality and Injury	Sensory Disturbance
Construction			
Site Preparation	X	X	X
Access Roads Construction and Modifications	-	X	X
Material and Equipment Delivery and Storage	-	X	X
Infrastructure Installation	-	-	X
Restoration of Temporary Areas	-	-	X
Testing and Commissioning	-	X	X
Operation and Maintenance			
Turbine Operation and Maintenance	-	X	X
Road Maintenance	-	X	X

Project Activity	Potential Environmental Effects		
	Habitat Loss/ Fragmentation	Direct Mortality and Injury	Sensory Disturbance
Power Line and Substation Maintenance	-	X	X
Vegetation Management	-	X	X
Safety and Security	-	-	X
Decommissioning			
Removal of Infrastructure and Site Restoration	-	X	X

X = Potential Interaction
- = No Interaction

12.3.2.1 Habitat Loss and Fragmentation

The Project may result in habitat loss, degradation, and fragmentation for bird species within the LAA. Construction activities such as vegetation clearing and grubbing will result in a short-term and long-term loss of habitat. Vegetation clearing will occur within the PDA for the construction or installation of access roads, turbines, transmission lines, and other Project infrastructure. For the purposes of the assessment, a conservative estimate of habitat that will be removed is approximately 1,468 ha.

Four SAR birds were observed during the breeding bird surveys: Common Nighthawk (24 observations), Olive-sided Flycatcher (15 observations), Canada Warbler (9 observations), and Rusty Blackbird (2 observations). Approximately 580 ha (39 percent) of the PDA was identified as possible suitable breeding habitat for one or more these SAR birds. However, based on the number and locations of SAR observations during the breeding period, much of the possible suitable SAR breeding habitat appeared to be unoccupied by those species. Approximately forty percent (229 ha) of the 580 ha is attributed to possible suitable breeding habitat for Common Nighthawk which represents previously disturbed areas (e.g., cleared areas).

The estimate of habitat loss is greater than the final project Footprint (e.g., roads will not be as wide as the PDA and 49 turbines will be built, not the 52 turbine locations assessed) and includes area currently occupied by roads. Therefore, the amount of clearing required for the Project construction will be less than what has been estimated for the purpose of this EA.

The iterative Project design process has prioritized avoidance and minimization of interactions with high-quality habitat (see Figure 2.2). During this process, several turbines and roads were removed or relocated from areas deemed high-quality habitat and turbines were positioned in areas previously affected by forestry activities. These adjustments were made to mitigate the loss of old-growth and mature forests, interior forest habitat, and wetlands. These changes are particularly advantageous for SAR bird species reliant on wetlands (e.g., Canada Warbler) and those typically associated with interior forest habitats (e.g., Evening Grosbeak) as the LAA has experienced heavy disturbance from forestry activities and contains limited mature and interior forest habitats. Approximately 150 km of access roads are required for the Project. To minimize the amount of habitat disturbance (i.e., clearing and ground disturbance), 77 percent (116 km) of these access roads will use existing roads.

Vegetation clearing creates edge habitat and alters the bird community occupying these areas. While clearing for transmission lines will lead to a loss of bird habitat, it will simultaneously provide habitat for species favouring edge or open environments (e.g., Pine Siskins and American Robins).

Not all habitat alterations will be permanent, and the areas reclaimed during restoration will return to the site's pre-disturbance condition, to the extent practicable.

The following key measures to mitigate the potential effects of the Project on bird habitat will be further detailed in a Project-specific EPP and will be implemented prior to and during construction:

- Careful site planning will be implemented to minimize habitat disturbance, mitigate habitat loss and fragmentation, and make use of existing roads and areas previously affected, such as clearcuts. The detailed design phase will involve a review of SAR bird habitat models and field survey findings.
- Vegetation clearing will be completed outside of the general nesting period for migratory birds. If clearing needs to occur within this period, the guidelines to avoid harm to migratory birds (ECCC, 2023) and regulators will be consulted.
- Vegetated buffers around wetlands and watercourses will be maintained to support connectivity for wildlife where possible.
- Grubbing and topsoil will be stockpiled for use during restoration.
- Cleared areas will be progressively revegetated during and after construction.
- Measures will be implemented to control and prevent the spread of invasive species.
- Alternative road de-icing methods will be employed during road maintenance to prevent the impacts of salt on birds and their habitat.
- Work crews will recognize the working limits of the PDA and will refrain from entering surrounding habitat.
- The Proponent will develop and implement ESC procedures.
- The Proponent will develop and implement a Wildlife Management Plan.

12.3.2.2 Direct Mortality and Injury

The Project may result in direct mortality and injury to birds during construction through vegetation clearing and increased traffic. Bird mortality and injuries can occur during operation and maintenance as birds may collide with turbines, or other wind farm infrastructure, including transmission lines.

Construction activities, such as vegetation clearing and grubbing, pose a high risk of increased mortality for birds. Without mitigation measures, there is a potential for nest destruction and subsequent mortality of nesting birds, young birds, and eggs, especially if these activities occur during the migratory bird nesting period. To address these risks, vegetation clearing will be scheduled outside of the general nesting period for migratory birds (e.g., generally mid-April to late August for Nesting Zone C3) (ECCC, 2023).

During construction and decommissioning, there is a threat of birds colliding with vehicles due to increased traffic and activity on site. This threat primarily arises from the transportation of materials, heavy machinery, and personnel to and from the PDA. This risk will be heightened during periods of increased bird activity in the LAA, such as migration and nesting. To mitigate this risk, measures such as limiting vehicle speed will be implemented, especially during periods of increased activity. The threat of bird collisions with vehicles will be local in the medium-term, continuing through the construction phase. Project-related traffic associated with maintenance during the Project's operation is expected to be minimal.

The Project can result in a direct increase in mortality risk for birds during operation through collisions with transmission lines, wind turbines, and collisions with other Project infrastructure. Transmission lines have the potential to harm, injure, or kill migratory birds through increasing risks of collision and electrocution. To mitigate this risk, the transmission line has been positioned to avoid large areas of water where birds may congregate. To increase line visibility, line-marking devices will be installed, and measures such as vegetation management around the transmission poles and lines will be implemented to reduce the risk of electrocution.

Zimmerling et al. (2013) estimated bird mortality from wind turbine collisions at 43 Canadian wind farms to be an average of approximately 8.2 (± 1.4) birds per turbine per year, ranging from 0 to 26.9 birds. Data from five Atlantic Canadian wind projects (2008 to 2012) showed non-raptor turbine mortality at approximately 1.17 (± 1.01) birds per turbine, ranging from 0 to 7.09 birds, with no recorded raptor fatalities (Birds Canada, 2016).

Radar data collected from the LAA indicate that during the spring migration period most detected targets are above the maximum turbine height (Appendix J). However, high target volumes were also found within the RSZ during spring and fall migrations, especially on nights with strong headwinds as migrating birds tend to move at lower altitudes in opposing winds than when flying with tailwinds. These findings suggest that certain weather conditions may elevate the risk of turbine collisions.

Migratory birds may maintain the same altitude above ground level at the higher elevations of the Cobequid mountains or they may descend to lower altitudes. The higher elevations of the Cobequid mountains, often above cloud ceiling, may necessitate lower flight altitudes above ground level for migrating birds and may result in birds migrating within the RSZ.

Predicting collision risk between turbines and nocturnally migrating birds using pre-construction baseline data (e.g., radar and acoustic data) remains challenging. The primary indicator of risk is the volume of birds migrating within the RSZ, although only a small fraction of these birds may collide with turbine rotors. Various models have been developed to estimate collision risk based on factors such as flight volume, species, rotor height, and RSZ. However, post-construction research suggests that these models often underestimate actual mortality rates, emphasizing the need for post-construction monitoring, especially following nights with unfavourable conditions (refer to Ausenco, 2024 in Appendix J).

Common Nighthawks were recorded during migration and breeding surveys within the LAA and, given the number of detections recorded during acoustic monitoring, Common Nighthawk are likely breeding within the LAA. Common Nighthawk may be at a greater risk of collision with turbines and blades than other birds due to its behaviour as an aerial insectivore as it frequently inhabits open habitat areas to forage at various altitudes. Moreover, its aerial displays, such as wing booms, may heighten the risk of collisions if nesting near turbines. As summarized in COSEWIC (2018), compared to other land bird species, the Common Nighthawk has notably low reported collision rates with vehicles, buildings, communication towers, and wind turbines. However, these rates do not consider population size or exposure. Despite potential losses from collisions, the open nesting habitats provided by these developments may offset such losses (COSEWIC, 2018).

Other species with aerial displays that have also been recorded within the LAA include American Woodcock and Wilson's Snipe. These species may also reach altitudes within the RSZ due to their behaviour.

A post-construction mortality monitoring program will be developed in consultation with ECCC-CWS and NSDNRR and implemented for a minimum of two years. Carcass searches will be conducted to target periods of increased activity (e.g., migration and breeding) and periods following unfavourable weather conditions (e.g., rain and headwinds). Surveys will be designed to account for searcher efficiency and scavenger rates.

Ongoing monitoring and adaptive management strategies will be implemented to assess and mitigate potential impacts on birds during the construction, operation and maintenance, and decommissioning phases of the Project.

The following key measures to mitigate the potential risks of bird collision will be further detailed in a Project-specific EPP and will be implemented prior to and during construction and operation:

- Vegetation clearing will be completed outside of the general nesting period for migratory birds. If clearing needs to occur within this period, the guidelines to avoid harm to migratory birds (ECCC, 2023) and regulators will be consulted.
- Vehicle speed will be reduced, especially in key areas during sensitive seasonal windows for wildlife.

- The Project-specific EPP will include emergency response protocols to protect birds from harm during accidents and/or malfunctions. Bird mortality incidents of 10 or more birds in a single event, or of an individual SAR, will be reported to ECCC and/or NSDNRR.
- The discovery of nests by staff will be reported to the environmental monitor at site and appropriate action or follow-up will be guided by the Project-specific EPP.
- Environmental personnel responsible for site monitoring during construction will receive training to recognize concerns related to migratory/breeding birds that may be present in PDA.
- Guidance specific to minimizing impacts to birds will be captured within a Wildlife Management Plan. These will include guidelines to avoid harm to migratory birds, actions/steps to take should a nest or unfledged birds be discovered, and appropriate buffers based on disturbance activities.
- If large unattended piles of soil occur on site during the migratory bird period, the Proponent will consider measures to cover or to deter birds (e.g., Bank Swallows) from nesting.
- Pileated Woodpecker nesting cavity will continue to be monitored as this species is listed on Schedule 1 of the Migratory Birds Regulations, 2022. If a Pileated Woodpecker nesting cavity is abandoned for at least 36 months and the tree is to be removed, a notification through the Abandoned Nest Registry will be submitted.
- Vegetation management practices to enhance visibility for birds and reduce the risk of collisions will be implemented.
- Overhead power line installation, operation and maintenance will follow, at minimum, the NSPI nesting birds and vegetation management protocols (NSPI, 2023).
- Vegetation around the transmission poles and lines will be managed to reduce the risk of electrocutions with birds and other wildlife.
- Transmission line visibility will be increased by bird flappers or other bird-flight diverters.
- A post-construction mortality monitoring program will be developed and implemented in consultation with NSDNRR and ECCC-CWS to assess the ongoing impact of wind turbines on wildlife, particularly birds, and inform adaptive management strategies.
- If post-construction mortality monitoring identifies significant annual bird mortality or significant bird mortality events (e.g., 10 or more birds at any one turbine; or 33 or more birds (including raptors) at multiple turbines), adaptive management strategies will be employed.

12.3.2.3 Sensory Disturbance

The Project can also result in indirect effects to habitat through sensory disturbance (e.g., noise, light pollution, dust, and vibrations). Sensory disturbance from noise, lighting, increased traffic volumes, and dust deposition may cause birds to avoid or abandon habitat and may cause stress or other physiological effects. These effects are generally considered greatest if disturbance occurs during periods of migration and nesting.

The Project's lighting infrastructure presents potential impacts on birds, particularly through attraction to lights during nighttime or low-visibility conditions. This attraction and disorientation can lead to collisions with illuminated Project infrastructure and this risk would be greatest during migration. Disoriented birds may circle light sources, deplete their energy reserves, and face exhaustion or forced landings, increasing their vulnerability to predation. Poor weather conditions exacerbate these effects, as they lower flight heights, potentially moving within the RSZ. Artificial light can also change birds' perceptions of habitat quality, resulting in selection or avoidance of illuminated areas (Adams et al., 2021).

To reduce disruptions to birds, seasonality will be considered when planning construction and maintenance activities. Lighting will be limited to safety and security needs during Project activities. During construction and maintenance, if lighting on site is required, spill-over light will be minimized and be side-shielded and directed downward to reduce the attraction of birds, where possible. Construction activities will be limited to the daylight hours, when possible, and will avoid illuminating the habitat adjacent to the worksite. Turbine and transmission line lighting levels will be minimized, while meeting Transport Canada's requirements for aeronautical safety. Wildlife and bird-friendly lighting options, such as ADLS lighting, are being evaluated. With these mitigations, impacts on birds related to lighting is expected to be low for the lifespan of the Project.

Noise generated by Project activities can impact birds in various ways, particularly during sensitive periods (i.e., nesting period for migratory birds). Noise can disrupt bird communication, directly impact the health of birds by triggering stress responses, and disrupt foraging and reproductive behaviours, potentially leading to decreased breeding success (Quinn et al., 2006; Mockford & Marshall, 2009; Mockford et al., 2011; Blickley et al., 2012). Noise disturbance can alter bird behaviour, causing them to avoid certain areas and potentially displacing them from important habitats (Marques et al., 2020). Furthermore, Project noise may mask environmental cues for birds, such as predator detection. Thus, careful planning and consideration of noise impacts is essential to minimize adverse effects on birds near the Project.

To reduce disruptions to birds, seasonality will be considered when planning very loud and random noise disturbance (e.g., blasting programs) during construction. Construction works in areas away from natural vegetation will be prioritised during the breeding window, when possible. Construction equipment and vehicles will be kept in good working order and loud machinery will be muffled.

Dust deposition during construction and decommissioning may cause birds to avoid or abandon habitat within the LAA. Impacts from dust generated from the Project are captured in Chapter 5 (Atmospheric Environment). Through the implementation of mitigation and management plans, these impacts are expected to be low.

Anticipated temporary sensory disturbance during construction and decommissioning is expected to have minimal impact on bird populations. This disturbance will be mostly restricted to daylight hours. Limited disturbance is expected during operation and maintenance, with no significant residual environmental effects anticipated.

It is anticipated that effects of light, noise, and dust to birds in the LAA will be low and can be mitigated through strategies to reduce these effects. The following key measures to mitigate the potential effects of the Project on birds will be further detailed in a Project-specific EPP and will be implemented prior to and during construction:

- Seasonal construction restrictions or phased construction plans will be implemented to avoid sensitive bird and wildlife periods.
- Specialized lighting systems (ADLS) is being considered to minimize impacts to wildlife.
- Onsite lighting will be restricted during Project activities to minimize disturbance.
- The fewest number of site-illuminating lights possible will be used in the PDA.
- Turbine lighting will not exceed the minimum standards in the Canadian Aviation Regulations (i.e., Standard 621, Section 12.2 and Figure 5-3).
- Site lighting will be designed to focus on human safety, shielded downward to minimize light pollution to the surrounding environment and adjacent habitat.
- Safety lighting will be shielded so that the illumination shines down and installed only where it is needed, without compromising safety.
- Movement detection lighting will be used on office structures, doors to turbines, gates, etc., which will turn off when not in use.
- Construction will occur during daytime hours and will be restricted at night, when possible, to avoid illuminating the habitat unnaturally, particularly during sensitive periods (migration and breeding).
- Noise-reducing technologies will be used to minimize the impact of construction noise on wildlife.
- Intense sound operations (i.e., blasting) will be scheduled to avoid the breeding migratory bird period, when possible.
- Blasting will be undertaken in accordance with regulatory requirements and will only be conducted by qualified blasting professionals.
- Pre-blast wildlife searches will be completed.
- Blasting will be monitored and will be planned to occur on days where weather conditions are less likely to cause excessive noise levels.
- Construction equipment and vehicles will be kept in good working order and loud machinery will be muffled.
- To avoid attracting birds and/or predators to the PDA, the site will be kept clean of food scraps and garbage, transporting waste to an approved landfill on a regular basis.
- The Proponent will develop and implement wildlife management procedures.

12.3.3 Residual Effects

Activities associated with the Project may induce short to long-term impacts on birds within the PDA and LAA, primarily due to vegetation clearing and cutting; collisions with wind turbines, transmission lines, vehicles, equipment, or infrastructure; and sensory disturbance.

Residual effects related to habitat loss during construction are predicted to be long-term, minor to moderate in magnitude, with this being a conservative estimate, assuming all habitat within the LAA is suitable and occupied. The extent of the effect will be local and will occur once during periods of low to moderate sensitivity (i.e., clearing will not occur within the general nesting window for migratory birds) and reversible.

The residual effects related to direct mortality and injury during the operation and maintenance phase are expected to be minor in magnitude, immediate (i.e., restricted to the PDA), occurring during times of moderate to high sensitivity, long-term, intermittent, and reversible. Bird mortality is predicted to be minor in magnitude based on the results of baseline surveys, though there were high proportions of targets detected within the RSZ during radar monitoring.

Through careful detailed design and micrositing of Project infrastructure to avoid high quality habitat, and the implementation of post-construction monitoring and adaptive management planning, potential significant effects can be mitigated and are, therefore, not anticipated.

12.4 Monitoring

Onsite monitoring for all wildlife species will be conducted during site preparation and construction activities.

As outlined in Section 12.3.2.2, a post-construction mortality monitoring program will be developed in consultation with ECCC-CWS and NSDNRR and implemented for a minimum of two years. Carcass searches will be conducted to target periods of increased activity (e.g. migration and breeding) and periods following unfavourable weather conditions (e.g., rain and head winds). The radius searched around each turbine will be determined based on the height of the turbine (as this affects fall distance of fatalities) and field conditions. Surveys will be designed to account for searcher efficiency and scavenger rates. These results will be used to measure mortality rates for the Project.

The results of the post-construction mortality monitoring program will be submitted to the appropriate regulatory agencies as required. Additional surveys or mitigations may be identified in consultation with regulators following review of the results. An Adaptive Management Plan will be prepared in consultation with NSDNRR and ECCC-CWS detailing acceptable bird mortality thresholds and appropriate operational responses should mortality records exceed those thresholds.

Data from post-construction surveys may also be shared with the AC CDC and *The Wind Energy Bird and Bat Monitoring Database* (NatureCounts - Wind Energy Bird & Bat Monitoring Database) (Birds Canada 2022).

13 Socio-Economic Environment

13.1 Overview

The current state and recent trends in the human environment, such as population, economy, land and resource use, access to utilities and transportation, recreational opportunities, and health are components of the socio-economic environment that may be affected by the Project. The Project will provide a source of revenue for the Municipality of Colchester, create jobs in the region, and reduce global carbon emissions; there may also be effects to other components of the socio-economic environment such as recreational activities and land use. Effects to other VECs described herein, such as air and water quality, could ultimately affect population or human health.

It is anticipated that the Project will interact with the socio-economic environment via various pathways during construction, operation and maintenance, and decommissioning. While existing roads will be used to the extent possible, it is anticipated that construction in the PDA may cause temporary disruptions to recreational trails and traffic. During operation and maintenance, it is anticipated that there will be changes in the visual landscape, where turbines are visible from some viewing points. Consultation with stakeholders is currently underway to prevent interactions with communication and radar systems.

Effects, mitigation measures, and residual impacts to the socio-economic environment as a result of the Project have been assessed in this Chapter. Mitigation will be further developed in a Project-specific EPP as well as contingency and management plans, such as a Traffic Management Plan, prior to construction to minimize adverse effects. Overall, Project implementation is expected to positively contribute to the economy through job creation, training opportunities, contributions to community groups, a stimulus to local businesses, and tax revenues. The Municipality of Colchester will collect tax revenues of approximately $2.8 million each year and the Project will provide substantial annual contributions to the community in excess of $300,000 per year. The Proponent is working with a local company to provide community members the opportunity to invest in the Windy Ridge Community Economic Development Investment Fund (CEDIF) and receive non-refundable tax credits. The Proponent is also working with the Municipality of Colchester to develop a Community Benefits Agreement which will be a binding agreement outlining the benefits provided to the municipality.

