PORT HAWKESBURY PAPER WIND

GOOSE HARBOUR LAKE WIND FARM PROJECT

Environmental Assessment Registration Document

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Environmental Assessment Registration Document

Prepared By:
Strum Consulting
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Prepared For:
Port Hawkesbury Paper Wind Limited Partnership
120 Pulp Mill Road
Port Hawkesbury, NS B9A 1A1

January 2023

January 20, 2023

Mr. Mark McInnis, Environmental Assessment Officer
Nova Scotia Department of Environment & Climate Change
Environmental Assessment Branch
1903 Barrington Street, Suite 2085
PO Box 442
Halifax, NS B3J 2P8

Re: Environmental Assessment Registration Document
Goose Harbour Lake Wind Farm Project

Mr. McInnis:

Please find enclosed the Environmental Assessment Registration Document for the Goose Harbour Lake Wind Farm Project.

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

Sincerely,

Bev Lock

Bevan Lock

Director – PHP Wind GP Inc. and PHP Wind LP Inc. carrying on business as Port Hawkesbury Paper Wind Limited Partnership

Cc Melanie Smith

EXECUTIVE SUMMARY

PHP Wind GP Inc. and PHP Wind LP Inc., carrying on business as Port Hawkesbury Paper Wind Limited Partnership (the Proponent), proposes to construct and operate the Goose Harbour Lake Wind Farm Project, a 130.5 megawatt (MW) wind development located near the communities of Lincolnville, Big Tracadie, and Mattie Settlement in Guysborough County, Nova Scotia. The Project will consist of 29 (4.5 MW) wind turbines along with associated infrastructure, including access roads and interconnection lines. Wind power is one tool of many that will allow the Port Hawkesbury Paper Facility to support the Province in proactively pursuing green energy sources and help move away from a dependency on electricity predominantly generated using coal.

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

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

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

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

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

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ACCDC	Atlantic Canada Conservation Data Centre
AQHI	Air Quality Health Index
ARIA	Archaeological Resource Impact Assessment
ATV	All-terrain Vehicle
ARD	Acid Rock Drainage
ARS	Avian Radar Systems
BBS	Breeding Bird Surveys
BMPs	Best Management Practices
BT	Biological Targets
°C	Degrees Celsius
CAAQS	Canadian Ambient Air Quality Standards
CAD	Computer-aided Design
CanWEA	Canadian Renewable Energy Association
CAO	Chief Administration Officer
CCME	Canadian Council of Ministers of the Environment
CCOHS	Canadian Centre for Occupational Health and Safety
CEO	Chief Executive Officer
CEPA	Canadian Environmental Protection Act
CH_4	Methane
cm	Centimeters
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CWS	Canadian Wildlife Service
dBA	Decibels (A-weighted)
DFO	Department of Fisheries and Oceans Canada
DND	Department of National Defence
EA	Environmental Assessment
ECCC	Environment and Climate Change Canada
EMF	Electromagnetic Fields
EMI	Electromagnetic Interference
EPP	Environmental Protection Plan
ESA	Endangered Species Act
FAC	Forestry Advisory Committee
FACU	Facultative Upland
FACW	Facultative Wetland
FWI	Fire Weather Index
GHGs	Greenhouse Gases
GIS	Geographic Information System
GPS	Global Positioning System
GWh/y	Gigawatt hours per year
ha	Hectares
HRM	Halifax Regional Municipality
Hz	Hertz
KMKNO	Kwilmu'kw Maw-klusuaqn
IBA	Important Bird Areas
IPCC	United Nations Intergovernmental Panel on Climate Change
kg	Kilograms
km	Kilometres
km^2	Square kilometres
km^3	Cubic kilometres