13.1.1 Regulatory Context

Assessment of the socio-economic environment considers the legislation, regulations, and guidelines or policies that are relevant to Project activities:

- *Crown Lands Act*
- *Electricity Act*
- *Environment Act*
- *Environmental Goals and Climate Change Reduction Act*
- *Forestry Act*
- *Mineral Resources Act*
- *Motor Vehicle Act*
- *Off-highway Vehicles Act*
- *Public Utilities Act*
- *Special Places Protection Act*
- *Trails Act*
- *Wilderness Areas Protection Act*
- *Wind Turbine Facilities Municipal Taxation Act*
- Canadian Aviation Regulations
- Municipality of the County of Colchester Wind Turbine Development By-law
- ECCC Guidelines for Wind Turbine and Weather Radar Siting
- NSECC Guide to Preparing an EA Registration Document for Wind Power Projects in Nova Scotia (The Guide, 2021)
- NSECC Guidelines for Environmental Noise Measurement and Assessment

13.1.2 Assessment Methodology

The description of the existing environment is based primarily on publicly available online data sources such as the following:

- Statistics Canada (StatCan)
- Health Canada
- Non-government organizations, such as the Community Foundation of Nova Scotia (CFNS)
- Public and stakeholder engagement
- Aerial and topographic imagery
- Municipality of Colchester
- Other federal and provincial government websites and publications

Information garnered during engagements with the public, Indigenous groups, community groups, and non-government organizations as described in Chapter 3 (Consultation and Engagement) were also incorporated.

The following studies were undertaken to support effects assessment relevant to the socio-economic VECs:

- Visual Impact Assessment (WSP, 2024a; Appendix K)

- Shadow Flicker Analysis (WSP, 2024b; Appendix L)
- Noise Assessment (WSP, 2024c; Appendix E)

13.1.2.1 Visual Impact Assessment

The Project visual simulation viewpoints were chosen based on input from community members, council, and rightsholders during the engagement process, selecting locations that capture the anticipated visual impacts that align with community concerns.

The visual simulations, completed by WSP (2024a; Appendix K), considered both the Windy Ridge and Kmtnuk wind turbines as panoramic photocompositions (Appendix K). At each viewpoint, a series of overlapping photos was taken to create a field of view wide enough to encompass all turbines potentially visible from the viewpoint. The location of each viewpoint and the specifications of each photo including camera height, viewing direction, and focal length were recorded. A model of the landscape in and around the Project was created in a 3D software suite and a LiDAR-based surface model was placed in the landscape.

The turbines are represented by 3D models approximating the appearance of the proposed models. Turbines are shown as facing the viewpoint directly, representing maximum visibility for each. Simulated cameras (i.e., views for each photo collected) were added for each viewpoint, which reflect the conditions of the survey (location, viewing direction, tilt, and focal length), rendering turbines as they would appear from the locations of the visual simulations (i.e., position and size of the turbines). The rendered turbines were then overlaid with the photos. Those blocked by foreground elements (e.g., vegetation, landforms) were removed. The resulting photocompositions were then stitched together into panoramic images and enhanced to show a fully blue-sky to maximize the potential contrast (Appendix K).

13.1.2.2 Shadow Flicker Analysis

Shadow flicker is the alternation of shadow and light that occurs when a wind turbine is between the sun and a receptor. The sun shining through the spinning turbine blades causes this effect (NSECC, 2021). WSP (2024b; Appendix L) completed a shadow flicker assessment (Appendix L) using the method outlined within the Guide. In January 2024, a field survey was conducted that identified 23 receptors within approximately 2 km of a Project turbine, although some of these receptors are located slightly more than 2 km from the closest Project wind turbine in the interest of fully capturing all potential shadow flicker effects.

The shadow flicker assessment used the WindPro software package and included locations of the turbines and the nearby dwellings, ancillary structures, and camps. Shadow flicker assessments typically include receptors located a maximum of 2 km from a wind turbine; beyond that, the intensity of the shadow cast has diminished.

The shadow flicker assessment evaluated two conservative modelling scenarios: the theoretical worst-case and the expected-case. The theoretical worst-case assessment assumes the sun is always shining during daylight hours (i.e., no cloudy periods), all Project wind turbines are always active (i.e., rotors always turning), and all Project wind turbines are always oriented with their rotors perpendicular to the line joining the sun and all receptors. The expected-case assessment used historical weather data to estimate the probability of sunshine for each month of the year and the probability of different wind directions (and hence turbine orientations). Both assessment cases applied conservative assumptions that receptors are sensitive to shadow flicker in every direction (i.e., each receptor assumed to have windows facing in all directions) and that there would be no screening of shadow flicker by vegetation, outbuildings, or other structures.

13.1.2.3 Noise Assessment

A noise assessment report was prepared for the Project by WSP in March 2024 (WSP, 2024c; Appendix E). The computer models for the Project noise assessment were developed using the CadnaA software package, in accordance with the Nova Scotia Noise Guidelines (Nova Scotia, 2023). CadnaA implements the noise propagation algorithm described in the International Organization for Standardization (ISO) 9613-2 technical standard (ISO, 1996). The computer models predict noise levels from operation of the Project and of the Kmtnuk wind project and incorporate wind turbine sound emissions and environmental conditions that are known to influence noise propagation (e.g., ground cover (0.5), temperature (10 °C), and humidity (70 percent)).

As described in Chapter 5 (Atmospheric Environment), WSP established an assessment area for the noise assessment as a 2 km buffer from the Project wind turbines and substation based on provincial guidance. The assessment used a baseline acoustic value recommended by Health Canada, where 35 dBA is considered the average baseline acoustic level in quiet, rural areas during nighttime periods (Health Canada, 2017).

13.2 Existing Environment

13.2.1 Population and Economy

Much of the information about the local and regional economy, such as demographics and employment data, presented in this section was garnered from the 2016 and 2021 Census reports available online from Statistics Canada (StatCan, 2023). This was supplemented through Proponent meetings with the Truro Colchester Partnership for Economic Prosperity, local businesses, the Colchester Food Banks and Municipality of Colchester District Councillors to better understand the community and the employment opportunities in the region, as described in Chapter 3 (Consultation and Engagement).

The PDA lies within Colchester County census division, which comprises three rural census subdivisions (A, B, and C), two towns (Stewiacke and Truro), and the Millbrook First Nations

Reserve (Table 13.1). The PDA spans parts of both Subdivision A and Subdivision B, the latter of which contains the population for the community of Debert. Comparing the results of the past two census surveys (2016 and 2021), Colchester County as a whole had a relatively low population growth of 1.8 percent compared to that of the province's 5.2 percent. Population density is lower in the county than that of the province as a whole, particularly in the rural subdivisions, averaging 10 people per km^2.

Table 13.1 Regional Populations

Census Area	2021	Change from 2016 (%)	2021 Population Density (per km^2)
Colchester County Division	51,476	+1.8	14
Subdivision A	3,762	+8.8	4
Subdivision B	19,806	+1.4	16
Subdivision C	12,476	-4.7	9
Truro (Town)	12,954	+5.7	345
Millbrook Reserve	921	+7.1	252
Nova Scotia Province	969,383	+5.2	18

StatCan, 2023

Between 2016 and 2021, the average monthly shelter costs for rented and owned properties in Colchester County increased by 17.5 percent and 9.7 percent, respectively (StatCan, 2023). The median after-tax income in 2020 was $58,400 with 99.7 percent of those employed speaking English. In 2021, 5.5 percent of the population of Colchester County identified as Indigenous.

Employment in the construction industry grew significantly between 2016 and 2021 (by 28 percent), possibly as a result of the inflated demand for housing construction and renovations during the COVID-19 pandemic (Canadian Forest Industries, 2021; StatCan, 2023). However, employment in the natural resource sectors of agriculture, forestry, fishing, and hunting decreased the most of all the documented sectors, employing 20 percent fewer in Colchester County in 2021 than in 2016 (StatCan, 2023). The closure of the Northern Timber pulp mill in 2020 made a significant impact on the forestry industry for both private and commercial contractors that sold pulpwood locally and within the province as a whole (Canadian Forest Industries, 2021). While in operation, Northern Pulp purchased 95 percent of sawmill chips produced within the province, 80 percent of which was from private lands.

Accommodation and food services employed 17 percent fewer people in Colchester County in 2021 than in 2016—which may also be attributable to the health-restrictions imposed on travel and social-distancing during the pandemic (StatCan, 2023; StatCan, 2022).

13.2.2 Land Use and Value

Part of the PDA covers the historic Londonderry iron mining district (Acadian Mines). Between 1849 and 1908, more than 2 million tonnes of iron were mined from the district (Wright, 1975). Remnants of these underground workings remain in the form of dozens of abandoned mine openings around the southwest portion of the PDA (Figure 13.1). South of the PDA, abandoned mine openings also remain from early 20th century coal mining operations. More recently, in 1999, a bulk sample of coal was extracted from this area but the site has since been reclaimed (Mining Association of Nova Scotia, 2019).

There are several aggregate deposits within the PDA. These aggregate deposits are typically glacial deposits (glacial outwash, etc.), many of which are used intermittently as borrow pits (Prime, 1991). Quality Concrete, a joint venture with Lafarge Canada Incorporated, operates an active aggregate quarry at the northwestern entrance to the PDA, off Trunk 4, where wet concrete may be procured for Project construction. Prior to 2016, Dexter Construction quarried the Belmont Pit near the southern extent of the PDA for sand and gravel that was used in a variety of local projects, including the twinning of Highway 104 in the Debert area (Mining Association of Nova Scotia, 2019). The quarry has since been decommissioned and its reclamation included the development of 3.65 ha of wetland habitat adjacent to the Chiganois River.

There are several active mineral claims within the LAA that may traverse the PDA (Figure 13.1). The southwestern portion of the LAA, within the area of the historic Londonderry iron mining district, is being explored for its iron oxide copper-gold potential. To the north of the PDA, near the Debert and Big Snare Lakes, there is active mineral exploration for rare earth elements listed on the NovaROC database for the Mineral Resources Development Fund Recipients (Province of Nova Scotia, 2023). The expiry dates for these mineral claims are as late as 2025 and are likely to be renewed as the holders perform more work on the claims. It should also be noted that the NovaROC database is updated regularly.

There is currently no active oil and gas production taking place in the LAA.

Private land owned by Northern Timber and Brookfield Lumber Company Limited in the LAA has been harvested for both lumber and pulpwood for decades. Evidence of forestry practices within the LAA was discussed in Chapter 1 (Introduction) and illustrated in Figure 1.3 (Appendix A). While logging is still in high demand, the 2020 closure of the Northern Pulp paper mill has resulted in decreased value for pulpwood harvesting (Canadian Forest Industries, 2021). The nearest communities to the Project are Debert to the south and Wentworth to the northwest of the PDA, each approximately 5 km from the Project. Along Route 246 are several farms interspersed with residences, as well as approximately 70 permanent residences or cottages along Old Debert Road, northwest of the PDA—all of which are located more than 2 km from the nearest proposed wind turbine associated with the Project. Approximately 50 permanent residences or cottages occur around the perimeter of Hart Lake, all of which are located more than 2 km from the nearest turbine and are accessed off Lafarge Lane and Trout Lake Road. There are also more populated areas bordering Folly Lake, along Trunk 4, Steven's Road, Reid Road, and Upper Belmont Road at the south. The LAA itself, while mostly uninhabited apart from a few seasonal camps, is a fragmented area that has been used for forestry, hunting, fishing, off-road trail use, and quarrying for decades, as evident from observations made by CBCL during field investigations and satellite imagery (Figure 13.2).

In 2011, homeowners in the Municipality of Colchester estimated that the average value for their single-detached dwelling was $168,200; in 2021 estimates averaged $233,200 (StatCan, 2023). Home ownership had a somewhat declining trend for the same time period, particularly for those in the age demographic of 25 to 39 years whose ownership rates dropped from 59 percent to 53 percent.

13.2.3 Visual Landscape

The visual landscape of the PDA is in the Cobequid Hills Ecodistrict and is characterized by rolling hills, forests, and river valleys. Within the LAA, elevations range from 178.5 to 355.3 masl. Being located within mountainous, fragmented terrain, high points within the PDA are visible from lower elevations of Folly Lake and Wentworth Valley. The visual simulations captured photos of the area as it currently exists from various viewpoints (Appendix K).

13.2.4 Utilities

13.2.4.1 Energy

While 13 percent of electricity generated in Nova Scotia is supplied by renewable energy, the province's power supply is still reliant on fossil fuels (CanREA, 2021). The Municipality of Colchester has been exploring the merits of renewable energy for over a decade. In an effort to reduce carbon emissions, a community initiative was established for Colchester and Cumberland counties to operate a wind farm that would predominantly be owned by local individual investors as a CEDIF. CCWF installed their first turbine in 2011 and procured a 20-year Power Purchase Agreement with NSPI to use the provincial power grid for distribution from the Tatamagouche substation (CCWF, 2023). CCWF now operates two 800 kW turbines and three 50 kW turbines. The Tatamagouche Wind Field, known as Spiddle Hill, powers 300 local homes. CCWF has a memorandum of understanding with the Proponent to be a minority owner of the Project.

The NSPI website (NSPI, 2023) lists other wind power producers currently operating in Colchester and Cumberland counties that are owned or partially owned by NSPI and contribute to the provincial grid:

- Nuttby Mountain Wind Energy, Colchester County – 22 turbines, 50.6 MW
- Higgins Mountain, Cumberland County – 3 turbines, 3.6 MW
- Springhill, Cumberland County – 2 turbines, 2.1 MW
- Amherst, Cumberland County – 15 turbines, 30 MW

There are several additional proposed onshore wind farm developments across both Colchester and Cumberland Counties that will tie into the provincial grid:

- Kmtnuk, Colchester County – 16 turbines, 98 MW
- Higgins Mountain, Cumberland County – 17 turbines, 100 to 119 MW
- Westchester, Cumberland County – 12 turbines, 50 MW

The Project and the Kmtnuk wind farm are connected through an access road at the eastern extent of the Project's PDA. The nearest turbines between the two projects are separated by a distance of approximately 1.1 km. The access points between the Project and Higgins Mountain are on opposite sides of Trunk 4, approximately 2.5 km apart. The nearest turbines between those two projects are sited approximately 6.1 km apart.

There are other wind producers listed for Colchester County that are part of the community feed-in tariff program used for local infrastructure such as Kemptown (2 turbines, 0.10 MW), and Greenfield (2 turbines, 3.2 MW).

CFNS reported in 2017 that there was a total of 39 wind turbines located within Colchester County with a total capacity of 70.6 MW and an annual production of approximately 185,640,000 kilowatt-hours (kWh)—91 percent of the county's usage (CFNS, 2017). The Municipality of Colchester procures 94 percent of its electrical power from NSPI and aims to add 2 MW/year of wind energy by 2050 (Municipality of the County of Colchester, 2021) as well as solar projects. Future undertakings recently approved by the province are discussed in Chapter 15 (Consideration of Cumulative Effects).

The existing 345 kV NSPI power corridor traverses the PDA at the southwestern extent of the turbine array, where the Project transmission line interconnection will be installed and will connect to the provincial power grid (Figure 13.3).

13.2.4.2 Other Utilities and Waste Management

While rural residents within and closely surrounding the LAA use domestic water wells and sewers, municipal public works departments operate five wastewater treatment facilities in local communities, the nearest located in Tatamagouche and Great Village (CFNS, 2017). The Colchester Waste Management Park is located in Kemptown, approximately 40 km via Highway 104 from the Trunk 4 Exit, which accepts construction and demolition waste, including contaminated soils and tires. The Maritimes and Northeast natural gas pipeline runs in an easterly direction approximately 6 km north of Route 246/256.

13.2.5 Communication and Radar Systems

Chapter 3 (Consultation and Engagement) lists stakeholders and regulators that were contacted via mail with information that described the turbine technical specifications and coordinates. The letters requested feedback, details, and specifics regarding potential concerns with potential EMI caused by the Project turbines. The Canadian Coast Guard, RCMP, Innovation, Science and Economic Development Canada, DND, and Bell Mobility

Incorporated confirmed that EMI is not anticipated. Land use assessment is underway by the NAV Canada Land Use program.

The Radio Advisory Board of Canada (RABC) and the Canadian Wind Energy Association (CanWEA) recommend that wind turbines be located at least 50 km from ECCC meteorological radar stations (RABC and CanWEA, 2020). As described in Chapter 5 (Atmospheric Environment), there are several weather stations located within a 50 km radius of the PDA: Debert (10 km), Truro (17 km), Middleboro (20 km), Jackson (24 km), Pugwash (30 km), Upper Stewiacke (40 km), and Lyons Brook (42 km). The Proponent has included ECCC in the notification letters to confirm that there will be no EMI anticipated.

NSPI will own the majority of the facilities operating above 44 kV. The only equipment operating above 44 kV under the Proponent's ownership is the high voltage wind farm collection transformers (34.5 to 138 kV, 230 kV, and 345 kV depending on the interconnection location) and the associated equipment from the transformer up to, but not including, the transmission line. The design and construction of these facilities will be reviewed by NSPI, who will take ownership of the lines and the associated interconnection switching stations following construction.

South of Folly Lake is the former NATO Satellite Ground Terminal, which was in use from 1982 to 2006. The terminal was one of only two NATO satellite communication facilities in Canada. While there used to be an active radar dome during those operations, the radar dome is no longer in service due to outdated control systems (Forsyth, 2024).

13.2.6 Transportation

13.2.6.1 Road Network and Project Access

The proposed PDA will include existing access roads, but they may require upgrades to mobilize equipment during the Project. Currently, the Proponent is evaluating the feasibility of multiple proposed access points into the site. While not all access points will be required, the Proponent does plan to use at least two separate access points in order to reduce traffic on any single access. The PDA can be accessed from the north via the Axe Handle Factory Road, near the intersection of Trunk 4 and Route 246 (Figure 13.3). Route 246 serves as a direct collector road to the provincial Trunk 4 that feeds the TransCanada Highway 104 from Wentworth Valley. The PDA may also be accessed from four points on Trunk 4, including the Lafarge public road and, furthest south, Plains Road. The distance from Plains Road to Highway 104 is approximately 4 km via Trunk 4.

The northern access from Axe Handle Road is located off Route 246, approximately 30 km from Highway 104 via Trunk 4. Route 246 also provides an indirect route to Highway 104 from the Project's northern access road (approximately 30 km), with connections at Route 256 toward Tatamagouche and south via Route 311, whose course comes within 3.5 km of the Gully Lake Wilderness Area.

The section of Highway 104 containing the exit to Trunk 4 will serve as the primary route to the PDA during construction for vehicles approaching from the east, such as turbine components. Vehicles approaching Trunk 4 from the west on Highway 104 will pay a toll at the Cobequid Pass Toll Plaza, located approximately 16 km west of Trunk 4. The toll plaza collects fees from traffic in both directions at that location (with the exception of vehicles with Nova Scotia registration). Tolls range from $4.00 for passenger vehicles to $24.00 for those having eight axles (Cobequid Pass Highway 104, 2023).

There are several small private roads that intersect the LAA, including Upper Belmont Road, that runs north-south through the eastern side of the Project and Trout Lake Road that traverses the western portion of the LAA near Folly Lake. Plains Road leads from Debert to the southern-most access road to the PDA. The aforementioned Axe Handle Factory Road exists to the north, while the Eastern Folly Mountain Road extends across the outer perimeter of the southern portion of the PDA. Many of the remaining roads are unnamed, and likely served as access roads to abandoned rock / mineral excavation sites or as logging roads.

The Province of Nova Scotia regularly conducts traffic counts along its 100 Series Highways, 1 to 99 Series Trunks, and 200/300 Series Routes, and makes the dataset available online. Data from the traffic count locations for the roads in the network closest to the PDA (Figure 13.3, Appendix A) are summarised in Table 13.2. Information from the province included the location and date of the count, and the average daily traffic (ADT) and annual average daily traffic (AADT). The AADT is more reflective of long-term average daily traffic conditions, and is the metric used in this assessment.

Table 13.2 NSDPW Traffic Count Summary for Nearby Roads

Road	Date	Description	ADT	AADT
Plains Road (EB)	08-15-2016	Plains Road – 100 m East of Trunk 4 (EB)	376	310
Plains Road (WB)	08-15-2016	Plains Road – 100 m East of Trunk 4 (WB)	421	340
Trunk 4	01-01-2022	Cumberland/Colchester County Line to Cobequid Pass (Glenholme)	--	1920
Route 246	06-08-2022	Trunk 4 (Wentworth) to Colchester/Cumberland County Line	517	480
Route 104 (EB)	05-12-2022	1.1 km east of Exit 11 (Glenholme)	5691	5610
Route 104 (WB)	04-25-2022	2.58 km west of Exit 12 (Masstown)	6057	6570

EB = Eastbound
WB = Westbound

13.2.6.2 Alternative Transportation

The Canadian National Railway Company (CN) operates a track running parallel to Trunk 4, west of the Project (Figure 13.3) with a station at Folly Lake (CN, 2023). The entrance to Folly Station Road is located approximately 700 m south of the PDA's entrance at Lafarge Lane. CN is the only transcontinental railway in North America, carrying cargo as far south as Mexico City. The rail line is used by VIA Rail for passenger transportation in Atlantic Canada. The Folly Lake track is rated the highest weight capacity of the CN routes.

While most residents travel by car, the Colchester Transportation Cooperative offers pre-arranged bus services on demand during daytime hours on weekdays for the county. There is a Maritime Bus terminal in Truro that provides courier and passenger transportation services to many connections within the Maritime provinces.

13.2.6.3 Airports

The nearest airport is located within the Debert Business Park, approximately 8.5 km south of the nearest Project turbine (Figure 13.3). The Debert Airport has two runways used for private aircraft and a flight school, 958 m and 1,524 m length (Debert Business Park, 2018). Accepting international transit from permit holders, an outpost of the Canada Border Services Agency, is present on site. The Debert Flight Centre, home to the Truro Flying Club, is closed at dusk; nighttime flying is available with prior notice (Debert Flight Centre, 2023). The nearest commercial airport is the Halifax Stanfield International Airport—airport code YHZ—located in Enfield approximately 65 km south of the nearest Project turbine. Transport Canada owns the airport, which is operated by the Halifax International Airport Authority (HIAA). The HIAA reported that 3.1 million passengers used the airport and cargo activity included 1,585 flights in 2021 (HIAA, 2022). The NAV CANADA control tower is a free-standing tower 22 m in height (HIAA, 2023). Two runways are operated, 10,500 feet and 7,700 feet in length.

13.2.7 Recreation and Tourism

The private and Crown properties that constitute the LAA are used year-round for off-roading activities, particularly by ATVs and snowmobiles. Consultation with the SANS, Fundy Trails, and North Shore clubs, as well as a review of the SANS 2021 to 2023 trail map (SANS, 2023), revealed a network of snowmobile trails across the LAA (Figures 13.2 and 13.3). The trails provide access to recreation, hunting, and fishing areas. As outlined in Chapter 3 (Consultation and Engagement), the Proponent has been working with local stakeholder groups to maintain access to all trails in the PDA for snowmobilers and ATV users.

There are several hiking trails that intersect the LAA (Figure 13.3). Annandale Falls, accessed from the existing rural road off Highway 246 that will form part of the PDA, is a moderately trafficked hiking trail. The proposed transmission line partially overlaps with Stevens Road Loop, a lightly trafficked loop trail near Folly Lake. Horse Pasture Brook Falls, near Folly Lake, is a moderately trafficked hiking trail within the Wentworth Valley Wilderness Area.

There are also a few lightly trafficked hiking trails that are accessible from Trunk 4 including Hart Lake Loop and Upper Hart Lake Brook. Chiganois River Falls is accessible using existing rural roads and trails in the northern eastern portion of the PDA. In total, there are 144 km of active transportation trails in Colchester County, with another 500 km for snowmobiles and 200 km for ATVs (CFNS, 2017).

The Wentworth Valley Wilderness Area to the west, Staples Brook Nature Reserve to the south, and the Gully Lake Wilderness Area are the closest parks and protected areas to the PDA (Figure 13.3). These parks and protected areas are accessible to the public and can be used recreationally for permitted activities. In wilderness areas such as Wentworth Valley Wilderness Area and Gully Lake Wilderness Area, permitted activities include low-impact recreation and tourism such as hiking, kayaking, canoeing, sport-fishing, and limited hunting (Gardner Pinfold Consultants Incorporated, 2017). In nature reserves such as the Staples Brook Nature Reserve, low-impact recreational activities such as walking and other activities that align with ecological integrity restoration and maintenance goals are allowed to occur (Gardner Pinfold, 2017).

With paved shoulders that lead to the rural roadway of Route 307, Trunk 4 is part of the Bicycle Nova Scotia's Blue Route, connecting Masstown to Wallace (Bicycle Nova Scotia, 2023). The purpose of the Blue Route provincial cycling network is to connect Nova Scotia's communities through designated cycling routes on secondary highways with paved shoulders, low traffic volume roads, hard surfaced trails, and city streets.

Belmont Mountain Range, a shooting range, is located approximately 2 km south of the PDA, on the west side of Upper Belmont Road. The Debert Golf Course, a 9-hole public golf course, is located on Reid Road, which may be used to access the PDA. Camp Evangeline, a Christian ministry and retreat centre and campground, is located north of Debert, outside the LAA. The Municipality of Colchester has indoor facilities as well for swimming and skating, notably the Rath Eastlink Community Centre which has an NHL-sized ice surface, a three-lane track, rock climbing, and aquatic facilities. The Rath Eastlink Community Centre is located in Truro.

Ski Wentworth, located approximately 5 km west of the nearest Project turbine (Figure 13.3), is an all-season tourist destination on Trunk 4 that was established over 90 years ago (Ski Wentworth, 2023). During ski season, the resort offers more than 20 alpine trails for downhill skiing, four of which offer night-time skiing. There are two quad-chair lifts, one T-bar, and a smaller lift for beginners to access three terrain parks. The resort also offers 10 km of groomed cross-country trails. Outside of ski season, they support access to biking and hiking trails, have a licensed patio that serves pub food and craft beer, and offer seasonal events such as chairlift rides to view fall foliage. Ski Wentworth has staff that work at the site year-round.

13.2.8 Human Health

Human health relies at least partially on several environmental factors, many of which are regulated by the Nova Scotia *Environment Act* and the *Canadian Environmental Protection Act*. Nova Scotia has adopted Health Canada's *Guidelines for Canadian Drinking Water Quality*, which outline criteria for safe levels of physical, chemical, microbiological, and radiological parameters (Health Canada, 2022a; NSECC, 2024). Both air and water quality, previously discussed in this document (Chapter 5: Atmospheric Environment and Chapter 6: Geophysical Environment), have proven effects on human health, with potential for adverse effects if unacceptable exposure to elevated chemical concentrations occurs. The potential for accidents and malfunctions, such as ice throw, and mitigation for such are discussed in Chapter 18 (Accidents and Malfunctions).

13.2.8.1 Air and Water Quality

As discussed in Chapter 5, Nova Scotia evaluates air quality against the CAAQS which were developed by the CCME to protect the health of all Canadians. They include standards for PM, SO_2, and NO_2.

Fine PM is characterized according to size: PM_{10}, which is equal to or less than 10 µm, is typically composed of dust granules that are invisible to the naked eye as individual specks, becoming a potential human health hazard. These particles are commonly generated from vehicle movement as exhaust emissions and dust. Emissions of $PM_{2.5}$, having a size of 2.5 µm or less, are small enough to inhale into the lungs and are believed to be of most concern to human health (CCME, 2024).

Combustion gases are produced by the burning of fossil fuels, including smoke from fires. Carbon monoxide is formed from the incomplete combustion of carbon compounds. Nitric oxide is released in the exhaust of internal combustion engines and furnaces. Nitric oxide is an unstable compound that is readily converted to NO_2, which contributes to the formation of acid rain and is a primary precursor pollutant in the formation of smog. SO_2 is produced by burning oil and coal for energy production and space heating; these contain sulphur as an impurity in various concentrations. Other sources of SO_2 include oil refineries, pulp and paper mills, and vehicles. Volatile organic compounds (VOCs) are those that readily evaporate from POL to form air toxins (New Brunswick Department of Environment and Local Government, 2022). Exposure to air pollutants can result in adverse impacts on human health, leading to increased medical attention, days on which existing respiratory illnesses are worsened, and restricted activity days, as well as premature mortality (CCME, 2024).

As discussed in Chapter 5 (Atmospheric Environment), based on the 2021 air quality monitoring data, the most current available during the EA preparation, the CAAQS have been met in the northern air zone where the RAA is located (NSECC, 2023a).

Exposure to elevated concentrations of contaminants in drinking water can lead to potential health risks to the local population. Nova Scotia is a known source of elevated concentrations of arsenic, uranium, and radon in soil, rock, and groundwater. Chapter 6 (Geophysical Environment) presents risk maps available from the Nova Scotia Department of Mines that show some risk areas for existing arsenic, uranium, and radon presence in the LAA (Figures 6.2, 6.3, and 6.4). Groundwater from igneous and metamorphic rock in Nova Scotia tends to exhibit higher concentrations of dissolved metals such as iron and manganese.

The Nova Scotia Groundwater Database (NSECC, 2023b) has limited amount of information available for registered wells, particularly for results of laboratory analysis. Therefore, a total of 90 registered wells within and surrounding the LAA were reviewed for water quality records, of which only 14 to 85 included some chemical parameters (Table 13.3). These wells are underlain by the same types of bedrock that influence groundwater quality within the groundwater LAA of 1 km (Chapter 6: Geophysical Environment; Figure 6.1).

Health Canada lists maximum acceptable concentrations (MACs) for contaminants associated with risks to human health (Health Canada, 2022a). Of the 14 records that included arsenic analytical results, one of those (7 percent) had a concentration of arsenic that exceeded the MAC value for that parameter (Table 13.3). Of the 64 records that included analytical results for manganese, four (6 percent) had a concentration of manganese that exceeded the MAC value for that parameter. Iron concentrations exceeded the aesthetic objective in 19 of the 85 available records (22 percent) that included analytical results for that parameter. The exceedance of the aesthetic objective value is not a health concern but affects the palatability of the water; iron can also stain laundry and plumbing fixtures.

Table 13.3 Well Water Quality

Parameter	MAC (mg/L)	Number of Records	Number and Rate of Exceedances
Arsenic	0.010	14	1 (7%)
Iron	0.3*	85	19 (22%)
Manganese	0.12	64	4 (6%)

*Indicates an aesthetic objective

Radon readily vaporizes from water and is therefore more of a health concern for release and concentration in indoor air than a concern for drinking water. Health Canada, therefore, does not list a MAC value for radon (Health Canada, 2022a).

Effects and mitigation for changes specific to air quality and groundwater are presented in Chapter 5 (Atmospheric Environment) and Chapter 6 (Geophysical Environment) and are not further assessed in this chapter.

13.2.8.2 Healthcare and Emergency Response Services

The region lies within the Nova Scotia Health Authority's Northern management zone. The Colchester East Hants Health Centre in Truro is the full-service 24-hour emergency hospital nearest the LAA (approximately 26 km from the nearest access road via Trunk 4 and Highway 107). The Lillian Fraser Memorial Hospital in Tatamagouche is a community hospital located approximately 20 km from the northern Project access road via Route 246 that can provide limited urgent care services with variable hours. There are two RCMP detachments in the Truro area and one in Tatamagouche.

The Emergency Management Office is responsible for emergency planning and response in the province, including storm preparation and support, and administers the 911 phone system to dispatch paramedics and RCMP first responders. There are two fire stations near the LAA: the Wentworth Volunteer Fire Department and the Debert Fire Brigade, each of which are located approximately 6 km from northern and southern access roads, respectively.

13.3 Effects Assessment

13.3.1 Boundaries

- Human Health: an LAA of 2 km from the PDA to include the LAA for Air Quality (500 m as determined in Chapter 5 (Atmospheric Environment)), Groundwater (1 km as outlined in Chapter 6: Geophysical Environment), and 2 km for sensory disturbance.
- Land Use and Value, Visual Landscape, and Recreation and Tourism: an LAA of 2 km from the PDA, where construction, operation and maintenance, and decommissioning may be visible and audible. An RAA of 5 km for these effects in consideration of other ongoing or planned activities.
- Population and Economy, Electricity and Other Utilities, Communication and Radar Systems, and Transportation: an LAA of 5 km that includes the communities of Debert and Wentworth. An RAA that extends to the County of Colchester for Population and Economy.

13.3.2 Potential Effects and Mitigation

Several changes were implemented for the Project to minimize potential direct and indirect adverse impacts on the socio-economic environment, where reasonable, while meeting engineering and design constraints. Detailed design of the Project and micrositing of turbines will further reduce potential adverse interactions between the Project and local users of the LAA. Micrositing involves exact placement of the turbine within the turbine sites as shown in the PDA. Direct and indirect effects of the Project on components of the socio-economic environment could occur through various interconnected pathways for the lifetime of the Project.

It is anticipated that most effects to the socio-economic environment will be positive. There will be employment opportunities and a stimulus to local businesses during all phases, and the Project will create a source of revenue to the Municipality of Colchester during operation and maintenance. Access to natural resources and recreational activities will be affected; adversely during construction but positively overall during operation and maintenance with improved access throughout the LAA. The county's goal to lower their own carbon footprint and efficiencies in electrical power distribution to Point Tupper will be achieved in the long-term. Project activities can affect the socio-economic environment as indicated in Table 13.4; these potential effects do not consider the detailed design of the Project and micrositing of turbines that is yet to be completed or the implementation of mitigation measures described herein.

Table 13.4 Potential Environmental Effects of the Project on the Socio-Economic Environment

Project Activity	Potential Interactions						
	Change in Population and Economy	Change in Land Use and Value	Change in Visual Landscape	Change in Utilities	Change in Transportation	Change in Recreation and Tourism	Change in Human Health
Construction							
Site Preparation	X	X	-	-	X	X	X
Access Roads Construction and Modifications	X	X	-	-	X	X	X
Material and Equipment Delivery and Storage	X	-	-	-	X	X	X
Infrastructure Installation	X	-	X	-	-	X	-
Restoration of Temporary Areas	X	-	-	-	-	X	X
Testing and Commissioning	X	-	-	-	-	-	-
Operation and Maintenance							
Turbine Operation and Maintenance	X	X	X	X	-	X	X
Road Maintenance	X	X	-	-	X	X	X
Power Line and Substation Maintenance	X	-	-	-	-	-	-

Project Activity	Potential Interactions						
	Change in Population and Economy	Change in Land Use and Value	Change in Visual Landscape	Change in Utilities	Change in Transportation	Change in Recreation and Tourism	Change in Human Health
Vegetation Management	X	-	-	-	-	-	X
Safety and Security	-	-	-	-	-	-	-
Decommissioning							
Removal of Infrastructure and Site Restoration	X	-	-	-	X	X	X

X = Potential Interaction

- = No Interaction

13.3.2.1 Population and Economy

During Project planning and construction, the Proponent intends to resource local labour and skillsets to support the work required as part of the Project. In addition to utilizing local expertise across the environmental, engineering, archaeological, public relations, and land surveying sectors to support with Project planning, construction activities will require local and regional labourers, equipment, and materials. Much of this will be considered standard construction services that do not require training specific to wind turbines.

Staffing will be required for the lifetime of the Project. It is estimated that construction and decommissioning activities will require 200 to 300 people; a part-time and full-time staff complement of 12 to 20 will be needed to support operation and maintenance. The influx of workers to the region will also contribute wealth back into the local economy through spending on goods and services such as restaurants, stores, and accommodations during all Project phases. The Proponent has been working with the Municipality of Colchester and First Nation partners to develop a committee focussed on maximizing local contracting and employment opportunities. There will be possibilities for establishing partnerships to provide training for those interested in gaining employment associated with the Project, with preferences to First Nations and members of the local community. Given the number of wind projects already implemented in Nova Scotia, it is expected that wind turbine specialists (such as those in turbine commissioning, crane operators, and/or specialized transport vehicle drivers) can be sourced from within the province.

Local businesses will have the opportunity to provide construction materials, such as crushed rock for the construction and modifications to access roads, concrete for foundations, and general construction equipment. Engagements with local businesses are discussed in Chapter 3 (Consultation and Engagement).

The Proponent has also committed to several direct benefits to members of the community:

- The Proponent will pay annual tax revenues of approximately $2.8 million to the Municipality of Colchester as per the provincial *Wind Turbine Facilities Municipal Taxation Act*.
- The Proponent will establish an annual proximity payment to homeowners within a specified distance of a turbine, to be determined with the Municipality of Colchester.
- Community members will have the opportunity to invest in the Windy Ridge CEDIF.
- The Proponent will establish a Community Benefits Agreement with the Municipality of Colchester.
- The Proponent will establish a Community Vibrancy Fund to provide annual funding for community improvement initiatives starting in 2026, at the end of the first year of operations.
- The Proponent will establish a $50,000 bursary to fund scholarships for students planning careers in the renewable energy industry. The scholarship program is intended to commence in 2024, prior to the start of construction, and will be replenished. Information pertaining to the eligibly for the scholarships will be

disseminated via multiple channels, following the finalization of the Benefits Agreement with the Municipality of Colchester.

Overall, it is anticipated that the economy of the Municipality of Colchester will benefit from Project implementation.

13.3.2.2 Land Use and Value

Implementation of a wind facility will impose limitations for other land uses in the PDA, but road upgrades and new access road construction may facilitate the use of land within the LAA. Harvesting of natural resources, such as forestry and mining, may be adversely affected within the LAA during construction, as access will be interrupted intermittently during road upgrades. There are, however, various access roads throughout the LAA and not all would be under construction at once; access via other routes will therefore be open. During operation and maintenance, while there may be less overall forested land due to clearing activities associated with the Project, these adverse effects are expected to be offset on the private land parcels due to the increase in revenue received through land lease agreements as previously described. Approximately 92 percent of the land leased for this Project is privately owned (only 8 percent being Crown land). Additionally, those using the area for harvesting natural resources may benefit from the road upgrades that will provide improved access and road conditions that will reduce wear on equipment. Approximately 116 km of existing roads will be included in the PDA and another 34 km will be constructed. There will be a low land use density of one turbine per 170 ha (i.e., one turbine per 420 acres) on average.

Extensive research examining the impacts of wind projects on property values has been conducted through the years. Community demographics and wind facility characteristics are site-specific, and effects on property values often largely depend on perception of visual impacts. While several studies have indicated that even large-scale wind farms have no significant impacts on property values, a recent peer-reviewed study using a 133-turbine wind farm in a rural community in Ontario has shown that, although the wind farm did not generally affect property values, the value of individual properties in close proximity to wind turbines can be adversely affected and impacts may be affected by community support (Vyn, 2015). Another recent study in the US indicated that property values may decrease during construction only to have a subsequent increase once operation begins (Brunner and Schwegman, 2022).

A study published this year by Brunner et al. (2024) compared data on commercial wind turbines and residential property transactions between 2005 to 2020 in both urban and rural areas across much of the US. The study concluded that property values for homes located beyond 2.4 km of a turbine in an urban area were unaffected. Those within 2.4 km of a turbine that experienced adverse effects (approximately 11 percent decrease) were predominantly located in urban communities with a population greater than 250,000 people (Brunner et al., 2024). However, the authors found that there was no impact on property values found in rural (agricultural and forested) areas with homes in proximity to wind turbines (population less than 250,000). Given that Colchester County has a population of approximately 51,500 people, and the Project turbines are located at minimum of 2 km from each building, it is unlikely that there will be adverse impacts on property values as a result of Project implementation.

Early consultation with the Municipality of Colchester as well as information gained through the EA process and public engagements resulted in alterations to the Project design as well as commitments to the municipality to promote positive effects to land use and value:

- A total of 17 turbines were removed or relocated based on feedback from the public. Some portions of the PDA that were proposed for location within the French River Watershed Protected Water Area and Crown land with sensitive habitat have been either relocated or removed from the Project design (see Figure 2.2).
- Access to the PDA uses existing roads and the PDA design itself has maximized the use of existing gravel roads.
- Once permission is granted, long-term leasing fees will be paid for Crown lands and to private property owners for land within the PDA.
- The Proponent will establish an annual proximity payment to homeowners within a specified distance of a turbine, to be determined with the Municipality of Colchester.
- The local public will be notified prior to construction.
- The Proponent will communicate Project activities and timing to local resource users and the public throughout the lifetime of the Project.
- Merchantable timber will be salvaged and used in accordance with Project agreements.
- The Proponent will continue to engage with local resource stakeholders about effects to resource use and the planned mitigation measures.
- The area of disturbance will be limited to the PDA.
- Clearing will be minimized to the extent possible.
- An EPP will be implemented that includes procedures for waste removal.
- A Complaint Resolution Plan will be developed and implemented by the Proponent.

13.3.2.3 Visual Landscape

Visual impacts are based on public perception of wind turbines, including lighting, paint colour, and degree of visual contrast from the surrounding landscape (Sullivan et al., 2012). The visual impact of wind turbines can also be influenced by its operating status. Visual impacts associated with an operating turbine are lower than that of one that is stationary (Saidur et al., 2011). When the blades are in motion, they can be less visible from a distance.