km/h	Kilometres per hour
kWh/year	Kilowatts per hour per year
LAA	Local Assessment Area
LABO	Eastern red bat
LACI	Hoary bat
LANO	Silver-haired bat
Lpm	Litres per minute
m	Metres
m^2	Square metres
m^3	Cubic metres
m/s	Metres per second
ms	Milliseconds
MARI	Maritime Archaeological Resource Inventory
masl	Metres above sea level
MBCA	*Migratory Bird Convention Act*
MBBA	Maritimes Breeding Bird Atlas
MBII	Migratory Bird Interaction Index
MBDI	Migratory Bird Density Index
MCG	Mi'kmaq Conservation Group
MDSM	Municipality of the District of Saint Mary's
MEKS	Mi'kmaq Ecological Knowledge Studies
mg/L	Milligrams per litre
mins	Minutes
mm	Millimetres
MODG	Municipality of the District of Guysborough
mS/cm	MilliSiemens per centimetre
MW	Megawatt
MYOT	Myotis Species
NFCs	Night Flight Calls
NI	No Indicator Status
NL	Not Listed
N_2O	Nitrous Oxide
NO	Nitric Oxide
NO_2	Nitrogen Dioxide
NO_x	Nitrous Oxides
NRCan	Natural Resources Canada
NREL	National Renewable Energy Laboratory
NS AAQS	Nova Scotia Ambient Air Quality Standards
NSAQR	Nova Scotia Air Quality Regulations
NSCCTH	Nova Scotia Communities, Culture, Tourism and Heritage
NSECC	Nova Scotia Environment and Climate Change
NSNRR	Nova Scotia Natural Resources and Renewables
NS Power	Nova Scotia Power
NSPW	Nova Scotia Public Works
NSSU	Nova Scotia Southern Upland (Atlantic salmon)
NSTDB	Nova Scotia Topographic Data Base
O_3	Ozone
OBL	Obligate
PESU	Tri-colored Bat
PHP	Port Hawkesbury Paper
PID	Property Identification
PM	Particulate Matter
ppb	Parts per billion

PPE	Personal Protective Equipment
Q_{20}	Long term safe yield
RAA	Regional Assessment Area
RABC	Radio Advisory Board of Canada
RPM	Revolutions per minute
s	Seconds
SAR	Species at Risk
SARA	Species at Risk Act
SGEM	Silvicultural Guide for the Ecological Matrix
SO2	Sulfur Dioxide
SOCI	Species of Conservation Interest
tCO2e	Tonnes of Carbon Dioxide Equivalent
tCO2e/y	Tonnes of Carbon Dioxide Equivalent per year
TRS	Total Reduced Sulfur
TSP	Total Suspended Particulate
UINR	Unama'ki Institute of Natural Resources
µm	Microns
$\mu g/m^3$	micrograms per cubic metre
UNKW	Unknown
UPL	Upland
UTM	Universal Transverse Mercator
VC	Valued Component
WAM	Wet Areas Mapping
WESP-AC	Wetland Ecosystem Services Protocol – Atlantic Canada
WHMIS	Workplace Hazardous Material Information System
WMA	Wskijnu'k Mtmo'taqnuow Agency
WSS	Wetlands of Special Significance

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1.0 PROPONENT DESCRIPTION

The Goose Harbour Lake Wind Farm Project (the Project) is a 130.5 megawatt (MW) wind power project proposed by PHP Wind GP Inc. and PHP Wind LP Inc., carrying on business as Port Hawkesbury Paper Wind Limited Partnership (the Proponent). The Project will be connected to the NS Power transmission system.

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

Table 1.1: Proponent and Consultant Contact Information

Proponent Information	
Project Name	Goose Harbour Lake Wind Farm Project
Proponent Name	PHP Wind GP Inc. and PHP Wind LP Inc. carrying on business as Port Hawkesbury Paper Wind Limited Partnership
Chief Executive Officer(s) / Principal(s)	Nigel Cave Bevan Lock
Mailing and Street Address	Port Hawkesbury Paper 120 Pulp Mill Road Port Hawkesbury, NS B9A 1A1
Proponent Contact Information for the EA Registration	Mark Savory, Project Director Phone: 902.237.7321 Email: mark.savory@porthawkesburypaper.com
Consultant Information	
Name of Consultant	Strum Consulting
Mailing and Street Address	Strum Consulting Railside, 1355 Bedford Highway Bedford, NS B4A 1C5
EA Contact	Melanie Smith, VP Environmental Assessment and Approvals Phone: 902-835-5560 Email: msmith@strum.com

2.0 PROJECT INFORMATION

2.1 Project Introduction

The Project is centered at the border of the Tracadie River and Clam Harbour/St. Francis River watersheds, near the communities of Lincolnville, Upper Big Tracadie, and Mattie Settlement in Guysborough County, Nova Scotia (Drawing 2.1).

The Project will use 29 wind turbines with a nominal 4.5 MW nameplate capacity. There are a variety of turbine models being considered for the Project. For the purposes of this EA, turbines with a hub height of 120 m and a rotor diameter of 150 m are evaluated. The turbine locations are shown on Drawing 2.2. Note that 32 locations were assessed as part of the EA to allow flexibility during the detail design phase; however, turbines will only be constructed at 29 locations. The Study Area consists primarily of Crown lands, with the use of some private lands necessary for the interconnection route. The Crown lands are currently utilized for forestry and recreational use. The application for the use of Crown land has been submitted and is under review.

Upon approval of the EA, construction activities are proposed to begin in summer/fall 2023 and, once constructed, the Project is expected to be operational for a minimum of 25 years.