A recent study by Hamza et al. (2022) concluded that, over the past three decades, there has been an evolution in the public perception of wind turbines, and there are notable differences in how the landform affects the perceived aesthetics. Responses to visual images of various sites, proximities, landscapes, and maturity of wind turbines' technology were recorded and the results revealed positive reactions to wind turbine vistas in seascape and landscape settings; reactions to images of wind turbines as an addition to buildings in urban contexts were unfavourable. While gender did not affect perception, younger individuals were more apt to react positively to wind farm images, which indicates that early exposure to wind turbine landscapes is driving an upward shift in positive perception.

Simulations based on the currently proposed turbine layout produced a predictive turbine visibility map that shows the number of turbines visible through various points in Wentworth Valley and Route 246. Turbines will be visible from some of the viewpoints around Folly Lake. Turbines are visible from Folly Mountain as shown from various viewpoints up to 4.4 km from the PDA as conceptualized using photography overlays (Appendix K).

Early consultation with the Municipality of Colchester as well as information gained through the EA process and public engagements resulted in alterations to the Project design (see Figure 2.2). Turbines that had the potential to change the visual landscape as viewed from the summit of Ski Wentworth have been removed from the design. The turbines closest to Folly Lake have also been removed to reduce visual impacts.

13.3.2.4 Utilities

Positive effects such as building and maintaining new electrical infrastructure will occur during construction and operation and maintenance. Renewable energy from Windy Ridge will allow Nova Scotia to power a green hydrogen and ammonia project at Point Tupper. The Project's implementation may also support the municipality in achieving the Municipality of Colchester's (2021) target for net-zero GHG emissions by 2050.

The Project will not be a user of municipal wastewater or potable water distribution systems in Debert or Tatamagouche. Nor will it affect the Maritimes and Northeast natural gas pipeline located north of the PDA. Waste products will likely be disposed at the Colchester Waste Management Park, which is equipped to accept construction and demolition materials, including contaminated soils and tires. Local waste management facilities may benefit from increased business; however, the capacity of the local waste management facilities will be considered.

Overall, positive effects are expected for local utility providers and no mitigation is proposed.

13.3.2.5 Transportation

During construction, there will be an increase in traffic from crew commuters; trucks to transport soil, rock, and waste; and flatbed trailer trucks transporting construction equipment approaching from both the east and west. It is anticipated that there will be traffic interruptions as a result of increased road users and slower moving vehicles.

The proposed construction is anticipated to add a maximum of 200 trucks/day to the local road network at peak of construction. When considering the traffic impacts, each truck represents one trip in and one trip out from the site, resulting in a total increase of 400 trips/day.

Since the specific information regarding trip distribution throughout the network is still being evaluated, these trips are not assigned among the various access points. Therefore, this assessment conservatively considered the impacts should all truck traffic be routed through the same access point on a particular day as a worst-case traffic scenario. Based on the AADT data, the overall increase in daily traffic on each roadway is presented in Table 13.5.

Table 13.5 Expected Traffic Increase Per Day During Peak Construction

Road	Percent Increase
Trunk 4	21%
Route 104 (EB)	4%
Route 104 (WB)	3%
Route 246	83%
Plains Road	62%

The additional daily truck traffic has very little impact to Route 104 conditions, with an increase less than 5 percent in either eastbound (EB) or westbound (WB) directions. In a rural area like this, the baseline traffic volumes are generally lower on minor roadways; therefore, with a development of this nature the additional traffic appears to show a notable increase for the network (excluding Highway 104) compared to the very low existing local traffic. This ranges from 21 percent on Trunk 4 to up to 83 percent on Route 246. This assessment considers the worst-case scenario, and it is more likely that these trucks will be distributed across the access points and not concentrated through just one route. The increase in traffic will be temporary, with the increased traffic conditions confined to peak construction periods over the approximate two-year construction phase (approximately 5 percent of the Project lifetime) and not permanent changes.

Turbines are expected to arrive in Nova Scotia via ship at either Liverpool or Sheet Harbour, Nova Scotia, and transported approximately 280 km to the PDA via series 100 highways, approaching Trunk 4 via Highway 104 east. It is not likely that rail will be used for delivery of Project infrastructure. During this period, transport vehicles carrying large turbine components at speeds lower than the maximum speed of those routes may temporarily interrupt traffic along Highway 104, Trunk 4, and Route 246. A Traffic Management Plan will be developed to prepare for the delivery of turbine components. The Proponent is evaluating multiple entrances to determine which would have the least impact and spread out the Project vehicle traffic in the LAA to reduce traffic impacts at individual entrances to the PDA.

Both Highway 104 and Trunk 4 are Schedule C Maximum Weight roads, having a weight restriction of 62,500 kg (NSDPW, 2023). Route 246 is a Schedule D Intermediate weight road, having a maximum weight restriction of 49,500 kg for most vehicles, and 62,500 kg for B Train vehicles, which are combinations of tractor with two trailers.

The following key measures to mitigate the potential effects of the Project on transportation resources will be further detailed in a Traffic Management Plan and will be implemented prior to and during construction:

- A Special Move Permit will be procured for vehicles with weights or dimensions greater than those listed in the Weights and Dimensions of Vehicles Regulations under the Nova Scotia *Motor Vehicle Act*.
- The regional RCMP will be notified of equipment deliveries that require Special Move Permits anticipated to affect traffic.
- The local public will be notified of the anticipated equipment delivery schedule.
- Access to and from the Project should follow predefined travel routes. Multiple entrances are being evaluated to minimize effects.
- The routing of Project traffic through residential areas will be avoided during the peak traffic periods.
- Adequate safety signage, fencing, guardrails, and/or warning tape will be installed to indicate restricted Project areas to advise members of the public.
- Safety warnings and signage will be clearly posted to advise hikers, cyclists, snowmobilers, and other resource users of the Project activities.
- Onsite equipment and vehicles will operate only within the PDA.
- Project vehicles will abide by posted speed limits.
- A Complaint Resolution Plan will be developed prior to construction.

13.3.2.6 Recreation and Tourism

The effects that a wind farm may have on local recreation and tourism depend on the visibility of wind turbines, the number of tourist attractions and tourists that frequent the area, and the area's degree of existing disturbance (Sæþórsdóttir et al., 2021), as well as perception of wind energy (Frantal and Kunc, 2011).

In July 2023, a telephone survey including 300 residents of the Municipality of Colchester was completed by a public affairs company to gather information about public perception and concerns for implementing wind projects in their community (Creative Currency, 2023). Survey results indicated that 90 percent of participants support the development of wind energy within the province; 86 percent support development within the Municipality of Colchester; and 68 percent support development within 3 km of their home.

Some of the trails that cross the PDA (Figure 13.3) may need to be temporarily re-routed to avoid heavy equipment during all phases of the Project. The Blue Route connecting Masstown to Wallace shares a section of Trunk 4 that will be used by heavy equipment and component delivery during construction and decommissioning activities. Cyclists on paved shoulders are at increased risk from heavy truck traffic, particularly wide loads and trucks with significant blind spots. A detailed Traffic Management Plan will be developed to mitigate the potential for incidents, which is discussed further in Chapter 18 (Accidents and Malfunctions).

There is a portion of the SANS trail network that overlaps with the PDA. During construction, snowmobile and ATV users may temporarily lose access to sections of trail and need to adapt to detours during road upgrades and clearing. Such effects may occur during operation and maintenance as well, though to a lesser extent. As outlined in Chapter 3 (Consultation and Engagement), the Proponent has been working with local clubs to maintain access to all trails in the PDA for snowmobilers and ATV users during Project operation through considerations in layout design, construction practices, and operational strategies. One practice during winter operation and maintenance, for example, could include using tracked vehicles during the winter to reduce the need to plough or intentionally ploughing snow onto snowmobile trails to increase the trail base. During the 2023/2024 winter geotechnical survey activities, only tracked vehicles were used on groomed SANS trails in the Cobequid Mountains to minimize disturbance and access to snowmobile trails. During operation and maintenance, ongoing communication with snowmobile and ATV users will remain a top priority to ensure shared access of the PDA.

Similar effects will also be felt by users of the Annandale Falls trail, Chiganois River Falls trail, and Steven’s Road Loop trails, which partially overlap the PDA. Access road routes and the transmission line RoW will be widened in some areas, which could lessen the natural experience of the hikers where an existing access road forms part of the trail. Conversely, increasing access routes and the transmission line RoW may increase opportunities for some snowmobile and ATV users. Other recreational activities such as hunting and fishing are not anticipated to be impacted by the Project since access to the surrounding area will not be severed and new or improved access may be created.

Although the layout of the PDA was strategically sited to use existing roads as much as possible (77 percent of the access roads will be existing roads), increased traffic on access roads during construction may lead to temporary interruptions or detours to ATV and/or snowmobile operators as well as hikers due to re-routing to avoid areas of construction within the PDA as well as decrease the probability of traffic incidences (further discussed in Chapter 18: Accidents and Malfunctions).

The Project commits to keeping recreation spaces open to local users and working proactively with clubs to engage and communicate with the members. Changes to Project design in response to public engagement (see Figure 2.2) and the following key measures to mitigate the potential effects of the Project on recreation and tourism will be further detailed in a Project-specific EPP as well as a Traffic Management Plan and will be implemented prior to and during construction:

- Turbines previously proposed for recreational areas around Frog Lake have been removed or relocated.

- Open engagement will be continued with Ski Wentworth, SANS, the Fundy Trail Snowmobilers Club, the North Shore Snowmobilers Club, and the ATV Association of Nova Scotia. These organizations will be notified regularly about Project activities that may affect trail use to minimize disturbance.
- Public notifications of construction and traffic disruption will be issued.
- Temporary detour and traffic control signage will be erected when and where necessary.
- Where trail paths enter safety setbacks, the Proponent will establish trail detours.
- The Traffic Management Plan will include community education and notification, as well as provision of escort vehicles for wide loads or vehicles that require increased turning radius to avoid disruption to tourism.

13.3.2.7 Human Health

Sensitivities to nighttime lighting, noise, shadow flicker, and electromagnetic field (EMF) have been cited as public concerns associated with wind farms. Sensory disturbance may also be affiliated with vibrations and visual impacts such as obstruction of views and aesthetics (Health Canada, 2014). Some Nova Scotians consider wind turbines a source of annoyance (Union of Nova Scotia Municipalities, 2015). Annoyance levels are typically self reported and can be influenced by the attitude individuals have with respect to wind turbines (Ellenbogen et al., 2012). Health Canada considers annoyance an indicator of health effect, as it can impact quality of life. The World Health Organization (WHO) also recognizes annoyance as an adverse health effect (Union of Nova Scotia Municipalities, 2015). Potential for accidents and malfunctions that could also affect human health (i.e., ice throw, structural damage, and fires) are discussed in Chapter 18 (Accidents and Malfunctions).

The Municipality of Colchester recently updated their Wind Turbine Development By-law (Chapter 56) to increase the setback distance of wind turbines from residences from 700 m to 2 km in February 2023. The intent of this increase was to mitigate potential adverse human health effects on the community from wind turbines. This Project was designed so that the nearest permanent dwellings are greater than 2 km away from the proposed turbine locations per municipal requirements. Legislated requirements and best practices associated with shadow flicker and noise exposure are also met and turbine placements have been strategically located to minimize annoyance caused by visual aesthetics to the extent practical.

Despite the potential adverse effects of wind energy projects on human health, wind energy projects can ultimately promote positive effects to human health by displacing emissions from other higher impact energy sources.

Anthropogenic Light

Aside from National Parks and Dark Sky Preserves, in Nova Scotia and in Canada there are no guidelines applicable to outdoor light levels and/or effects on human health. Potential effects of the Project on ambient light are assessed in Chapter 5 (Atmospheric

Environment) and are not further assessed in this section. The key measures to mitigate the potential effects of the Project on human health as a result of changes to ambient light levels are itemized in Section 5.3.2.2 and will be further detailed in a Project-specific EPP to be implemented during all Project phases. This includes consideration of adoption of an ADLS, which would keep the nighttime lights off unless a low flying aircraft is within the vicinity of the turbines. This will serve to reduce annoyance experienced by residents in the area.

Acoustic Environment

The 2014 Health Canada study on the impacts of wind turbines on community health and wellbeing found that self-reported instances of sleep disturbance, illnesses, chronic diseases, and stress were not affiliated with wind turbine noise exposure. Nonetheless, increasing wind turbine noise levels statistically correlated with increasing annoyance levels (Health Canada, 2014a).

Health Canada (2014a) and the Union of Nova Scotia Municipalities support WHO's recommendation for a nighttime noise limit of 40 dBA at the exterior of homes as being protective of sleep, general health, and does not exacerbate pre-existing medical conditions (Union of Nova Scotia Municipalities, 2015). The *Guide to Preparing an EA Registration Document for Wind Power Projects in Nova Scotia* has adopted this value and it is therefore applied in the Project's Noise Assessment Report (WSP, 2024c; Appendix E).

Wind turbines produce noise from two main sources, the motor and the wind passing over the blades. Low frequency noise is not usually heard by humans, but there is potential that it could make small vibrations more noticeable (Canadian Centre for Occupational Health and Safety, 2023). Low frequency noise has been used to describe frequencies less than approximately 30 hertz (Hz), the perception of which is often described as a feeling or pressure rather than something that is heard (Health Canada, 2014b). Health Canada has found that the scientific evidence base in relation to wind turbine noise exposure and health is limited, which includes uncertainty as to whether or not it contributes to the observed community response and potential health impacts (Health Canada, 2014b).

Changes to noise levels from baseline during all phases of the Project were assessed in the context of human health in Chapter 5 (Atmospheric Environment). In combination with natural and non-industrial anthropogenic sources, WSP (2024c) determined that Project operation will comply with the permissible sound levels outlined in the provincial noise guidelines within both the LAA and the RAA (Appendix E). No tonal components were identified with turbine operation and, therefore, the Project will not cause low frequency noise issues.

Potential noise effects during Project construction are short-term (anticipated to take less than two years) will vary based on the type of construction activities and the shifting proximity to receptors during the course of this phase (WSP, 2024c). The primary noise sources associated with construction will include blasting, trucks and other vehicles, backhoes and graders, cranes, and smaller equipment such as welding units as well as back-up alarms on mobile equipment. Noise levels at receptors during construction activities will depend primarily on the number, type, and proximity of noise sources. Construction noise levels will decrease as the distance between the receptors and construction activities increases and nighttime construction activities will be avoided as much as possible.

The key measures to mitigate the potential effects of the Project on human health as a result of changes to the acoustic environment are itemized in Section 5.3.2.3 and will be further detailed in a Project-specific EPP to be implemented prior to and during construction.

Shadow Flicker

Shadow flicker occurs when sunlight passes through the blades of an actively rotating wind turbine and reaches an observer on the ground, resulting in flickering light. The distance of the shadow flicker depends on several factors such as the time of day and season as well as the location of the observer relative to the wind turbine (Ellenbogen et al., 2012). Turbines have also been known to produce glint (i.e., flashes of reflected light) when the turbine blades are reflective. However, modern wind turbine blades, including those proposed for the Project, are treated with a non-reflective coating to minimize glint.

Studies suggest that shadow flicker is not experienced beyond a distance of 1.4 km from the turbine for large-scale turbines (Ellenbogen et al., 2012). Other studies reveal that, beyond 15 rotor diameters from a wind turbine, shadow flicker is decreased to a point where it is not observable (Haac et al., 2022). A scientific review of turbines and human health noted that, by 2014, there were roughly 60 scientific peer-reviewed articles that studied the links between turbines and human health and that the available scientific evidence suggested that shadow flicker is not likely to affect human health (Knopper et al., 2014).

NSECC standards outlined in the Guide stipulate a maximum of 30 hours of flicker over the course of a year and/or no more than 30 minutes per day, which coincides with the worst-case guidelines typically applied in other international jurisdictions (Koppen et al., 2017). The shadow flicker assessment (both worst-case and expected-case) concluded the Project will comply with both the 30 hours per year limit and the 30 minutes per day limit at all 23 receptors within the LAA (Appendix L). As such, the Project is not anticipated to result in unacceptable shadow flicker effects. Results of modelling that include Windy Ridge turbines and those of the Kmtnuk and the Higgins Mountain wind power projects also show that the effects are anticipated to be within those limits for the RAA.

The Proponent is committed to operating the Project in compliance with the Guide (NSECC, 2021). A Complaint Resolution Plan will be developed and implemented by the Proponent (including an investigation process to confirm reported exceedances).

Electromagnetic Field Exposure

EMF is composed of invisible waves that travel through space and exert force on charged particles in the frequency range of 1 Hz to 3 kilohertz, which is outside the visible range of the electromagnetic spectrum. In Canada, electrical distribution has a frequency of 60 Hz (Health Canada, 2022b), which is considered extremely low frequency EMF. Common sources of extremely low frequency EMF include household wiring, electrical appliances and household electrical products, power lines, transformer boxes, and electrical substations. The technical specifications for the turbines selected for this Project list a frequency of 50 and 60 Hz for the electrical system and transformer.

There has been public perception that EMF exposure from wind turbines can lead to adverse health effects (McCallum et al., 2014). Available scientific evidence suggests that EMF associated with the operation of wind turbines is not likely to adversely impact human health (Knopper et al., 2014) and that EMF levels in the vicinity of wind turbines are actually less than those produced by common household electrical devices (McCallum et al., 2014).

Health Canada, along with the World Health Organization, monitors scientific research on EMF and human health as part of its mission to help Canadians maintain and improve their health (Health Canada, 2012). International exposure guidelines for exposure to EMF have been established by the International Commission on Non-Ionizing Radiation Protection. Health Canada does not consider that any precautionary measures are needed regarding daily exposures to EMF. There is no conclusive evidence of any harm caused by exposures at levels found in Canadian homes and schools, including those just outside the boundaries of power lines (Health Canada, 2022b). EMF exposures in Canadian homes, schools, and offices are far below these guidelines. Therefore, there is no indication that EMF levels from the Project wind turbines, collector lines, or the associated transmission line will affect public health in the LAA.

The key measures to mitigate the potential effects of the Project on human health as a result of changes to the acoustic environment are itemized in Section 5.3.2.3 and will be further detailed in a Project-specific EPP to be implemented prior to and during construction.

The Proponent is committed to operating the Project in compliance with the Guide (NSECC, 2021). Key measures to mitigate the potential effects of the Project on human health as a result of changes to the acoustic environment or changes to ambient light levels are itemized in Section 5.3.2.2 and Section 5.3.2.3, respectively. The following additional measures to mitigate the potential effects of the Project on the human health, will be further detailed in a Project-specific EPP and will be implemented prior to construction:

- Turbines blades will have a non-reflective coating to minimize blade glint.
- To minimize light diffusion, only the minimum amount of obstruction avoidance lighting will be placed on the turbines.
- Ground lighting, such as construction and security lighting, will be focused toward the ground to minimize visibility at a distance.

- The intensity of light flashes will be minimized as much as Transport Canada allows. The Proponent is evaluating the possibility of using ADLS as further mitigation.
- A Complaint Resolution Plan will be submitted to NSECC. The plan will include an investigation process to confirm reported exceedances of noise and shadow flicker.

13.3.3 Residual Effects

13.3.3.1 Changes in Economy

Construction and decommissioning of the Project will provide medium-term employment for not only local residents of the RAA, but within the province as a whole where goods and services will need to be procured. During operation and maintenance, there will be training opportunities for Indigenous peoples for long-term employment. The Proponent will also be contributing to the local economy through community benefit funds and long-term leasing agreements for property owners. The Proponent will make annual tax payments to the Municipality of Colchester as per the provincial *Wind Turbine Facilities Municipal Taxation Act*. In addition, the Proponent has committed to providing financial support for a variety of community benefits and bursaries within the county. Implementation of the Project is therefore anticipated to result in an overall continuous, long-term benefit to the community's economy.

13.3.3.2 Changes in Land Use and Value

Based on initial stakeholder engagement and Project infrastructure plans, the magnitude of positive change with respect to the property values for those within the LAA is expected to be moderate for the lifetime of the Project. There will be long-term positive effects for those who will be leasing their land to the Proponent (PIDs provided in Chapter 1: Introduction) and those who use the existing access roads for natural resources industry. Changes will be reversible upon decommissioning. Where landowners opt to retain constructed and/or upgraded access roads during decommissioning, improved access through the PDA will be permanent. It is anticipated that the Project will not have significant effects on land use and property values.

13.3.3.3 Changes in Visual Landscape

Based on stakeholder engagement and changes made to the originally proposed design, the magnitude of change with respect to the visual landscape for those within the LAA is expected to be moderate within the LAA. Turbines will be visible continuing long-term through the lifetime of the Project, but this residual effect is reversible through decommissioning. The perception of wind turbines is subjective among demographics, and individuals tend to be more receptive to wind farms in rural locations such as the Project area.

13.3.3.4 Changes in Transportation

There will be moderate and intermittent traffic disturbances within the LAA. Existing access roads are normally used for slow-moving, off-road vehicles. Those roads will be upgraded to manage the turning radius needed for the anticipated trailer lengths, which will improve movement inside the LAA for the long-term, and those effects will be reversible.

Increased traffic in the RAA during construction and decommissioning is anticipated to be minor on an intermittent basis. Turbine components will be transported mainly via the Trans-Canada Highway, which is already a high-traffic route capable of handling large transport vehicles. Adverse effects during those phases will be more apparent on Trunk 4 where most of the proposed access roads to the PDA are located. The Proponent is evaluating access points to determine which options best mitigate traffic disruption. Effects will be temporary during the construction phase.

The timing is considered to have a low effect on this VEC. A Traffic Management Plan will be developed prior to construction which will entail procedures to alert the public and transportation authorities and arrange escorts for wide-load vehicles during intermittent periods of infrastructural component deliveries to the PDA.

13.3.3.5 Changes in Recreation and Tourism

Changes in recreation and tourism are anticipated to be moderate, medium-term, and limited to the LAA. During construction and decommissioning, trails may be diverted intermittently where they share RoW with the existing access roads or where safety set-backs need to be temporarily established. The timing of when these residual effects is moderate, considering that the trails are considered all-season. The effects are reversible, however, and the Proponent has engaged various recreational trail user organizations through Project planning with the intent to enhance trail stability and enjoyment. The Proponent will continue to do so to minimize disruption. During operation and maintenance, the site will be open to public access. Mitigation outlined for noise and visual effects will also minimize effects to recreation and tourism.

13.3.3.6 Changes in Human Health

Changes in human health related to changes in air quality, groundwater water quality, ambient light, shadow flicker, and noise are anticipated to be minor in magnitude within an LAA of up to 2 km, where there may be discernible noise, light, dust, and vehicle emissions during Project activities. These effects will be predominantly isolated to the construction and decommissioning phases, will occur intermittently, and Project-related changes in human health factors will be reversible. During the course of the Project, the Proponent will be responsive to public complaints as per a Complaint Resolution Plan to be submitted to NSECC prior to construction. Public safety in regard to accidents and malfunctions, such as ice throw, will be mitigated through remote monitoring and regular inspections by onsite staff during operation and maintenance as discussed in Chapter 18 (Accidents and Malfunctions).

13.4 Monitoring

Monitoring is not required for these VEC components, although the Proponent will be responsive to complaints. As noted in Chapter 6 (Geophysical Environment), pre-blast well water quality surveys will be completed for domestic water wells within 800 m of blasting as per a Blasting Management Plan to be submitted to NSECC prior to construction. As part of that plan, notification protocols will be developed for contacting NSECC and NSDNRR should elevated levels of uranium be encountered.

14 Heritage and Cultural Resources

14.1 Overview

The assessment of the Project on heritage and cultural resources encompasses sites of archaeological, historical, cultural, and architectural significance, as well as resources of social, cultural, or spiritual importance to Indigenous peoples.

An initial Archaeological Resources Impact Assessment (ARIA) for this Project was conducted by Boreas Heritage Consulting Incorporated (Boreas) in 2022. The ARIA identified areas considered to exhibit high potential for encountering archaeological resources within the PDA, recommending those for inclusion in subsequent field assessment. Onsite surveys were initiated in December 2023 and are currently ongoing. To date, field assessments are approximately 90 percent complete, resulting in the identification of 20 high potential areas (HPAs). The ARIA will be completed in 2024 and the results will be submitted to NSCCTH. NSECC will be provided with the acceptance letter from NSCCTH prior to any disturbance in identified HPAs.

Clearing and ground disturbance during construction, such as grubbing, excavation and blasting, can damage archaeological and heritage artifacts and/or features that lie within the PDA. During decommissioning and site restoration, previously undisturbed artifacts may be moved around, damaged, and/or buried deeper when infrastructure is removed and the ground smoothed.

Effects, mitigation measures, and residual effects to these resources as a result of the Project have been outlined in this chapter. Field investigation results will be used to confirm high potential areas and Project-specific mitigation measures will be included in a Project-specific EPP and a Contingency Plan prior to construction to minimize adverse effects.

14.1.1 Regulatory Context

Assessment of heritage and cultural resources considers relevant provincial and federal legislation and guidelines:

- *Constitution Act, 1982*
- *Special Places Protection Act*
- *Heritage Property Act*

- *Cemeteries and Monuments Protection Act*
- NSCCTH (2014) Archaeological Resource Impact Assessment Guidelines
- Mi'kmaq Ecological Knowledge Study Protocol, 2nd Edition (Assembly of Nova Scotia Mi'kmaq Chiefs, undated)

14.1.2 Assessment Methodology

14.1.2.1 Archaeological Resource Impact Assessment

Heritage and archaeological resources were identified through two ARIAs for this Project. The first ARIA was conducted in March 2022 under Permit A2022NS40, directed by Colin Hicks (Boreas, 2022). That permit was valid from March 4 to December 31, 2022. The second ARIA, also by Boreas, is currently being conducted in accordance with the terms of Heritage Research Permits A2023NS233 and A2024NS008.
As per Heritage Research Permit requirements, KMK was advised of the proposed Project.

The 2022 ARIA was based entirely on background research of the area—the environmental context, the archaeological context, and the historical context of the region, within which lies the PDA:

- The environmental context was examined to identify past and current environmental influences or conditions that may elevate archaeological potential within the PDA (i.e., topography, local resources, and potential for agriculture).
- The archaeological context of the region was 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 proposed Project.
- The historical context of the region was examined to identify how people used and occupied the local area based on evidence from published archival documents, ethnohistoric records, local oral traditions, historic maps, local and/or regional histories, scholarly texts, and available property records.

The 2022 ARIA is based primarily on available online data sources for the general region:

- The Maritime Archaeological Resource Inventory, maintained by the Nova Scotia Museum on behalf of NSCCTH
- Present-day and historic aerial photographs and topographic maps
- Previous archaeological surveys conducted in the surrounding area
- Documentation of existing identified heritage sites near the PDA
- Archaeological and historical literature for the region
- National and/or provincial historic sites or designations in the surrounding area

Boreas (2022) identified topographical and hydrological attributes that correlate with archaeological potential and incorporated that data into an archaeological potential model they developed in-house. In 2024, Boreas produced an updated archaeological potential model that reflects the final layout of the PDA.

14.1.2.2 Mi’kmaq Ecological Knowledge Study

The MEKS is currently underway and is being completed in accordance with the Mi’kmaq Ecological Knowledge Protocol, 2nd Edition. The MEKS approach has two primary components:

- Mi’kmaq Traditional Land and Resource Use Activities – Considers both past and present uses of the LAA, using 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). It also considers resource availability/abundance in the area and its surroundings, their use, and their importance with regards to the Mi’kmaq.

The field components of the MEKS were completed from May 15 to 17, 2024. Interviews undertaken by the MEKS team with Mi’kmaq knowledge holders are ongoing for the Project. Interviewees are being shown topographical maps of the LAA and asked to identify locations of historic and current activities, if known. These interviews will result in a collection of data that reflect the most recent Mi’kmaq traditional use in this area, as well as historic accounts. The data gathered will inform mitigation measures specific to Project activities within the LAA.

14.2 Existing Environment

Proximity to water for drinking, resource exploitation, and transportation is a key factor in identifying precontact and historic resources for Mi'kmaq, as well as early Euro-Canadian and African Canadian archaeological potential. The Debert River south of the PDA, is one of the largest rivers in the region. The Salmon and Debert River watersheds provided corridors for transportation, including access to the Bay of Fundy, which allowed the Mi'kmaq to access the resources in the interior of the province.

14.2.1 Archaeological and Heritage Sites

14.2.1.1 Background

A review of the MARI database revealed an absence of registered archaeological sites located near the PDA. This likely reflects a lack of archaeological investigation rather than an absence of archaeological sites. This review identified the presence of 38 registered archaeological sites within an approximate 10 km radius of the PDA. Of these, 25 are precontact/Mi'kmaq, historically ranging from the Saqiwe'k L'nuk to the Kejikawe'k L'nu'k, including the Debert-Belmont complex.

In total, there are 13 historic sites within a 10 km radius of the PDA. The historic sites range from the colonial period to the early 20th century. These sites include settlements, industrial or manufacturing areas, and a single cemetery.

The nearest registered prehistoric (Palaeo-Indian) site is located at the Debert Rifle Range, approximately 2 km from the PDA, where artifacts consisted of three cores and a flake of chert.

Debert is part of the Debert-Belmont complex, representing one of the largest and most intact Palaeo-Indian sites in North America and the oldest sites of human habitation in Eastern Canada (Rosenmeier et al., 2012, in Boreas, 2022). The community of Folly Mountain was established in 1805 and the original settlers were most likely descendants of Londonderry Township proprietors (Matheson 1989:8 in Boreas, 2022). Located southwest of the PDA, Londonderry, founded in 1762, is located on the Great Village River, approximately 9.5 km north of the Cobequid Bay.

A nearby prehistoric (late Archaic) site is located approximately 1.2 km north of Route 246, east of Myres Brook. The site consists of several isolated finds in a plowed field, including two fully grooved axes and three adze blades.

14.2.1.2 Results of Archaeological Potential Model and Field Surveys

The results of the Boreas archaeological potential model suggested that portions of the PDA, particularly those in the vicinity of the primary rivers, lakes and associated smaller watercourses, have elevated potential for encountering archaeological resources. Previous archaeological assessments conducted near Debert/Belmont, located south of the PDA, confirmed the presence of several significant archaeological resources representing the Saqiwe'k L'nuk and increases the potential for encountering archaeological resources within the PDA.

Based on the results of the archaeological potential model, Boreas Heritage is currently conducting onsite archaeological reconnaissance within the PDA to ground truth and delineate areas exhibiting high archaeological potential and document any archaeological resources identified. Field assessments to date have been completed for approximately 135 km (90 percent) of the road network in the PDA and 46 turbine locations (88 percent), resulting in the identification of 20 HPAs.

14.2.2 Indigenous Cultural Resources

The network of navigable rivers, streams, coastal routes, portage routes, and footpaths provided travel routes and access to resource areas throughout Mi'kma'ki. The Chiganois River and Debert River allowed access to resources in the interior of the province and served as transportation corridors to facilitate interaction and trade with neighbouring groups.

Mi'kmaw placenames, those which have survived the influx of European travellers and settlers, demonstrate the Mi'kmaq had a significant understanding of the local landscape and resources. Mi'kmaw placenames are known for at least 27 landmarks within an approximate 20 km radius of the PDA and include descriptions of the landscape, reference specific human experience on the land, and indicate local species and resources. Placenames in the area may also connect to Mi'kmaw legends that speak to physical transformations of the landscape.

14.3 Effects Assessment

14.3.1 Boundaries

- Archaeological Resources: Effects to archaeological artifacts and features as a result of the Project will be isolated to the PDA for the lifetime of the Project.
- Indigenous Cultural Resources: The boundary of the LAA has been established as 5 km by MGS. The MEKS is still in progress; therefore, specific temporal boundaries and effects have not yet been determined.

14.3.2 Potential Effects and Mitigation

Several changes were implemented for the Project to minimize potential direct and indirect impacts on heritage and cultural resources, where reasonable, while meeting engineering and design constraints. Detailed design of the Project and micrositing of turbines will further avoid those resources when practicable and reduce potential interactions. Micrositing involves exact placement of the turbine within the turbine sites as shown in the PDA. As discussed in Chapter 2 (Project Description), the estimated extent of disturbance in the PDA is an exaggerated estimate that will ultimately be much smaller after detailed design is complete.

Direct and indirect effects of the Project on heritage and cultural resources could occur through various interconnected pathways. During construction, there will be blasting and/or excavation in some locations of the PDA. Fill will be used in the PDA as well for developing access roads and turbine pads, which could damage artifacts unseen at the surface or underground within the PDA. Excavation will also be required in some areas of the PDA where drainage infrastructure is installed to prevent flooding and ground subsidence. Restoration of the PDA during decommissioning could damage and/or move artifacts that were not previously disturbed. Similarly, heritage features, such as historic foundations, may be discovered in the PDA and Indigenous cultural resources could be disturbed. Project activities can affect heritage and cultural resources as indicated in Table 14.1; these potential effects do not consider the detailed design of the Project and micrositing of turbines that is yet to be completed or the implementation of mitigation measures described herein.

Table 14.1 Potential Environmental Effects of the Project on Heritage and Cultural Resources

Project Activity	Potential Environmental Effects: Effects on Archaeological, Heritage, and Cultural Resources
Construction	
Site Preparation	X
Access Roads Construction and Modifications	X
Material and Equipment Delivery and Storage	-
Infrastructure Installation	-
Restoration of Temporary Areas	-
Testing and Commissioning	-
Operation and Maintenance	
Turbine Operation and Maintenance	-
Road Maintenance	X
Power Line and Substation Maintenance	-
Vegetation Management	X
Safety and Security	-
Decommissioning	
Removal of Infrastructure and Site Restoration	-

X = Potential Interaction
- = No Interaction

There are specific Project activities that could adversely affect buried artifacts and archaeological/heritage features (such as historical foundations and/or infrastructure) within the PDA:

- Site preparation involving earthworks could cause exposure of, or damage to, buried artifacts and heritage features.
- Site preparation activities, such as clearing and grubbing, can cause damage to surficial, but unnoticed, artifacts and features.
- Construction and upgrades of access roads will introduce new material that could further cover or even compact buried artifacts.
- Site drainage and erosion during operation and maintenance can result in exposure or damage to artifacts and features that were undisturbed during construction activities.

A systematic shovel testing program will continue to identify potential archaeological resources for any HPAs, or parts thereof, that cannot be avoided during the detail design phase of the Project. Following completion of the field assessment, the results will be incorporated into the Draft 2023 ARIA Report, which will be submitted to NSCCTH for review and approval. The final report will be provided to NSECC.

The PDA shows proposed locations for 52 turbines; three of those, however, represent alternate locations that may be considered during detailed design if one of the preferred 49 locations is deemed unsuitable. Most of the turbine locations proposed are within areas modelled as having low archaeological potential but will be included in field surveys prior to construction. Some access road sections lie within high potential areas. It is anticipated that more HPAs will be identified as field surveys continue.

Specific mitigation measures will be developed based on the findings of the shovel testing program. Those measures will be incorporated into the Project-specific EPP as well as a Contingency Plan for response and communications should there be a discovery suspected to be an archaeological or heritage artifact or feature.

Archaeological and heritage sites fall under the jurisdiction of the *Special Places Protection Act*, which is administered by NSCCTH and the Nova Scotia Museum. A Contingency Plan for discovery will be established prior to construction activities. The plan will contain elements of the province's Generic EPP for the Construction of 100 series highways (Nova Scotia Department of Transportation and Public Works, 2007) for archaeological discovery response:

- A chain of communications will be established for reporting a discovery that includes the environmental monitor, the Proponent, the Project Archaeologist, and NSCCTH.
- Should a potential archaeological or heritage resource be encountered during construction, all work will be stopped immediately.
- Construction crews will flag off the area of concern, prevent public entry, and not attempt to move or remove any artifacts unless the integrity of those artifacts is threatened.
- The Project Archaeologist will conduct an initial investigation and, if necessary, report the findings to the relevant authorities. The Project Archaeologist will, at a minimum, contact the Curator of Archaeology, Nova Scotia Museum, and the Coordinator of Special Places at NSCCTH.
- Work activities at that location will not recommence until approval is given by NSCCTH.
- Should human remains be encountered, work shall immediately stop, and the RCMP will be notified. If the resources are suspected to be of Mi'kmaq origin, KMK will also be contacted.

Specific activities that could affect Indigenous cultural resources within the LAA may be identified in the MEKS currently underway.

14.3.3 Residual Effects

14.3.3.1 Archaeological and Heritage Resources

The ARIA was based on background research and modelling to identify high potential areas for archaeological and heritage resources. There are risks, however, to encountering buried heritage features in low potential areas as well. The geographical extent of adverse effects will be isolated to the PDA. After detailed design and micrositing, incorporating the results of the ARIA shovel testing, and application of mitigation measures, the magnitude of effects on archaeological and heritage resources will be minor. This residual effect will be immediate, but possibly irreversible. The potential for a significant effect on archaeological and heritage resources and knowledge can be mitigated through field investigations and development of a Discovery Plan for reporting revealed artifacts and features.

14.3.3.2 Indigenous Cultural Resources

Upon completion, the MEKS report and recommendations by MGS will be reviewed by the NSCCTH and KMK to determine if any mitigation measures are required to support the continued traditional use of the LAA by the Mi'kmaq of Nova Scotia.

14.4 Monitoring

The results from onsite investigations currently underway and consultation with NSCCTH will determine whether there are high-potential areas that warrant archaeological monitoring during construction activities. NSECC will be provided with the acceptance letter from NSCCTH prior to completion of any disturbance in newly proposed areas.

15 Consideration of Cumulative Effects

15.1 Overview

Cumulative environmental effects refer to the combined impact of multiple stressors on the environment over time. Rather than considering individual impacts in isolation, cumulative effects assessments look at the overall consequences of various human activities or undertakings on VECs.

The cumulative effects assessment identifies existing, planned, and reasonably foreseeable projects and activities for which environmental effects could overlap in time and space with those of the proposed Project. Where such overlap is recognized, the potential for cumulative effects and requirements for additional mitigation measures are discussed.

Cumulative effects assessment for this EA focuses on residual effects of Project activities that may interact with the residual effects of other projects and activities, including those that have shaped the existing environment of the LAA and RAA. While the existing environment for each VEC may itself be a result of cumulative effects that have occurred through historic activities, potential additive or synergistic effects of residual Project-related effects are considered.

Other wind projects have already been constructed or are in stages of development in Colchester and Cumberland counties. There are registered projects listed for EA under federal and provincial jurisdictions in the area. Residual effects of natural resource harvesting and other land use activities is already evident within the RAA. To offset potential cumulative environmental effects of the Project in combination with these other land use activities and wind projects, the Proponent is committed to enhancing the suitability and quality of habitat within the LAA and as described in Chapter 10 (Terrestrial Wildlife), the Proponent has proposed the concept of a moose corridor, primarily to improve ecological connectivity and habitat for Mainland Moose, that will also conserve habitat for other wildlife and flora (see Section 10.3.2.1.1). Furthermore, the Proponent is committed to actively participating as a partner in initiatives aimed at preserving and improving connectivity in the broader Colchester/Cumberland region.

15.1.1 Regulatory Context

Assessment of the potential for cumulative environmental effects considers relevant provincial and federal legislation and guidelines:

- Nova Scotia *Environment Act*
- Nova Scotia EA Regulations
- A Proponent's Guide to Environmental Assessment (NSECC, 2018)
- The Guide (NSECC, 2021)

15.1.2 Assessment Methodology

The assessment of potential cumulative environmental effects generally follows the approach outlined in the Interim Technical Guidance developed by the former Canadian Environmental Assessment Agency (2018) (now the Impact Assessment Agency of Canada (IAAC)) *Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012*. This approach is similar to and builds upon the methods implemented in this EA to identify and evaluate the Project-specific environmental effects presented in Chapter 4 (Assessment Methods and Initial Screening).

The scope of the cumulative environmental effects assessment is based on the following:

- Identification of residual environmental effects of the Project that may occur even with implementation of avoidance and mitigation measures. It is the residual environmental effects of the Project that have potential to interact with effects of other projects or activities and result in a cumulative environmental effect.
- Identification of VECs that will be carried through the cumulative environmental effects assessment (i.e., those VECs that are likely to have residual environmental effects).
- Defining the spatial and temporal boundaries within which cumulative effects could potentially occur. Boundaries are primarily based on ecosystem-centred spatial and temporal boundaries; where such boundaries are unclear or do not exist, activity-centred or administrative and technical boundaries are applied.
- Identification of other projects and activities that are considered in the cumulative environmental effects assessment. Past and existing projects and activities are identified based on evidence available from reliable resources, such as government databases or published reports. Future projects and activities are identified if they are registered or recently approved under the NSECC EA registry, identified in a publicly available development plan, or officially announced by a proponent.