2.2 Purpose and Need for the Undertaking

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

In its assessment report, *Climate Change 2022 - Impacts, Adaptation and Vulnerability*, the United Nations Intergovernmental Panel on Climate Change (IPCC) provides a detailed synopsis of the impacts associated with climate change on both global and regional scales. Evidence from all continents indicates that many biological systems and habitats are currently being affected by regional climate change. Ecological changes include those to the thermal dynamics and quality of aquatic habitats, shifts in migratory timing and ranges of fauna and flora, changes in fish abundance, and increased risk of extinction and loss of forest habitat (IPCC, 2022). In North America specifically, the increase in ground, water, and atmospheric temperatures has resulted in the direct mortality and redistribution of many flora and fauna species. In addition, coastal flooding along with an increase in the frequency and intensity of extreme weather events will continue to impact the socioeconomic environment through displacement and / or damage to communities and economies (IPCC, 2022). Impacts of climate change are, and will increasingly be, felt across environmental, social, human health, and economic sectors (IPCC, 2022).

Canadian climate experts acknowledge that the debate has largely evolved from questions about the reality and causes of climate change, to what actions can be taken to adapt to the realities of a changing climate. As the second most important and fastest growing (along with solar) renewable energy source in Canada (NRCan, 2017), wind energy is a critical component of Canada's renewable energy strategy. Wind energy is emission-free; with every megawatt of wind energy generated, greenhouse gas emissions are reduced in comparison to previous levels associated with coal-related production (NSNRR, 2015). Numerous benefits can be expected from the transition to renewable energy, including:

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

As part of this overall strategy, the Project will diversify the energy mix that powers the Port Hawkesbury Paper (PHP) Facility. Wind power is one tool of many that will allow the PHP Facility to support the province to proactively pursue green energy sources and help move away from a dependency on electricity predominantly generated using coal.

The Project is committed to sharing economic opportunities with the local community, throughout the development and life-span of the Project, via the use of local skills and labour where possible, municipal tax revenue, and ongoing energy literacy/education.

2.3 Regulatory Framework

2.3.1 Federal

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

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

Table 2.1: Federal Regulatory Requirements

Requirement	Regulatory Body	Status/Comments
Notification of Project	RCMP	Notification Sent, Response Pending
Aeronautical obstruction clearance	Transport Canada	In progress.
Lighting design for navigational purposes	Transport Canada	In progress.

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

2.3.2 Provincial

The Project is subject to a Class I EA as defined by the Environmental Assessment Regulations under the Nova Scotia *Environment Act*. As such, this submission has been prepared in accordance with:

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

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

Table 2.2: Provincial Regulatory Requirements

Requirement	Regulatory Body	Status/Comments
Watercourse Alteration Permit Wetland Alteration Permit	Nova Scotia Environment and Climate Change (NSECC)	Alternation applications will be submitted to NSECC in accordance with the Activities Designation Regulations following EA approval. Locations requiring alteration are described in Sections 7.3.1-7.3.3
Endangered Species Act, SNS 1998, c. 11 (*ESA*)	Nova Scotia Natural Resources and Renewables (NSNRR)	Compliance legislation – there is no expectation that an *ESA* permit will be required.

Requirement	Regulatory Body	Status/Comments
Use of Crown lands	NSNRR	Application has been submitted.
Notification of blasting (if required)	NSECC, NS Health and Safety	To be confirmed following the geotechnical investigations.
Overweight/Special move permit	NS Public Works (NSPW)	Future approval.
Access permit Work within highway right-of-way Use of right-of-way for pole lines	NSPW	Future approval.
Elevator lift license	NS Labour Skills and Immigration	Future approval.
Archaeology Field Research Permit	NS Communities, Culture, Tourism and Heritage (NSCCTH)	Permit obtained to complete the archeology assessment.
Nova Scotia Temporary Workplace Traffic Control Manual	NSPW	Compliance for the use of provincial roads during the construction, operation and decommissioning phases of the Project.

2.3.3 Municipal

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

Table 2.3: Municipal Requirements

Requirement	Regulatory Body	Status/Comments
Building and Development Permits	Municipality of the District of Guysborough (MODG)	Permit application to be submitted following EA Approval.
Noise Control By-Law	MODG	Compliance noise levels for construction activities.

2.4 Funding

No government funding has been secured for the Project, though an application to the NRCan Smart Renewables and Electrification Pathways Program was submitted on December 22, 2022. The Canadian Infrastructure Bank have expressed interest via a 2019 Memorandum of Understanding to participate in the Project as an advisor and/or an investor.