Analysis of potential cumulative environmental effects follows a similar pathway of effects assessment that was used to evaluate the Project-specific environmental effects. Several resources were consulted to identify other activities and upcoming projects in the region whose environmental effects may interact with those of the Project:

- The NSECC EA registered projects database (NSECC, 2024)
- Canadian Impact Assessment Registry (IAAC, 2024)
- Public and Indigenous engagements

- Onsite field studies

15.2 Other Projects and Activities

15.2.1 Wind Projects

Since the construction of the Nuttby Mountain wind project, there have been several other wind power projects planned for development in the area. Three new wind projects have recently been approved and scheduled for construction and operation within a time frame that partially coincides with that of the Windy Ridge Wind Project (NSECC, 2023). These developments in Cumberland and Colchester counties are illustrated in Figure 15.1:

- Kmtnuk Wind Power Project, Colchester County, 16 turbines
- Higgins Mountain Wind Farm Project, Colchester and Cumberland Counties, 17 turbines
- Westchester Wind Project, Cumberland County, 16 turbines

One project, Blueberry Acres in Cumberland County, is currently under environmental study for a planned array of 10 turbines (Figure 15.2).

The Project and the Kmtnuk wind farm are connected through an access road at the eastern extent of the Project's PDA, with a distance of approximately 1 km between their nearest turbines. The access points between the Project and Higgins Mountain wind farm are on opposite sides of Trunk 4, approximately 2.5 km apart; the nearest turbines of which are sited approximately 6.1 km apart. The wind farms shown on Figure 15.1 span a total distance of approximately 44 km.

In neighbouring counties, other nearby wind farms have also received approval under provincial EA legislation:

- Ellershouse 3 Wind Project, Hants County
- Bear Lake Wind Power Project, Hants and Halifax counties
- Weavers Mountain Wind Energy Project, Antigonish and Pictou counties
- Goose Harbour Lake Wind Farm Project, Guysborough County
- Benjamins Mill Wind Project, Hants County
- Mersey River Wind Farm, Queens County

15.2.2 Other Undertakings

The Canadian Impact Assessment Registry managed by the IAAC lists a Notice of Determination (September 2023) for approval of a renewable energy project with locations at multiple First Nations communities in Nova Scotia, the nearest of which are located in Millbrook and Pictou (IAAC, 2024). The collective Nova Scotia Mi'kmaw Net Metering Solar Project is an initiative to reduce community GHG emissions and energy costs, create employment, and give the Mi'kmaq of Nova Scotia more control over their energy and environmental future. The project proposes to build a net metered solar photovoltaic system, up to 100 kW at each location.

The possibilities for offshore wind projects are currently being investigated through a regional assessment for areas near Halifax (IAAC, 2024). The Regional Assessment of Offshore Wind Development in Nova Scotia assessment process includes engagement with Indigenous groups, federal and provincial authorities, non-government organizations, and the public. The purpose of the assessment is to inform future project-specific federal impact assessments and decisions for offshore wind projects in these areas.

The NS-NB Reliability Intertie Project was recently approved with conditions in December 2023 under the Nova Scotia EA process (NSECC, 2024). NSPI is planning to construct a new 345 kV transmission line twinning the existing 96 km power line from Onslow, Nova Scotia, to the New Brunswick border, which is part of a longer line called the NS-NB Reliability Intertie. This second interconnection is intended to assist NSPI in meeting provincial renewable energy targets, balance wind generation, and strengthen grid connectivity. The Project interconnection point is located within the current NSPI transmission corridor near NSPI's planned infrastructure.

15.2.3 Past and Existing Land Use and Activities

Past and existing land use and activities are described in Chapter 13: Socio-economic Environment. The following sub-sections provide a brief synopsis of those that could result in cumulative environmental effects in combination with residual environmental effects of the Project.

15.2.3.1 Natural Resources Industry

As summarized in Chapter 13 (Socio-Economic Environment, Section 13.2.2), historical and current forest harvesting and mining activities occur within the Project RAA (Figure 15.1). These activities have resulted in forest loss and fragmentation. Forestry and mining/quarrying activities have contributed to the current state of the RAA, which is characterized by mostly fragmented forests containing harvested areas and forestry roads that create edge environment. The Project RAA lies within areas that have undergone mineral exploration over the years, resulting in a myriad of abandoned mine openings and active quarries. Figure 15.1 illustrates the area of forest loss/disturbance that has occurred between 2001 and 2022 in the area (Global Forest Watch, 2024) as well as the mineral claims and abandoned mines in the RAA.

Combined, these natural resource extraction activities have resulted in a highly visible cumulative effect of land disturbance (Figure 15.1) over the past two decades. It is anticipated that these industries will continue during the lifetime of the Project.

15.2.3.2 Transportation

The Project RAA contains multiple existing public roads that access Debert, dwellings that use existing roads that form portions of the PDA, Route 246 at its northern access, the Trans-Canada highway to the south (Highway 104), and Trunk 4 to the east (Figure 13.3). Highway 104 is heavily trafficked, connecting Nova Scotia with New Brunswick, and allows transport of heavy equipment and wide loads on a regular basis. Highway 104 will serve as the primary transportation route to access the respective collector roads for all four projects listed above that are under development (Figure 15.1).

15.2.3.3 Recreation and Tourism

An extensive network of all-season trails used for hiking, ATVs, and snowmobiles has been established throughout the environment of the RAA and will continue to be used during the lifespan of the Project (Figure 13.2). The Higgins Mountain and Kmtnuk wind power EAs (Strum Consulting, 2023a and 2023b) indicate that fragmentation and human presence are similar in those project areas.

15.3 Cumulative Effects Assessment

15.3.1 Boundaries

As outlined in Chapter 4 (Assessment Methods and Initial Screening), an RAA boundary has been established for VECs where potential effects of this Project may interact with those of other activities, resulting in cumulative effects. The boundaries of the RAAs are illustrated in Figure 15.2. While some residual effects have been identified, most are anticipated to be contained within the VEC's LAA and considered to be short-term with low significance. The following RAAs have been defined:

- Atmospheric Environment – 5 km
- Flora – Contiguous natural habitat areas
- Wetlands – 1 km
- Terrestrial Wildlife – Cumberland/Colchester Mainland Moose subgroup concentration area
- Bats – 5 km
- Birds – 5 km
- Population and Economy – Colchester County
- Visual Landscape – 5 km
- Electricity and Other Utilities – Province of Nova Scotia
- Transportation – Colchester County
- Recreation and Tourism – 5 km
- Indigenous Cultural Resources – 5 km

15.3.2 Potential Cumulative Effects and Mitigation

Table 15.1 presents the anticipated interactions that may lead to cumulative effects of the Project in combination with other projects and activities that are described in Section 15.2.

Table 15.1 Screening of Potential Cumulative Environmental Effects

VEC	Dominant Cumulative Effects Drivers	Dominant Spatial and Temporal Nature	Potential Cumulative Effects	Potential Interaction with Other Projects and Activities	Project Contribution to Cumulative Effects	Potential Degree of Overall Cumulative Interaction	Mitigation
Acoustic Environment	Close proximity of projects	2 km, long-term	Construction and turbine noise	Neighbouring wind facilities, recreational activities, natural resource harvesting, traffic	Low	Low, no threshold exceedances	Conventional project-specific
Ambient Light	Close proximity of projects	5 km, long-term for turbine lights	Lighting from turbines	Neighbouring wind facilities	Low	Low, no threshold exceedances	Conventional project-specific
Flora	Connecting habitat	Contiguous natural habitat	Loss of habitat and introduction of invasive species	Forestry, recreational activities, intertie twinning, neighbouring wind facilities	Low	Low	Conventional project-specific
Wetlands	Connecting hydrology	1 km	Loss of wetland habitat	Forestry, recreational activities, intertie twinning, connecting access roads between neighbouring wind facilities	Low	Low, wetland alteration permitting and restoration will be completed	Conventional project-specific
Terrestrial Wildlife	Connecting habitat	Cumberland/ Colchester Mainland Moose subgroup concentration area, long-term	Behavioural disturbance and habitat loss	Forestry, recreational activities, intertie twinning, neighbouring wind facilities	Low	Moderate	Mitigation and monitoring across all four wind projects
Bats	Mobile ecology	5 km	Collision and habitat loss	Forestry, neighbouring wind projects	Low	Low	Mitigation and monitoring across all four wind projects

VEC	Dominant Cumulative Effects Drivers	Dominant Spatial and Temporal Nature	Potential Cumulative Effects	Potential Interaction with Other Projects and Activities	Project Contribution to Cumulative Effects	Potential Degree of Overall Cumulative Interaction	Mitigation
Birds	Mobile ecology	5 km	Collision and habitat loss	Forestry, recreational activities, neighbouring wind projects	Moderate	Low	Mitigation and monitoring across all four wind projects
Population and Economy	Multiple contributors	Colchester County	Monetary benefits to residents and municipality	Multiple wind projects and natural resources industry	Moderate	High	Positive effect; no mitigation required
Visual Landscape	Multiple receptors	5 km	Change in vista	Multiple wind projects and natural resources industry	Low	Moderate	Conventional project-specific
Electricity and Other Utilities	Multiple users	Province of Nova Scotia	Strengthened grid resource and protection	Proponent agreements with NSPI and twinning of the inter-provincial intertie	Low	Low	Positive effect; no mitigation required
Transportation	Multiple users	Colchester County	Traffic disruption	Forestry, intertie twinning, neighbouring wind facilities	Low	Moderate	Conventional project-specific
Recreation and Tourism	Multiple users	5 km	Disruption and possible trail detours	Forestry, intertie twinning, neighbouring wind facilities	Low	Low	Conventional project-specific
Indigenous Cultural Resources	Combined areal span	5 km	Facilitated access to hunting/ fishing areas	Forestry, neighbouring wind facilities	Low	Low	Review of MEKS by NSCCTH and KMKNO will determine if mitigation measures are required

15.3.2.1 Atmospheric Environment

The RAA for air quality comprises an extent of 5 km around the PDA; for others, the extent of Nova Scotia's northern air zone, which includes neighbouring wind projects and the Point Tupper Green Hydrogen/Ammonia project – Phase 1 that will be powered by the Project's renewable energy (NSECC, 2023). Turbine lighting will need to make turbines visible to an extent that meets Transport Canada approval.

Project construction partially coincides with that of other wind facilities in Colchester-Cumberland counties and also with that of the NSPI NS-NB Intertie twinning project. Vegetation clearing and site preparation for NSPI's planned transmission line RoW is scheduled to begin in fall 2024, with erection of infrastructure taking place between 2026 and 2027 (NSPI, 2023a). While construction of these projects may coincide, individual Project effects for non-GHG emissions of noise, light, and dust are not expected to be significant. As for cumulative noise between the Project and other wind projects, discussed in Chapter 5 (Atmospheric Environment), noise modelling determined that cumulative noise between the Project and the Kmtnuk wind facility will not exceed provincial guidelines at Project receptors (Appendix E). The WSP report (Appendix E) noted as well that noise from the Project turbines will not interact cumulatively with the Higgins Mountain wind project turbines. The potential for cumulative effects on the acoustic environment from the Project with neighbouring wind power projects is therefore negligible.

The Project will contribute to reductions in GHG emissions for the province. The Project will supply renewable energy to EWF's Point Tupper Green Hydrogen/Ammonia project – Phase 1, which uses proton exchange membrane water electrolysis technology that typically consumes 50 kWh to produce 1 kg of hydrogen (Bernard and Somtochukwu, 2021). Using supporting wind projects and solar developments, EWF expects to generate up to 2,500,000 MWh of green electricity annually, which will provide the power to produce approximately 38,000 T of green hydrogen and 213,000 T of green ammonia per year (Strum, 2022). When considering the Project's 340 MW capacity, should the entire amount of energy produced be used toward the production of green hydrogen and ammonia via the Haber-Bosch process, approximately 562 tCO2e would be generated annually to produce approximately 22,800 T of green hydrogen and 129,000 T of green ammonia. Producing the same amount of conventional ammonia using steam reformed methane would generate up to 258,000 T of CO2e annually (Fertilizer Canada, 2023). These projections indicate that the Project's renewable energy output could reduce global CO_2 emissions from ammonia production by up to 257,000 T per year.

The net effects of the renewable energy projects in Colchester County and the Point Tupper Green Hydrogen/Ammonia project – Phase 1 will result in a positive cumulative effect to the atmospheric environment that needs no mitigation beyond that already outlined in Chapter 5: Atmospheric Environment.

15.3.2.2 Flora

The RAA for flora is the contiguous habitat where fragmentation could result in loss of rare species and flora habitat as well as facilitate the introduction and spread of invasive species. With careful detailed design and micrositing of Project infrastructure to avoid sensitive habitats and active habitat enhancement efforts, effects on terrestrial flora are anticipated to be not significant. Vegetation around the turbine base and road edges will naturally regenerate, which will offset the long-term loss of vegetation following construction. The Proponent is committed to preserving habitat within the LAA and as discussed in Chapter 10 (Terrestrial Wildlife), has proposed a collaborative large-scale land conservation effort in the region, primarily to improve ecological connectivity and habitat for Mainland Moose, but that will also conserve habitat for other flora and fauna.

15.3.2.3 Wetlands

The Project is located within an active forest management area. Current and historic use of the 1 km RAA for forestry and recreational offroad vehicle use has visibly altered wetland habitat. Forestry activities have resulted in a loss of wetland habitat or altered wetland function through vegetation clearing and compaction by machinery. Several wetlands within the LAA that may be impacted by the Project have been harvested in other areas. Project-related loss of wetland habitat and function will be offset through wetland compensation. Residual effects of the Project on wetland habitat will be limited to the PDA, and hydrology will be maintained, reducing the likelihood of long-term effects on wetland function or Project contributions to cumulative effects in the RAA.

15.3.2.4 Terrestrial Wildlife

The RAA for terrestrial wildlife incorporates area occupied by the Cumberland-Colchester subgroup of Mainland Moose that is identified as Core Habitat within the Mainland Moose Recovery Plan (NSDNRR, 2021). Ongoing natural resource industry and the development of renewable energy projects and electrical infrastructure in the area fragments habitat through clearing activities that can affect wildlife movement, increase mortality and injury due to collisions, and create sensory disturbances from light and noise. Forest clearing is known to reduce cover habitat for thermoregulation and shelter but can encourage foraging habitat through natural regeneration. Forest clearing and road construction activities could also facilitate the movement of White-tailed Deer to moose habitat, heightening the risk of disease transmission. Increased accessibility to forested areas of the region could make illegal moose poaching more prevalent.

As discussed in Chapter 10 (Terrestrial Wildlife), the Proponent is committed to preserving habitat within the LAA and has proposed a collaborative large-scale land conservation effort in the region, primarily to improve ecological connectivity and habitat for Mainland Moose, but that will also conserve habitat for other flora and fauna. The enhancements to habitat will prioritize considerations for connectivity to intact protected habitats, such as the Wentworth Valley Wilderness Area and other high-quality habitat zones.

Through proposed mitigation and monitoring, anticipated effects on terrestrial fauna, including Mainland Moose, are expected to be moderate. However, post-construction monitoring will be conducted to determine if the mitigation measures are effective to maintain or enhance the population of Mainland Moose and cumulative effects on the population, should they occur in the RAA, will be detected by monitoring programs to be approved by NSDNRR prior to the construction of the four neighbouring wind projects forecasted:

- Kmtnuk Wind Power Project
- Higgins Mountain Wind Farm Project
- Westchester Wind Project
- Windy Ridge Wind Project

Per EA Approval conditions, monitoring at each wind farm will be conducted for a minimum of two years once their respective turbines become operational; the monitoring approach must be approved by NSDNRR and ECCC-CWS. Monitoring efforts across a 4 km span will provide a broader picture of residual effects on Mainland Moose for the regulatory agencies than that of a Project-specific program.

15.3.2.5 Bats

The RAA for bats is considered to be an extent of 5 km around the PDA, which contains portions of the Higgins Mountain and Kmtnuk wind projects as well as the NSPI intertie twinning project. Low levels of bat activity were detected within the LAA during baseline monitoring—the majority of which were identified as *Myotis* species. Provincial and federal recovery strategies recognize anthropogenic disruptions as being additive effects to the challenges of WNS. Ongoing natural resource industry and the development of renewable energy projects and electrical infrastructure in the region could increase the risks of collisions with turbines and power lines as well as habitat loss and fragmentation. The proximity of known hibernacula in the region indicates the presence of migration pathways that could traverse this and other local wind farms and the NSPI intertie twinning project.

To offset potential cumulative environmental effects of the Project in combination with the other land use activities and wind projects, the Proponent is committed to enhancing the suitability and quality of habitat within the LAA and has proposed a collaborative large-scale land conservation effort in the region, primarily to improve ecological connectivity and habitat for Mainland Moose, but that will also conserve habitat for other flora and fauna.

Through the establishment and adherence to mitigation measures within the LAA during Project activities, anticipated effects are expected to be minor. Cumulative effects on bat populations of the RAA will be detected by monitoring plans to be approved by ECCC-CWS and NSDNRR for this and the other three nearby wind projects listed above. The results of the post-construction monitoring program will be submitted to the appropriate regulatory agencies as required. Additional surveys or mitigation measures may be identified in consultation with regulators following review of the results. Should post-construction monitoring indicate that further mitigation is needed, an Adaptive Management Plan will be prepared in consultation with NSDNRR and ECCC-CWS. Monitoring efforts across a 4 km span of projects will provide a broader picture of effects on bats for regulators than that of a Project-specific program.

15.3.2.6 Birds

The RAA for birds is considered to be an extent of 5 km around the PDA, which contains portions of the Higgins Mountain and Kmtnuk wind projects as well as the NSPI intertie twinning project. Similar to the effects on other wildlife, clearing vegetation leads to a loss of habitat for some birds while simultaneously providing habitat for species favouring edge or open environments. While ongoing natural resource industry and the development of renewable energy projects and electrical infrastructure in the area will continue to change habitat and behaviour, fragmentation is already evident and the existing environment is a cumulative result of two decades of activity in the RAA.

A recent report states that that wind power projects have a relatively small impact on bird populations compared to those of other human-related hazards and the use of fossil fuel sources (Murphy and Anderson, 2019). The Project layout has been designed to avoid sensitive features, use existing access roads, and site turbines in disturbed habitats, to the extent practicable. With proper mitigation and monitoring, adverse effects to birds as a result of this Project are not expected to be significant.

To offset potential cumulative environmental effects of the Project in combination with these other land use activities and wind projects, the Proponent is committed to enhancing the suitability and quality of habitat within the LAA and is and has proposed a collaborative large-scale land conservation effort in the region, primarily to improve ecological connectivity and habitat for Mainland Moose, but that will also conserve habitat for other flora and fauna.

Through the establishment and adherence to mitigation measures within the LAA during Project activities, anticipated effects are expected to be minor to moderate. Cumulative effects on bird populations of the RAA will be detected by monitoring plans to be approved by NSDNRR and ECCC-CWS for the Project and the other three nearby wind projects. Should post-construction monitoring indicate that further mitigation is needed, an Adaptive Management Plan will be prepared in consultation with NSDNRR and ECCC-CWS. Monitoring efforts across a 4 km span of projects will provide a broader picture of effects on birds for regulators than that of a Project-specific program.

15.3.2.7 Socio-economic Environment

The RAA for some components of the socio-economic environment comprises an extent of 5 km around the PDA; for others, cumulative effects can be anticipated at the extent of the county or the province as a whole. The implementation of the Kmtnuk, Higgins Mountain, and Westchester projects along a similar timeline, and within 44 km of one another, could create competition for the equipment, labour, and materials resources for construction and Project components. Traffic interruptions for the delivery of turbine components could be cumulative if construction at other sites coincides with that of this Project, particularly on Highways 102 and 104 which will serve as the major transportation routes for the turbines from seaports in southern Nova Scotia. However, construction of the Project is expected to occur after the others in the RAA are complete or nearly complete and these potential effects, if they occur, will be isolated to the short-term construction phase.

The Project will contribute to energy harnessed by other wind facilities and a solar photovoltaic system to generate and export carbon-free, green hydrogen, and ammonia by leveraging renewable resources to create sustainable energy solutions (EWF, 2022). The Point Tupper Green Hydrogen/Ammonia project will provide long-term and large-scale storage of renewable energy for Nova Scotia's electrical grid. For longer discharge durations, compressed hydrogen and ammonia are more attractive, compared to other energy storage technologies, due to their relatively low capital costs for energy storage volumes. Furthermore, the EWF 280 MW PEM electrolysis plant will have sufficient flexibility to provide primary and secondary power reserves to Nova Scotia's grid. The investments made by EWF can quickly respond to peak demand by lowering its hydrogen production and making wind and solar power available to the grid. This will help displace fossil fuel consumption during peak demand times.

In 2023, the province issued its Green Hydrogen Action Plan to encourage the development of green hydrogen projects in Nova Scotia (Government of Nova Scotia, 2023). Seven goals and 23 actions have been outlined to harness the province's natural resources and export capability, clean economy leadership, and responsive regulation toward hydrogen developments. While the province plans to use offshore winds as a renewable energy source for future hydrogen production, onshore wind resources and solar projects are currently the most feasible. The province's plan was developed to align with the federal Hydrogen Strategy for Canada, which outlines actions to leverage hydrogen production as a tool to achieve the country's goal of net-zero emissions by 2050 (NRCan, 2020).

Between the Windy Ridge and Kmtnuk wind projects, economic contributions to the Municipality of Colchester will include:

- $152 million in municipal taxes over the lifetime of the Projects
- $100,000 annually in a community vibrancy fund
- $300,000 annually in proximity payments
- $50,000 in a replenishing bursary fund
- 350 to 400 jobs during construction
- 20 to 30 part time/full time jobs during operation and maintenance

The net effects of these and other renewable energy projects in Colchester County and the Point Tupper Green Hydrogen/Ammonia Project will result in a positive cumulative effect to the socio-economic environment of the province that needs no mitigation beyond that already outlined for the VEC's LAA.

15.3.3 Significance

The Project will result in some residual environmental effects similar those of other historic and/or current activities already evident in the area. Cumulative effects for this Project are not anticipated to be significant after proper planning and mitigation measures are established for this and other projects under development within the RAA. Monitoring programs described for biological VECs such as moose, birds, and bats will facilitate early detection of adverse effects and inform further mitigation, should it be necessary.

16 Summary of Potential Environmental Effects

Potential environmental effects associated with the Project activities have been assessed for each VEC. The assessment involves characterizing existing conditions within the spatial boundaries of each VEC, including examining the impacts of past and current land-use activities that influence current conditions. Potential environmental impacts from Project activities have been evaluated across all phases—construction, operation and maintenance, and decommissioning. For each potential effect, the physical activities interacting with the VEC have been identified and assessed.

The assessment adopts a conservative approach, using conservative assumptions related to the estimated extent of disturbance. As outlined in Chapter 2 (Project Description), the PDA is an exaggerated estimate that will ultimately be much smaller after detailed design is complete. The final extent of the PDA is expected to be less than half the area described in this EA to assess the potential impacts of the Project. Because of this, the residual effects characterization may also be an overestimate.

Mitigation and environmental protection measures are proposed to minimize or eliminate residual effects, and on the basis that these mitigation and environmental protection measures will be implemented, residual effects have been characterized including an assessment of their significance. The residual environmental effects for construction, operation and maintenance, and decommissioning for each VEC are presented in Chapter 5 to 15. Table 16.1 provides a summary of the residual effects assessment for each VEC, including the significance.

Table 16.1 Summary of Residual Effects for Routine Operations

Valued Component	Potential Effect	Mitigation Reference (Section)	Residual Effect Characterization						Significance of Residual Effect
			Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	
Atmospheric Environment	Change in Air Quality	5.3.2.1	Minor to Moderate	Immediate to Local	Low	Short- term	Once	Reversible	Not significant
	Change in Ambient Light	5.3.2.2	Minor to Moderate	Immediate to Local	Low	Long-term	Intermittent	Reversible	Not significant
	Change in Acoustic Environment	5.3.2.3	Minor to Moderate	Immediate to Local	Low	Long-term	Intermittent	Reversible	Not significant
Geophysical Environment	Bedrock & Soils: Change in Quantity	6.3.2.1	Moderate	Immediate	Low	Long-term	Continuous	Irreversible	Not significant
	Bedrock & Soils: Change in Quality	6.3.2.1	Minor	Immediate	Low	Medium-term	Continuous	Reversible	Not significant
	Groundwater: Change in Quantity	6.3.2.2	Minor	Local	Low to Moderate	Short- term	Once	Reversible	Not significant
	Groundwater: Change in Quality	6.3.2.2	Minor	Local	Low	Long-term	Continuous	Irreversible	Not significant
Aquatic Environment	Change in Fish Habitat: Instream	7.3.2.1	Minor	Immediate	Low	Short- term	Once	Reversible	Not significant
	Change in Fish Habitat: Riparian Area	7.3.2.1	Minor	Immediate	Low	Long- term	Once	Reversible	Not significant
	Change in Water Quality	7.3.2.2	Minor	Immediate to Local	Low	Short- term	Once	Reversible	Not significant
	Mortality or Injury in Fish	7.3.2.3	Minor	Immediate to Local	Low	Short- term	Once	Reversible	Not significant
Flora	Habitat Loss and Fragmentation	8.3.2.1	Minor to Moderate	Local	Low	Long-term	Once	Reversible	Not significant
	Loss of Flora SAR/SoCC	8.3.2.2	Minor to Moderate	Immediate	Low	Short- term	Once	Irreversible	Not significant
	Degradation of Flora Habitat	8.3.2.3	Minor	Local	Low	Long-term	Once	Reversible	Not significant
Wetlands	Loss of Wetland Habitat	9.3.2.1	Moderate	Immediate	Low to Moderate	Long-term	Once	Reversible	Not significant
	Change in Wetland Hydrology	9.3.2.2	Moderate	Local	Low to Moderate	Long-term	Once	Reversible	Not significant
	Change in Wetland Function	9.3.2.3	Moderate	Local	Low to Moderate	Long-term	Once	Reversible	Not significant
Terrestrial Wildlife	Habitat Loss/ Fragmentation	10.3.2.1	Moderate to Large	Local to Regional	Low to Moderate	Long-term	Once	Reversible	Not significant
	Collision Risk	10.3.2.2	Moderate	Immediate	Low to Moderate	Medium-term	Intermittent	Reversible	Not significant
	Disruption of Life History	10.3.2.3	Moderate	Local	Low to Moderate	Long-term	Once	Reversible	Not significant
	Other Threats (Poaching/ disease)	10.3.2.4	Moderate	Local	Low to Moderate	Long-term	Once	Reversible	Not significant
Bats	Habitat Loss/ Fragmentation	11.3.2.1	Minor	Local	Low	Long-term	Once	Reversible	Not significant
	Direct Mortality and Injury	11.3.2.2	Minor	Intermediate	Moderate to High	Long-term	Intermittent	Reversible	Not significant
	Sensory Disturbance	11.3.2.3	Moderate	Local	Low	Long-term	Intermittent	Reversible	Not significant

Valued Component	Potential Effect	Mitigation Reference (Section)	Residual Effect Characterization						Significance of Residual Effect
			Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	
Birds	Habitat Loss/ Fragmentation	12.3.2.1	Minor to Moderate	Local	Low to Moderate	Long-term	Once	Reversible	Not significant
	Direct Mortality and Injury	12.3.2.2	Minor	Intermediate	Moderate to High	Long-term	Intermittent	Reversible	Not significant
	Sensory Disturbance	12.3.2.3	Minor	Local	Moderate to High	Short-term	Intermittent	Reversible	Not significant
Socio-Economic Environment	Change in Population and Economy	13.3.2.1	Moderate	Regional	Low	Medium-term	Continuous	Reversible	Significant (positive)
	Change in Land Use and Value	13.3.2.2	Moderate	Local	N/A	Long-term	Continuous	Reversible	Not significant
	Change in Visual Landscape	13.3.2.3	Moderate	Local	N/A	Long-term	Continuous	Reversible	Not significant
	Change in Utilities	13.3.2.4	Minor	Regional	N/A	Long-term	Continuous	Reversible	Not significant
	Change in Transportation	13.3.2.5	Minor to Moderate	Local	Moderate	Long-term	Intermittent to Continuous	Reversible	Not significant
	Change in Recreation and Tourism	13.3.2.6	Moderate	Local	Moderate	Medium-term	Intermittent	Reversible	Not significant
	Change in Human Health	13.3.2.7	Minor	Local	N/A	Medium-term	Intermittent	Reversible	Not significant
Heritage and Cultural Resources	Effects on Archaeological and Heritage Resources	14.3.2	Minor	Intermediate	N/A	Short-term	Once	Irreversible	Not significant
	Change in Indigenous Cultural Resources	14.3. 2	TBD	TBD	TBD	TBD	TBD	TBD	TBD

17 Effects of the Environment on the Project

Effects of the environment on the Project can arise from natural hazards, including extreme events. These have the potential to affect the Project components, schedule, and/or costs. The Project has been designed to best resource and withstand the existing environment and the anticipated changes in weather and frequency of natural disasters. All phases of the Project, however, are subject to effects such as delays in construction and decommissioning as well as changes in power generation and requirements for infrastructure repairs during operation and maintenance.

17.1 Natural Hazards

17.1.1 Extreme Weather

Climate change factors indicate that Nova Scotia can expect the occurrence of tropical storms more often, bringing more intense rainfall, strengthening winds, and flooding. While the number of hurricanes is not expected to increase, warming waters allow these storms to travel further north without weakening (NSECC, 2022). Climate change is also expected to increase the frequency, duration, and intensity of heat waves and droughts.

On September 24, 2022, Hurricane Fiona significantly impacted southeastern Nova Scotia. Fiona was the deepest cyclone on record to make landfall in Canada with maximum winds near 157 kilometres per hour (km/h) (Pasch et al., 2023). The storm resulted in thousands of downed trees and power lines across Atlantic Canada. Most recently, Hurricane Lee made landfall in southwestern Nova Scotia on September 16, 2023, as a tropical storm, with gusts of 117 km/h recorded at the Halifax Stanfield International Airport (Bauman, 2023).

In July 2023, a summer storm event resulted in some areas of Nova Scotia receiving 250 mm of rain within a 24-hour period, resulting in damages to over 500 sections of roadways (NSDPW, 2023) as well as existing access roads within the PDA. Roads on steep slopes and near open cut areas can be vulnerable to washouts and even landslides during periods of heavy rain and spring freshet. The risk of landslides to people and infrastructure in the province is considered minimal in most areas, attributable to bedrock geology and forestry practices (NSDNRR, 2021a). Highland areas, such as the Cobequid Hills, however, have a higher risk for shallow landslides and rock landslides. As discussed in Chapter 6 (Geophysical Environment), a draft geotechnical investigation report described the existing till in the PDA to be composed of sandy silty clay that is susceptible to erosion (Strum, 2023).

Despite the high elevation within the PDA, it is possible that flooding could occur on site during extreme precipitation. The Chignecto Isthmus, which supports the major traffic and trade corridor between Nova Scotia and the mainland of Canada, is becoming a focus for climate change adaptation due to its increasing risk of flooding anticipated from land subsidence, extreme weather events, storm surges, and sea level rise (Wood Environmental & Infrastructure Solutions, 2022). During construction and decommissioning, extreme weather events throughout the region could cause delays in the delivery of materials and equipment. Extreme events throughout the region can cause delays in construction activities and/or damage equipment and materials being used.

During operation and maintenance, any of these extreme events within the LAA can cause damage to the facilities, forcing temporary shutdowns and repairs. Even extreme temperatures can affect the operations of wind turbines when conditions exceed the operational design range of -20 / -30 °C cold to a maximum temperature of 40 °C. As discussed in Chapter 5 (Atmospheric Environment), heat extremes have not yet reached 40 °C in available records at either Debert or Jackson weather stations, but an extreme low of -35 °C was recorded in Debert in January 1993 (an elevation of 38 m) and an extreme low of -40 °C was recorded in Jackson in January 1994 (at an elevation of 91 m, which is more comparable to that of the PDA (ECCC, 2023).

Heavy or prolonged precipitation during extreme events can result in the accumulation of ice on access roads, resulting in hazardous road conditions. Application of salt to roads during winter to facilitate the melting of surface ice for improving driving conditions can lead to pooling of salt water, which can sometimes cause electrical shorting on some components of power wires, such as the insulators (NSPI, 2024). Salted roads can also lead to arcing, whereby salt blows onto wires during high winds. Both cases can result in power outages.

Although turbines are built to withstand high winds, their operations will need to be paused at maximum wind speeds in the range of 22 to 30 m/s (depending on the turbine model), negatively affecting energy production and revenue. In addition, other infrastructure such as the power lines may be damaged by high winds and require repair. The most frequent weather-related power outages in Nova Scotia are caused by downed trees and branches resulting from high winds and contacting power lines (NSPI, 2024).

17.1.2 Wind

While storm-related winds are expected to increase in strength and frequency, there has been evidence for decreasing mean wind speeds in North America (–0.084 m/s per decade) during the period of 1979 to 2018 (Intergovernmental Panel on Climate Change (IPCC), 2021) as a result of climate change. This 'stilling' tendency, however, has possibly been reversing after 2010 and the global mean surface winds strengthened, although the robustness of this reversal is unclear given the short period of study and interannual variability. Given that the anticipated lifespan of the Project is approximately 35 years, it is unlikely that declining local wind resources will affect energy production.

17.1.3 Icing

Atmospheric icing refers to any type of accumulation of ice or snow on a surface during a meteorological event. This type of icing is mainly caused by precipitation, such as freezing rain and wet snow, or passing clouds and fog. Ice formation on wind turbine blades is dependent upon air temperature, wind speed, surface shape, and liquid water content of the air (Canadian Renewable Energy Association (CanREA), 2020). Air temperatures ranging between 3 °C and -2 0°C can hold the amount of moisture required for icing; precipitation at temperatures below -5 °C, however, is not likely to stick. Therefore, icing is most likely to occur between -4 °C and 2 °C.

The International Energy Agency (IEA), under the Wind Task 19, has been studying and reporting on wind turbine icing and operational controls for more than a decade (IEA, 2018). There are different atmospheric icing conditions that exist for the accretion of ice on structures, including wind turbines. These are in-cloud icing (rime or glaze ice) and precipitation icing (freezing rain and wet snow). The following describes the ice build-up on wind turbines:

- Rime Ice – in-cloud icing where water droplets form a rime on the blades and occurs at temperatures down to -20 °C.
- Glaze ice – caused by freezing rain or wet in-cloud icing and forms a smooth layer of ice that is strongly adhered to the blades at temperatures between 0 and -6 °C.
- Wet snow – partly melted snow crystals with high liquid water content become sticky and are able to adhere to the surface of the turbine blade and occurs when the air temperature is between 0 and 3 °C.

It is important to understand site-specific frequency of potential icing events. The IEA provides Icing Classes in five categories, Class 1 being the lowest risk of icing events (0 to 0.5 percent of the year) and Class 5 being an area with the highest icing potential events (less than 10 percent a year). VTT Research of Finland (2024) has compiled an international Wind Power Icing Atlas that provides the IEA Icing Class rating for locations around the world. The Project is located in an Icing Class 2 area, which indicates that meteorological icing is only expected to occur 0.5 to 3 percent (2 to 10 days) a year (VTT, 2024).

Furthermore, the duration of rotor icing strongly differs for a wind turbine blade at standstill compared to that of a rotating turbine whose flow velocity and vibration reduces ice incubation time (International Energy Agency (IEA) Wind, 2017). Ice is more likely to form on other Project infrastructure such as above-ground power lines, roads, towers, nacelles, hubs, blades, and the MET tower.

Ice accretion on rotor blades reduces the aerodynamic performance of the turbine, which can result in production losses. Blade icing also increases vibrations and fatigue loads that can reduce turbine lifespan, leading to measurement and control errors that cause mechanical and/or electrical failures. Structural damage as a result of icing and other environmental conditions is discussed in Section 18.5 (Structural Damage). Ice shedding is most likely to occur when there is ice accumulation on the blades that becomes subject to milder temperatures (usually at and above 0 °C) that prompt melting (CanREA, 2020). The risks of ice throw to human health and safety may lead to temporary shut-downs of individual turbines. Ice throw is considered an accidental event as described in Chapter 18 (Accidents and Malfunctions).

17.1.4 Wildfires

Fire season is described by the NS *Forests Act* as the period of greatest fire risk, listed as April 15 to October 15 inclusive for Colchester County (NSDNRR, 2021b). Uncontrolled wildfires can be caused by natural occurrences such as lightning strikes, human negligence or by accident, and sparks from equipment including ATVs and chainsaws. Fire origins are most associated with populated areas. Only three percent of fires in the province are started by lightning; 97 percent are started by human activity, much of which is arson (NSDNRR, 2021b). While uncontrolled fires usually begin in residential areas, the vast majority of land damaged by wildfire is Crown land.

In 2022, a total of 2.81 ha was burned by wildfire in Colchester County, most of which occurred during two fire events in May (NSDNRR, undated). The provincial fire season for 2023 has been the worst in recorded history. In November 2023, the provincial dashboard (which is updated daily) reported that 220 wildfires had burned a total of 25,093.29 ha across the province by the end of fire season (Province of Nova Scotia, 2023). Eight of those fires occurred in Colchester County, burning 3.42 ha.

Lightning has been known to strike turbines, causing fires and structural damage. Due to their height, fire suppression from ground crews is often ineffective for turbine fires and therefore fire can result in complete loss of the structure (New Brunswick Department of Energy, 2008).

The Nordex turbines are equipped with lightning protection and overvoltage in accordance with the standards for turbines (IEC 61400-24). The blades are equipped with a highly conductive tip made of aluminum which attracts lighting. There are large conductor cables in the blade that transfer the energy through a rotating connection at the rotor, which is grounded to the tower and then into ground. The conductor cables from the rotor to tower are intended to prevent electricity going through the sensitive components including electrical and mechanical (e.g., bearings).

17.1.5 Seismic Activity

The PDA overlaps the Cobequid fault, which is part of a broader series of faults within the Northern Appalachian Seismic Zone (Fader, 2005). The fault series is not, however, located near the edges of tectonic plates. Nova Scotia as a whole is considered to have a relatively low risk for earthquakes that have the strength of magnitude (MN) 5 or more that is associated with causing damages to infrastructure (NRCan, 2021). There has not been an earthquake of 5 MN or more centred in Nova Scotia since 1855. There have, however, been reports of events felt in the region, such as the 2.6 MN event felt in Dartmouth in March 2020, a 3.0 MN near Yarmouth in 2016, and a 3.6 MN near Digby in 2015 (CBC News, 2020).

17.1.6 Sinkholes and Subsidence

Sinkholes can cause extensive damage to buildings, roads, and other infrastructure—the primary hazard being sudden collapse of cavities in the bedrock created by the dissolution of soluble evaporite or carbonate rocks in karst topography. As discussed in Section 6.2, the PDA lies within an area of low karst risk with bands of medium karst risk occurring southeast of the PDA. There are no sections of the PDA that approach these medium-risk areas. The draft geotechnical report indicated that there is no evidence of karst, subsidence, or sinkholes in the PDA (Strum, 2023).

The sections of Highway 104 and exits that lead to Trunk 4 near the PDA are considered high risk karst terrain. The province's high-risk areas account for ninety-six percent of the sinkholes in the Nova Scotia Sinkhole Database (Drage and McKinnon, 2019). Should subsidence or sinkholes damage the highways used to access the PDA during any phase of the Project, there could be delays for deliveries and staff commutes during road repairs. It is possible that, should sinkholes cause major traffic detours, transportation via alternate collector roads may be considered.

Human activities that result in water table decline (such as groundwater pumping) and changes to surficial water drainage patterns are the two main causes of subsidence.

17.2 Management and Adaptation

Project components and design have considered the existing environment and the need to adapt to climate change. Using the approach outlined in the *Guide to Considering Climate Change in Project Development in Nova Scotia* (Nov Scotia Environment, 2011), this Project is considered low risk based on the nature, magnitude, and sensitivity to climate risks:

- The Project is not vulnerable to sea level rise, being located inland at a high elevation.
- Project operation and maintenance does not depend on the availability of natural resources such as groundwater or surface water.
- The Project operation and maintenance is not adversely affected by drought or growth seasons for agriculture and forestry.
- The anticipated lifespan of the Project is 35 years.

Effective surface water diversion measures will be designed to accommodate extreme precipitation. To protect the integrity of the Project footprint, effective drainage infrastructure, such as culverts, will be installed during construction to prevent surface water pooling around foundations and access roads. Access roads will be constructed and upgraded to the current 1:100 year flood design criteria. Such diversion measures may require upgrades and maintenance over time to accommodate increasingly severe precipitation events and will be considered during site restoration at the time of decommissioning. An EPP with erosion control measures will be developed prior to the beginning of construction activities.