2.5 Structure of the Registration Document

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

Table 2.4: EA Registration Document Structure

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

3.0 DESCRIPTION OF THE UNDERTAKING

3.1 Geographical Location

The Project is located within Guysborough County, east of the community of Lincolnville and south of the communities of Big Tracadie and Mattie Settlement, NS (Drawing 2.1). The Project is situated at one of the highest elevations within the county, encompassing provincial Crown lands and private land parcels. The approximate center of the Project is 45.55066 N, 61.49887 W.

A Study Area was established as a large assessment area based on land parcels (i.e., PIDs) that are included in the development area (Table 3.1; Drawing 2.2). This Study Area was used for desktop assessments and to subsequently inform and refine field surveys and the Project design. An Assessment Area was subsequently established for detailed field investigations, which includes the physical footprint of the Project where the direct physical disturbance is expected to occur (i.e., the Project Area), plus a 100 m buffer around the turbines, a 25 m buffer on either side of the centerline for the road network system, and a 10 m buffer on either side of the interconnection route.

Table 3.1: Land Parcels within the Study Area

PID	Landowner
35050715	Interest of His Majesty (Crown Land)
35050491	NS Natural Resources (Crown Land)
35003003	PHP freehold land
35203611	NS Natural Resources (Crown Land)

3.1.1 Siting Considerations

The Study Area is an ideal location for a wind farm due to its strong wind resource, proximity to transmission lines, and distance away from residences. Further, historic timber harvesting in the area has created a network of roadways that have allowed the area to be more accessible. As part of the Project planning, a detailed constraints analysis was conducted to ensure that potential effects to the environment, nearby residents, and sociocultural resources were minimized. This analysis was continually updated and refined based on the results of Project-specific desktop studies, modeling, and field assessments. As a result, several previous turbine layout iterations were reviewed to reflect a growing knowledge of the Study Area and surrounding community and environmental considerations before finalizing the layout (Drawing 3.1).

Specifically, layout modifications considered the following:

- Siting within an optimal wind regime.
- Avoidance of interference with telecommunication and radar systems.
- Maintenance of a vegetated buffer between turbine locations and field identified watercourses.
- Avoidance of lakes, or other visible open water bodies as identified in 1:50,000 provincial mapping.
- Maintenance of a minimum 30 m buffer between turbine locations and field identified wetlands.
    - NSNRR requests that larger buffer distances (*i.e.*, 70-80 m from the tip of blade) are incorporated into the Project design where a species of conservation interest (SOCI) has been identified during breeding season within a wetland. Where appropriate, this buffer has been incorporated into Project planning.
- Avoidance of known protected areas, field identified archaeological resources, significant habitats, wildlife sites, provincial parks, or reserves.
- Avoidance of Mi’kmaq resources.
- Maintenance of a minimum setback distance between turbines and occupied dwellings external to the Project’s proposed operations.
    - In Guysborough County, a setback distance of two times (2.0 x) the maximum height of the turbine is required in residential areas, and four times (4.0 x) the maximum turbine height in institutional areas.
- Predictive sound modeling results to meet NSECC standards (*i.e.,* 40 dBA for dwellings, daycares, hospitals, and schools).
- Predictive shadow flicker modeling results to meet NSECC standards (*i.e.,* no more than 30 hours of flicker over a year and no more than 30 minutes of flicker on the worst day).

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

- The use of a site that has been previously disturbed by forestry activities (*i.e.*, tree clearing and logging trails/roads are present throughout the Assessment Area).
- Redeveloping and expanding upon an existing site, which incorporates existing roads into the Project design, minimizing overall new road disturbance impacts and clearing requirements.
- Wetland and watercourse alterations will be minimized in association with turbine locations and road construction by maximizing the use of existing roads and disturbed areas.
- Locating turbines closer together, minimizing the geographic extent of disturbance.

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

Table 3.2: Summary of Minimum Setbacks and Separation Distances

Setback Category	Distance	Relevant Regulators / Stakeholders
Watercourses	30 m from turbine	NSECC
Wetlands	30 m from turbine	NSECC / NSNRR
Wetlands of Special Significance	at least 30 m, to be determined in consultation with NSECC	NSECC / NSNRR
Protected Areas and Public Resources	300 m	NSECC, NSNRR
Rare Plants and Lichens	Species specific (Sections 7.4.1 and 7.4.2)	NSNRR
Public Roads	390 m *(2 x Turbine Height)*	MODG
Powerlines	293 m from non-project-related powerlines, except designated crossing locations *(1.5 x Turbine Height)*	Nova Scotia Power Inc. (NS Power)
Shadow Flicker	As necessary to meet shadow flicker constraints based off shadow flicker modelling (Section 10.3)	NSECC
Sound / Noise	As necessary to meet sound / noise constraints based off sound modelling (Section 10.5)	NSECC

3.2 Physical Components

3.2.1 Turbine Specifications

The Project will be comprised of 29 turbines. Although the turbine model has not been confirmed, specifications being considered throughout the EA are provided in Table 3.3.

Table 3.3 Turbine Technical Specifications

Turbine Component	Specifications
Rated Capacity	4.5 MW
Rotor Diameter	150 m
Hub Height	120 m
Cut-out Wind Speed	3.0 m/s / 24.5 m/s
Swept Area	17,671 m^2
Rotor Speed (variable)	4.9 to 12.0 revolutions per minute (RPM)
Pitch Control	Hydraulic, one per blade -10° to 95°
Generator	Asynchronous with cage rotor, 4800kW, 0-100 Hz, 6 pole with 3x 800V stator (at rated speed)
Brake System	Brake disc on high-speed shaft
Yaw Control	Plain bearing system, forged yaw ring heat-treated. Plain bearings PETP, 0.55°/sec
Remote Monitoring	Via Wind Farm Controller

3.2.2 Road Layout

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

3.2.3 Substation and Power Collection Systems

The Project will have a dedicated overhead 230kV transmission interconnection to the NS Power transmission system. There will be a 230kV switching station immediate adjacent the existing NS Power L-7012 230kV transmission line. The 230kV transmission interconnection remains within lands owned by PHP and crosses one land parcel under the control of NSNRR (Drawing 3.2).

3.3 Project Phases

The Project will include three phases:

- Site preparation and construction
- Operations and maintenance
- Decommissioning

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

3.3.1 Site Preparation and Construction

During the construction phase, Project roads will be maintained with additional gravel or periodic grading. Any material removed for road construction will be stored or disposed of in accordance with regulations and best practices for road construction. Any material stored on-site will be

managed with appropriate erosion and sedimentation control measures or re-used.
The following equipment is typically used during road upgrading and construction:

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

Laydown Area and Turbine Pad Construction
General activities during the creation of the laydown, turbine pad, and turbine foundation construction areas may include:

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

The tower foundations will be approximately 25 m diameter (typical for a 4.5 MW wind turbine) and extend to a depth of 2.5-3 m below grade. Foundations will be backfilled (underground) with the exception of the concrete pedestal which will be 33-35 m^2 diameter and extend up to 300 mm above ground to support the wind turbine tower structure.

Each wind turbine temporary laydown area is expected to cover up to 60 m x 80 m of area. The exact arrangement of each turbine pad and crane pad will be designed to suit the specific requirements of the turbine and the surrounding topography during the detailed design process.

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

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

- Light cranes
- Light trucks

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

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

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

Grid Connection
Electricity produced from each turbine will be fed into a local aboveground power collection network within the Project boundaries that will be routed to the Project’s substation which will step-up the voltage from 34.5 kV to 230 kV and connect to NS Power’s transmission system at the same voltage level.

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

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

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

The following equipment is expected to be used this process:

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

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

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

3.3.2 Operation and Maintenance

Maintenance activities will conform to manufacturer's equipment specifications, industry best management practices, and facilities standard operating procedures.

The life span of the Project is estimated to be a minimum of 25 years. During this time, roads will be used to access the turbines by operations and maintenance personnel. The roads will be maintained as required. During the winter months, all roads will be plowed, sanded, and/or salted, as needed to ensure safe driving conditions and access in the event of an emergency.

A vegetation management plan will be initiated to ensure that access roads and turbine locations remain clear of vegetation. Vegetation management will include removal and pruning. Timing of vegetation management will depend on site specific conditions.

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

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

3.3.3 Decommissioning

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

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

- Dismantling and removal of the turbines and tower sections.

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

3.3.4 Environmental Management and Protection

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

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

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

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

3.4 Project Schedule

Table 3.4 presents the Project schedule from EA registration to Project decommissioning.

Table 3.4: Project Schedule

Project Activity	Timeline
EA Registration	Winter 2023
Post-EA Environmental Monitoring Programs	2023 - onward
Geotechnical Assessment	Winter/Spring 2023
Engineering Design	Winter-Fall 2023
Municipal Decision on Development Agreement	Winter/Spring 2023
Clearing	Summer/Fall 2023
Construction	Spring 2024-Fall 2025
Commissioning	Summer/Fall 2025
Operation	Summer 2025 - onward
Decommissioning	2049 or beyond.

4.0 PROJECT SCOPE AND ASSESSMENT METHODOLOGY

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

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

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

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

4.1 Site Sensitivity

Potential wind farms are assigned a category level, according to a matrix provided in the Guide to Preparing an EA Registration Document for Wind Power Projects in Nova Scotia (NSECC, 2021). This matrix considers the overall Project size and the sensitivity of the Project. The category level then outlines guidance for the collection of baseline data and post-construction monitoring requirements.