Environmental conditions for the region are an important part of choosing turbine specifications and in overall Project design. Procedures for operation and maintenance will manage the impacts of extreme weather events. To prevent damage to overhead power lines and power interruptions during extreme weather, the RoW of the power corridor will be kept clear of trees. The modern turbine model selected for this Project has been manufactured to withstand extreme weather conditions to prevent structural damage. Vibration sensors in the turbine detect conditions that can lead to damage of rotating blades, such as ice accumulation or high winds, and trigger auto-shutdown of the turbine.

The provincial fire indices, which are updated twice daily online during fire season, will be monitored. Project activities will be restricted and/or temporarily suspended during any phase of the Project should NSDNRR mandates require. To prevent spread of fire to Project components during operation and maintenance, areas around the structures will be kept clear of scrub, low brush, and long grass. Burning will be prohibited on site. Should a fire be observed by onsite staff, it will be reported immediately to the NSDNRR hotline 1-800-565-2224 or 911 emergency services. Road improvements will facilitate ground access for emergency responders.

Operation and maintenance staff will report signs of subsidence to the Proponent and be cognizant of activities that can lead to water accumulation. Application of salt to roads in response to icy conditions will be avoided. Earthworks during decommissioning will also incorporate grading that will not contribute to risks of subsidence and sinkholes in the restored areas.

Turbine towers and blades are built to withstand intense vibratory wind loading; seismic activity, therefore, would be more likely to damage foundations than the above-ground turbine infrastructure (Prowell and Veers, 2009; Nuta et al., 2011). A seismic survey has been completed and results provided in the draft geotechnical report indicate that the site is expected to be either Class A or Class B as defined in the National Building Code of Canada (final report pending), and that either class is favourable for the development of this Project (Strum, 2023).

18 Accidents and Malfunctions

Accidental events and malfunctions are unplanned events with a low probability for occurrence. Although unlikely, an accidental event or malfunction can cause significant adverse environmental effects and have the potential to affect one or more of the VECs identified in Table 4.1 in Chapter 4 (Assessment Methods and Initial Screening). The following accidents and malfunctions were identified as having the potential to occur during construction, operation and maintenance, and/or decommissioning:

- Transportation-related Accidents
- Erosion Control Malfunctions
- Hazardous Materials Spills
- Ice Throw
- Structural Damage
- Fires

The Proponent has retained RES to oversee the construction of the Project as well as its initial operation. As the world's largest independent renewable energy company, RES has established a stringent Health, Safety, Environment, and Quality system that is integrated into every project and addresses spill and accident prevention, personal protective equipment (PPE), and emergency response. RES was awarded Health and Safety Team of the Year by the British Safety Industry Federation in 2022 (RES, 2024).

A Project-specific EPP will be developed prior to the commencement of Project activities; EPP components are outlined in Chapter 2 (Project Description). The EPP will include a Contingency Plan that will provide emergency response measures for accidental occurrences. NSECC has a generic guide for developing contingency plans (NSECC, 2021). Through the Project Contingency Plan, staff will be informed of the appropriate communication channels, including contact information that is readily accessible to field crews and site environmental monitors.

18.1 Transportation-related Accidents

Accidents and malfunctions of vehicles and heavy equipment have the potential to adversely affect the environment and pose human health and safety risks. Traffic accidents that result in vehicular damage can result in injuries and/or damages to infrastructure that force activity shutdowns and use provincial emergency response resources. A Traffic Management Plan will be developed prior to the construction phase and posted on the Project website. Mitigation measures to prevent transportation-related accidents are to be considered for both public roads and onsite access roads:

- Special Weather Statements and Warnings issued by ECCC will be considered before driving.
- Speed limits will be established and enforced for access roads.
- Speed limits will be adhered to on public roads.
- Careful attention will be used to minimize construction traffic on school bus routes during pick-up and drop-off times.
- Cell phone use while driving will be prohibited.
- Should the site be snow-covered, site personnel are to drive only on known terrain.
- Diversions of existing trails for hiking and ATVs will be visibly and prominently marked to avoid entrance of ATVs to the site while heavy equipment is in use.
- Appropriate training for onsite personnel will be provided that includes site safety protocols and emergency response procedures.

18.2 Erosion Control Malfunctions

Malfunctions of drainage infrastructure may occur during any phase of the Project, leading to runoff and discharge to nearby waterbodies. Overwhelmed drainage networks can be eroded and cause subsidence on the site. Runoff can produce elevated levels of total suspended solids that can adversely affect the aquatic environment, particularly fish and fish habitat.

ESC measures are particularly important to prepare for spring runoff and extreme or prolonged rainfall events. The Project will be designed and constructed to consider both typical and extreme weather functionality. An ESC Plan and a Surface Water Management Plan will be developed and implemented by the Proponent. As part of the EPP, a Contingency Plan will be included that addresses emergency response to malfunctions that can damage roads, cause pooling around foundations, and/or lead to drainage into waterbodies. The onsite environmental monitor will report damaged and/or poorly functioning drainage components to the Proponent as part of daily operation and maintenance. Proper sloping and drainage will also be considered during decommissioning.

The Proponent will develop a Contingency Plan to be implemented in the event of an erosion control malfunction. Contingency measures recommended by the NSDPW's Generic EPP for the Construction of 100 Series Highways (NSDPW, 2007) are applicable to this Project:

- Conduct staff training (e.g., tailgate safety and environmental meetings to inform staff of potential problems and hazards).

- Plan and practice storm alertness measures, outlining conditions for work stoppages, pre-storm staff meetings, inspections, and preventative maintenance of ESC measures such as covering highly erodible surfaces, emptying of settlement ponds, and proactive measures to ensure critical ESC measures near watercourses will withstand storm runoff, seasonal impacts, and wind.
- Confirm availability of equipment and operators that can be mobilized on short notice to install/repair berms, dams, diversion ditches, catchment ponds, and turbidity curtains.
- Stockpile ESC materials, including quantities and locations for strategic placements such as:
  - ESC blankets/matting and staples (or tarps/plastic sheeting)
  - Sandbags, clear stone
  - Water pumps and hoses
  - Turbidity curtains
- Implement typical approaches for temporary control of water flow and erosion until new ESC measures can be implemented, such as excavation of cross ditches to divert runoff away from surface water bodies and into catchment ponds or vegetated areas; excavation of temporary water storage areas; berm construction; bank stabilization, and deployment of backup turbidity curtains. Approaches will vary depending on season, and the contractor will indicate approaches for summer (low flow periods), spring-fall (high flow periods) and for frozen ground (high-flow periods).
- Develop standard protocols for notification of failures to the Proponent, NSDPW, and NSECC/DFO inspectors.
- Develop standard protocols for incident and near miss reporting to the Proponent and NSECC to provide documentation of the failure (a Near Miss Report details failures that did not result in the loss/release of sediment), the intention being to identify the cause and help prevent future occurrences.

18.3 Hazardous Materials Spills

A hazardous material spill has the potential to cause significant adverse environmental effects depending on the size and location of the spill. Accidental discharges of POL or other hazardous materials can contaminate the soil, leaching through the unsaturated zone to local groundwater flow systems, which could further spread the contamination plume in the groundwater LAA. Spills can also travel via runoff to surface waters or wetlands. Volatile compounds can vaporize into the surrounding air. Through pathways such as these, wildlife habitat can be adversely affected and there could be effects to human health.

Since POL on site will primarily be those associated with the operations of vehicles and heavy equipment, as well as the turbine nacelles, there is a low probability for occurrence of POL release and the magnitude will be limited to the volume of POL contained by the equipment. The Nordex platform chosen for the Project uses an electric motor drive for pitching the wind turbine blades, as opposed to a hydraulic ram pitch system. This engineering shift has eliminated the potential release of hydraulic fluid and provides a more environmentally friendly solution.

Standard operating procedures developed by RES for other renewable resource projects include protocols for spill response and the requirement of onsite spill kits.

Fuel and hazardous materials spill response will be included in a Contingency Plan to be developed as part of the Project-specific EPP. Spills will be reported immediately by onsite personnel to the NSECC using their 24-hour emergency response hotline: 1-800-565-1633.

As a reference, the NSDPW (2007) Generic EPP provides guidelines for waste management as well as the handling and storage of POL:

- Hazardous material containers will be properly labeled in compliance with the requirements of the Workplace Hazardous Materials Information System (WHMIS).
- Onsite personnel will have training in WHMIS, transportation of hazardous goods, spill response, and site-specific procedures.
- Safety Data Sheets (SDS) will be available for all hazardous materials in use or stored on site.
- The environmental monitor will be responsible for monitoring the operating condition of the equipment used on site to ensure it is in good working condition.
- Hazardous materials will be handled only by site personnel who are trained and qualified in the handling of these materials, and only in accordance with manufacturer's instructions and government regulations.
- Waste hazardous materials will be separated, stored, transported, and handled in accordance with regulatory requirements and disposed of at an approved hazardous recycling or disposal facility.
- Equipment used will be mechanically sound with no oil or gas leaks. The environmental monitor will regularly inspect equipment and leaks will be repaired immediately.
- There will be no fuelling, storage, washing, or servicing of vehicles within 30 m of a watercourse, drainage ditch, areas with a high water table, or exposed and shallow bedrock.
- There will be designated refuelling and POL storage areas, each located a minimum of 30 m from any waterbody or environmentally sensitive feature. Storage and refuelling procedures must meet the Nova Scotia Petroleum Management Regulations under Sections 25 and 84 of the *Environment Act*.
- Fuel storage areas will be clearly marked and/or barricaded to prevent damage from vehicles.
- Spill clean-up materials shall be accessible and maintained in the designated areas of fuel and chemical storage as well as heavy equipment vehicles.

18.4 Ice Throw / Shed

Wind turbines operating during specific meteorological conditions can introduce the hazard of ice throw or ice shed (fall) in the surrounding area. The risk of an individual or vehicle being struck by ice is very low, but setback distances to non-participating property lines and roadways are key to minimize the potential for an incident. The potential risk to public safety is determined by the size of the ice fragments thrown, distance thrown, and probability that someone will be within the landing zone. The risk of wind turbine blade icing is discussed in Section 17.1.3 (Icing).

In recent years there have been a number of peer-reviewed papers where field studies of ice throw in the Nordic states have demonstrated that the vast majority of ice pieces of the size that could cause serious injury or fatality are thrown within the tip height of the turbine (Lunden, 2017; Bredesen et al., 2017). In 2017, Swedish researchers published the findings of their IceThrower study (Lunden, 2017). This involved icing wind turbine blades in the field and then determining the area where ice was thrown surrounding the turbine. This study showed that 75 percent of the ice thrown was found within one rotor diameter distance from the turbine tower and only 1 percent of very small fragments were identified beyond 1.5 times the rotor diameter distance (which was the same as the total height of the turbine). This is the basis of the common setback of 1.1 times the total height of a turbine to roads and non-participating property lines. This distance has become an almost universal setback across North American jurisdictions to protect non-participating property owners and vehicles on roads.

The Nordex wind turbines proposed to be used at the Project have a rotor diameter of 163 m, hub height of 118 m and a total height of 199.5 m. Based on the IceThrower study this would predict that 99 percent of ice thrown from the Nordex turbines would be a distance of less than 200 m, or the tip height of the turbine. Only one percent of ice thrown would be beyond this distance and would be of a size that would likely not cause serious injury or death.

CanREA currently recommends a formula to predict maximum distance for ice throw (CanREA, 2020):

[$dt = 1.5 * (D + H)$], where:
dt = Maximum throwing distance (m)
D = Rotor diameter (m)
H = Hub height (m)

At maximum, the Project turbines will have a hub height of 118 m and a rotor diameter of 163 m. Using the CanREA (2020) formula, the maximum ice throw distance of very small fragments of ice is anticipated to be 422 m. However, it should be noted that this formula does not include consideration of gravity, aerodynamic drag, turbine specifications, operational mode, and site topography (IEA, 2022). Should those factors be considered, it is predicted that ice throw that could potentially be dangerous to health would be within 219 m (1.1 x tip height).

The Project turbines, in accordance with the Municipality of Colchester's Wind Turbine Development By-law, are set-back at least 2 km from dwellings and a minimum of 200 m from public roads and external property lines. This effectively means that no ice throw will reach dwellings and that the risk to traffic on public roads is negligible.

IEA recommends mitigation measures to reduce the risk of ice throw from wind turbines (IEA, 2018):

- During meteorological conditions that would be conducive to icing, wind turbines can be temporarily shut down.
- Ice build-up on turbine blades during operations causes them to vibrate. This vibration triggers automatic imbalance sensors in the turbines and they are automatically shut down to avoid damage to the turbines and avoid throwing ice.

The largest risk to onsite work crews is ice shed/fall of the ice from blades to the base of the tower. CanREA's (2020) *Best Practices for Wind Farm Icing and Cold Climate Health & Safety* recommends mitigation that applies to initial approaches by onsite maintenance personnel to investigate both ice throw and blade breakage that will protect occupational safety. In addition, the Project will develop a site-specific Health and Safety Plan and training to protect worker safety:

- Observe with binoculars whether the turbine is iced before entering the throw zone.
- Remotely turn the nacelle to face opposite side of the access door.
- If necessary, shut down the turbine and those near the route to your destination.
- Park vehicles outside throw zones.

The Project is not proposed to be gated; therefore, the public will be able to continue to use the area for recreational purposes. There will be signs posted at turbine access road entrances that warn during winter that icing conditions can occur and that individuals should remain away from the turbines. In addition, information sessions with the local snowmobile clubs and recreational users will be held to communicate the risks of approaching turbines during icing conditions. The probability of an individual being struck by ice is extremely low given automatic shutdown of turbines during icing conditions and appropriate setback distances and it does not pose a significant risk to individuals.

18.5 Structural Damage

Extreme weather, manufacturing faults, and turbine blade wear can lead to fatigue loads that can reduce turbine lifespan through various means, including blade damage and breakage. Extremely cold weather can induce additional blade fatigue, such as brittle material fracture and nonuniformities on the surfaces (Algolfat et al., 2023). Extreme weather, including wind and icing, are discussed in Chapter 17 (Effects of the Environment on the Project). Other extreme events, such as heavy rainfall and lightning strikes, can result in delamination and tip detachment. It is, therefore, important to detect damages at the earliest possible stage to maintain durability and sustainability and protect public safety.

Damage to wind turbine blades results in increased or irregular vibrations (Algolfat et al., 2023). The turbine selected for this Project contains vibration sensors that will detect these conditions and trigger auto-shutdown of the turbine. Poor management, monitoring, and maintenance can lead to severe structural damage that has been reported for some wind facilities. The use of vibration sensors in the Project-selected turbines will act as a valuable detection system for impending malfunctions and structural damages. Heeding warnings from the sensors will facilitate preventative maintenance for each turbine to protect structural integrity, maximize production, and ultimately minimize long-term costs of repairs and risks to public safety.

Structural failures, although rare, can happen with wind turbines. It has been estimated that 1 in 10,000 blades can fail within any given year (Rijksdienst, 2014). Total turbine collapse or structure failure is also rare. In the event that a turbine tower fails it falls within tip height of the turbine. Rogers and Costello (2022) modelled the probability of blade failure and impact on roads:

> *Results for these example turbines show that the typical setback of 1:1 x tip height is generally sufficient at reducing risk to extremely low levels (between 1 impact in 1 million years and 1 impact in 10 million years) for roads in rural areas which tend to be lightly traveled.*

Therefore, given the setback distances to roads and homes, it is unlikely that structural failure of turbines or blades would significantly impact public health.

The Proponent recognizes that strict monitoring and regular structural inspection is necessary for wind production facilities and will promptly repair/replace damaged parts, and prevent operations of iced turbine rotors, for the sustainability of the Project. During operation and maintenance, the Proponent will implement the following measures:

- Ensure replacement parts share the same temperature rating as the original components.
- Use POL appropriately rated for the climate to avoid thickening in the generators, gearboxes, motors, gears, etc.
- Remove frost from high voltage circuits prior to energizing.
- Routinely perform system inspection and calibration procedures.
- Monitor ECCC weather forecasts for warnings and special weather statements.
- Be prepared to quickly employ remote shutdown of the system during high-risk conditions, such as extreme weather events, or when there are indications of equipment malfunction.

- Shut down individual turbines with worn or damaged equipment until replaced or repaired.
- Develop and implement a Contingency Plan.

To further mitigate risks to local infrastructure and public safety, the Project has been designed to locate turbines at a minimum setback of 2 km from civic addresses and a setback distance of 200 m or more from public roads.

18.6 Fires

Project construction, operation and maintenance, and decommissioning activities that may accidentally cause a fire include:

- Sparking equipment or hot vehicular exhaust
- Refuelling
- Vehicle accidents
- Other human activities

Accidental fires may have serious adverse effects such as habitat loss, mortality to wildlife and vegetation, atmospheric emissions, and damage or loss of property. In addition, there is potential for fire suppressant chemical runoff during firefighting (NSDPW, 2007).

Fire ignition in turbines can be caused by lightning strikes, electrical malfunctions, mechanical malfunctions, and aging components (You et al., 2023). Flammable materials used in wind turbines such as fiberglass-reinforced polymers, foam insulation, wires, and the POL required to lubricate mechanical components of the nacelle can fuel such fires.

The selected turbine model for this Project has lightning/surge protection that is based on the electromagnetic compatibility compliant lightning protection zone concept, which comprises the implementation of internal and external lightning/surge protection measures under consideration of the International Electrotechnical Commission standard 61400-24. The nacelle components are equipped with an automatic lubrication system that prevents friction in the rotors and cools the gearbox.

Guidance for mitigation measures and contingency plans for fire prevention is available in the NSDPW generic EPP and will be specifically addressed in the Project EPP.

As outlined in Chapter 17 (Effects of the Environment on the Project), the Nova Scotia Fire Index is to be monitored during construction, operation and maintenance, and decommissioning activities. An area around each turbine base will be grubbed to act as a form of a fire break. Onsite personnel will have fast access to fire suppressant equipment and PPE. Flammable chemicals/POL will be stored at a designated fuelling and hazardous material storage site with secondary containment.

In the event of a fire, local and provincial emergency response services and procedures would be initiated, starting with a call to 911. Fires will also be reported immediately by the environmental monitor to the NSDNRR using their 24-hour emergency response hotline: 1-800-565-2224. Onsite staff would be advised to remove obstacles on access roads, such as vehicles that could impede emergency response crews. Local fire departments will not be asked to fight a turbine fire, rather to set a permitter around the base of the turbine to ensure that fire from the turbine will burn itself out and not catch adjacent vegetation. The Proponent will provide local fire departments information about points of access, as well as education on the Project and a site tour.

Mitigation measures recommended by the Canadian Electricity Association (2020) will be implemented to prevent and control fires near electrical infrastructure applicable to this Project:

- Staff will be trained on how to use extinguishers safely and effectively.
- Onsite personnel will be trained on procedures for extinguishing small nacelle fires.
- The Proponent will replace wood components (buildings / power poles) that have deteriorated due to wear and/or pose a risk as an ignition source if they are subject to weather conditions that exceed their operating design standards.
- Power lines will be regularly inspected to identify lines that require rebuilds. Old lines will be replaced as needed to preserve safety and meet new operating standards and fire mitigation standards.
- RoWs will be regularly maintained through vegetation management. Vegetation or other material coming in contact with transmission and distribution lines can create ignition risk as they may ignite and/or cause flashover electrical charges.
- Fuel hazards (tree trimmings/slash) will be removed from RoWs.
- RoWs and other open spaces will be gravel, mineral soil, frequently mowed grass, or maintained vegetation (ground-cover shrubs) to act as firebreaks—an obstacle to the spread of a fire.
- Animal deterrents will be installed around the substation to reduce wildlife contact with equipment that can trigger fires.
- Hazardous materials within the substations will be protected by following WHMIS standards.
- A Contingency Plan will be developed and implemented.

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APPENDIX A

Figures

APPENDIX B

AC CDC Report

APPENDIX C

Greenhouse Gas Emission Calculations

APPENDIX D

Consultation and Engagement Tables

APPENDIX E

Windy Ridge Noise Assessment

APPENDIX F

Domestic Water Well Records

APPENDIX G

Aquatic Tables

APPENDIX H

Flora Species Tables

APPENDIX I

Wetland Photo Log, WESP-AC Functional Scores and Summary Tables

APPENDIX J

Bird Tables, Windy Ridge 2023 Radar and Acoustic Monitoring Baseline Report

APPENDIX K

Visual Simulations

(high-resolution visuals can be viewed on the NSECC website:
https://novascotia.ca/nse/ea/projects.asp)

APPENDIX L

Windy Ridge Shadow Flicker Report

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