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

4.2 Assessment Scope and Approach

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

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

- Identify VCs that the Project may interact with (by activity and phase) within established spatial and temporal boundaries.
- Establish the existing conditions for VCs.
- Identify potential interactions between the Project and the VCs.
- Assess the potential effects that could occur from the interaction.
- Identify mitigation measures to reduce or eliminate those effects.

- Evaluate the significance of the residual environmental effects using VC-specific criteria.
- Identify monitoring of follow-up programs to verify predictions and/or evaluate the need to implement adaptive management.

4.3 Identification of Valued Components

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

- Physical environment
  - weather, climate, air quality
  - geology, hydrogeology/groundwater
- Biophysical environment
  - watercourses, fish and fish habitat
  - wetlands
  - flora, fauna (including Mainland moose), habitat
  - bats
  - avifauna
  - species at risk (considered in the appropriate VC chapter, as necessary)
- Human environment
  - economy, land use, transportation, recreation and tourism, human health
  - archaeological and cultural resources
  - electromagnetic interference
  - shadow flicker
  - visual impacts
  - sound

4.4 Spatial and Temporal Boundaries

4.4.1 Spatial Boundaries

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

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

As detailed in Section 3.1, a Study Area was established as a large assessment area based on land parcels (i.e., PIDs) that are included in the development area (Table 3.1; Drawing 2.2). An

Assessment Area was established for more detailed field investigations. The Assessment Area represents the physical footprint of the Project where the direct physical disturbance is expected to occur (i.e., the Project Area), plus a 100 m buffer around the turbines, a 25 m buffer on either side of the centreline for the road layout, and a 10 m buffer on either side of the interconnection route. Where appropriate, the Study Area and Assessment Area are identified as the LAA and RAA for specific VCs in the individual VC chapters.

4.4.2 Temporal Boundaries

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

Table 4.1: Temporal Boundaries

Project Phase	Temporal Boundary
Site Preparation and Construction	Site clearing to commence summer/fall 2023 with road construction and turbine assembly through 2024 and fall 2025
Operation and Maintenance	Minimum 25 years
Decommissioning	Approximately minimum of 25 years post-commissioning

4.5 Potential Project-Valued Component Interactions

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

4.6 Effects Assessment Criteria

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

Table 4.2: Effects Assessment Criteria

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

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

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

Table 4.3: Definition of Significant Residual Environmental Effect

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

4.7 Monitoring and Follow-up

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

5.0 THE MI’KMAQ OF NOVA SCOTIA

5.1 Overview

The Project is centered on Long Lake, west of Goose Harbour Lake Reservoir and within both Epekwitk aqq Piktuk District (Territory) and Eskikewa’kik District (Territory). Paqtnkek Mi’kmaw Nation is the nearest Mi’kmaq community located approximately 19 km west of the center of the Project Area and Study Area (Drawing 5.1). Paqtnkek Mi’kmaw Nation is on Paqtnkek-Niktuek No. 23, consisting of 204.8 hectares (ha). Other Paqtnkek lands today include 43.4 hectares at

Welnek No. 38, located 18 km east of Antigonish. Much of the local history of the area was centered around Canso and Guysborough areas. Canso has a recorded history as early as the 1500s and was an important fishing station for European fishing fleets and Mi'kmaq trading until the British established fortifications at Canso.

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

5.2 Mi'kmaq Ecological Knowledge Study

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

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

The MEKS consists of two major components:

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

A total of 14 interviews were undertaken by the MEKS Team with Mi’kmaq knowledge holders from the First Nation communities of Paqtnkek, Pictou Landing, and We'koqma'q between October and November 2022. Interviewees were shown topographical maps of the Project Area and its 5 km buffer and asked to identify where they undertake their activities as well as to identify where and what activities were undertaken by other Mi’kmaq, if known. These interviews allowed the MEKS Team to develop a collection of data that reflected the most recent Mi’kmaq traditional use in this area, as well as historic accounts. The data gathered was also considered in regard to its significance to the Mi’kmaq people.

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

Traditional Use in the Project Area

- There is reported Mi’kmaq use reported on the Project Area. Activities include trout and salmon fishing, along with deer, partridge, and rabbit hunting. The majority of activities took place as recent past (11-25 years ago) and historical past (+25 years ago) categories. There were no active usage areas reported.

Traditional Use in the Study Area

- Trout and salmon fishing, along with deer, partridge, and rabbit hunting were also activities reported by interviewees in the highest frequency. There was other fishing, hunting, and gathering activities reported as well. Overall, the activities took place primarily in the recent past and historical past categories.

Historic Review

- There are very few known archaeological finds/sites found within the vicinity of the Study Area due to little development.

- There is sparse potential for natural resources within the Study Area concerning stone of suitable properties for tools and weapons for early peoples. There are no reported sources of Black Ash within the Study Area or that part of the province, which is a valuable resource for tool handles and craft-basket making to early peoples then and to the Mi’kmaq today.

- A review shows no current and active First Nation Claims within the Study Area. Paqtnkek Mi’kmaw Nation has one “Invited to Negotiate” and “Active” Specific Claim concerning loss of land in 1827 with the Crown Grant to Peter McChesney without surrender.

No recommendations were provided in the MEKS completed for the Project. Overall, the Project is not expected to limit access to species, locations, use, availability, and frequency of use within the Study Area and the Proponent is committed to engaging and working with the Mi’kmaq of Nova Scotia throughout the duration of the Project.

5.3 Mi’kmaq Engagement

Outreach and engagement with Mi’kmaq communities specific to the Project has been active since 2021. The Proponent focused early engagement efforts near Chedabucto (Guysborough) and Unama'ki (Cape Breton Island) due to proximity to the Project. A series of update meetings and correspondence took place during the spring through winter of 2022.

In-community outreach took place from June to August of 2022 and included a series of presentations to Paqtnkek Chief, Council, and executive, as well as participation in their Trades Fair (Figure 5.1).

Figure 5.1: Paqtnkek Trades Fair held June 27-28, 2022, at the Paqtnkek Gymnasium

The Project Team completed community visits to the Mi’kmaw Summer Games in Potlotek, which included a meeting with Chief Wilbert Marshall. The Team also participated in a series of meetings with Chief Norman Bernard and presented to Wagmatcook Council and Executive in September 2022.

A series of conversations with Chief Annie Bernard Daisley of We'koqma'q First Nation, along with their Chief Executive Officer (CEO), concluded with a proposed meeting / presentation on the Project in November 2022 which, due to unforeseen circumstances, is being rescheduled.

In October and November of 2022, a series of update / information letters were sent to 12 Mi'kmaq community Chiefs, covering all Mi’kmaq leadership, except for Sipekne’katik, as they were in the process of an election. Sipekne’katik has since been notified. Each letter included an offer to present or meet on the Project development to address any questions or concerns that might arise.

Engagement with the Mi’kmaq of Nova Scotia is summarized in Table 5.1.

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

Community/ Organization	Representative(s)	Details
	First Nations	
Acadia First Nation	Chief Debbie Robinson	October 26, 2022 Letter from Project Manager.
Annapolis Valley First Nation	Chief Gerald Toney	November 1, 2022 Letter from Project Manager.
Eskasoni First Nation	Chief Leroy Denny	October 26, 2022 Letter to Chief from Project Manager.
Glooscap First Nation	Chief Sid Peters	November 1, 2022 Letter from Project Manager.
L'sitkuk (Bear River) First Nation	Chief Carol Potter	October 30, 2022 Letter from Project Manager.
Membertou First Nation	Chief Terry Paul Jennifer Deleskie, Senior Business Development Officer, Membertou Corporate	November 5, 2021 Introductory meeting with Chief and Senior Business Development Officer. October 26, 2022 Letter to Chief from Project Manager.
Millbrook First Nation	Chief Bob Gloade	October 26, 22 Letter from Project Manager.
Paqtnkek First Nation	The late Chief Tma Francis Acting Chief Corey Julian Rose Paul, CEO, Bayside (Paqtnkek business arm) Darryl MacDonald, Chief Administration Officer (CAO) Council Band Directors	January 11, 2022 Introductory meeting with Chief, Band Directors, and some Council members. February 7, 2022 Follow-up meeting with Band Business Director and interested Council members to answer more detailed questions about the Project. June 23, 2022 Meeting with Chief, CEO Bayside, CAO. June 27-28, 2022 Project Team attended Trades Fair. April 26, 2022 Meeting with Chief and Council, CEO Bayside, and CAO on partnership opportunities. August 4, 2022 Meeting with CAO Bayside to discuss potential funding opportunities. August 11, 2022 Meeting with Chief (CEO Bayside and CAO sent regrets) about potential vendor partnership. October 26, 2022 Letter to Acting Chief from Project Manager.

Community/ Organization	Representative(s)	Details
Pictou Landing First Nation	Chief Andrea Paul	November 2, 2022 Letter from Project Manager.
Polotek First Nation	Chief Wilbert Marshall	July 21, 2022 Project Team attended Mi'kmaw Summer Games and met with Chief. October 26, 2022 Letter from Project Manager.
Sipekne'katik First Nation	Chief Michelle Glasgow	January 17, 2023 Letter from Project Manager.
Wagmatcook First Nation	Chief Norman Bernard Council	April 24, 2022 Chief Norman Bernard – touch base to ensure community is informed and engaged in the process and development from the onset. September 20, 2022 Project presentation to Chief, Council, and Executive followed by Q&A. November 1, 2022 Letter to Chief from Project Manager.
We'koqma'q First Nation	Chief Annie Bernard Daisley Gioia Usher, CEO	April 25, 2022 Phone conversations with Chief and CEO to ensure community is informed and engaged in the process and development from the outset. November 1, 2022 Letter from Project Manager. November 21, 2022 Meeting and presentation to Chief and Executive postponed - to be rescheduled.
Organizations		
UINR	Board of Directors/ Unama'ki Chiefs	December 2, 2021 Introductory meeting.
KMKNO	Patrick Butler, Senior Mi'kmaq Energy and Mines Advisor	July 12, 2022 Letter from Project Manager requesting presentation to KMKNO and Assembly of Mi'kmaw Chiefs.
WMA	Board of Directors	January 4, 2023 Provided Project Overview and discussed if WMA was the organization to continue potential partner engagement discussions.

5.3.1 Review of Concerns

The proposed Project has been well received with Mi'kmaq community leadership, with some recommending working closely with Paqtnkek initially as the closest community to the development. Other communities expressed familiarity with the Proponent's corporate and operational history and shared positive experiences, specifically We'koqma'q where there is a pre-existing service provider relationship with the community's security company.

5.3.2 On-going Engagement

The Proponent is committed to on-going, meaningful engagement with the Mi'kmaq of Nova Scotia and will continue to provide regular updates and seek feedback throughout the Project. The Proponent submitted a request to present to the Nova Scotia Assembly of Mi'kmaq Chiefs in spring 2022; however, the agendas have been delayed with Duty to Consult presentations. The Project Team will continue to follow up with individual community leadership as well as with Kwilmu'kw Maw-klusuaqn (KMKNO), Unama'ki Institute of Natural Resources (UINR), and Wskijnu'k Mtmo'taqnuow Agency (WMA).

6.0 GOVERNMENT AND PUBLIC ENGAGEMENT

The Proponent is committed to meaningful engagement with government, the public, stakeholders, and the Mi'kmaq of Nova Scotia. To date, the Project Team has participated in meetings, delivered presentations, and hosted five open house events in Lincolnville (two), St. Francis (one), Auld's Cove (one), and the Town of Guysborough (one). Associated presentations, posters, meeting agendas, advertisements, and feedback are provided in Appendix C.

6.1 Engagement with Government Departments, Agencies, and Regulators

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

Table 6.1: Government Meetings and Events

Government Departments, Agencies, & Regulators	Representative	Dates, Activities, Comments
Federal Government		
Canadian Coast Guard (Vessel Traffic Systems Radars)	Wind Farm Coordinator	September 2022 EMI study notification letter sent via email. January 2023 Updated layout to be submitted.
Department of National Defence (DND)	Military Air Defence and Air Traffic Control; Military Radio communication users	September 2022 EMI study notification letter sent via email. January 2023 Updated layout to be submitted.
ECCC	Weather Radars	September 2022 EMI study notification letter sent via email. January 2023 Updated layout to be submitted.
Innovation, Science, and Economic Development Canada	Nova Scotia District Office	September 2022 EMI study notification letter sent via email. January 2023 Updated layout to be submitted.
RCMP	Wind Farm Coordinator	September 2022 EMI study notification letter sent via email. January 2023 Updated layout to be submitted.
Provincial Government		
CWS	Wildlife Biologist EA Analyst	June 2019 Email correspondence regarding the review and feedback on the proposed Avian Assessment Plan. August/September 2020 Email correspondence regarding the review and feedback on the proposed Avian Assessment Plan.

Government Departments, Agencies, & Regulators	Representative	Dates, Activities, Comments
NSECC	EA Officer EA Supervisor Business Relations Manager Air Quality Protection Advisor	June 2021 NSECC shared advice from ECCC/CWS on bird radar requirements. January 2022 Email correspondence regarding data sensitivity for Mainland moose and what data should be provided in the EA versus to NSNRR directly. October 2022 Email exchanges regarding the approach for incorporating the results of the Archaeological Resource Impact Assessment (ARIA) into the EA and to discuss the timing of the NSCCTH review of the ARIA.
NSNRR	Species at Risk Biologist	January 2022 Email correspondence regarding data sensitivity for Mainland moose and what data should be provided in the EA versus to NSNRR directly May 2022 Email correspondence regarding guidance for bat, bird, and wood turtle surveys. Additional correspondence regarding the criteria for determining if a site is considered "coastal". June 2022 Email discussions about bat monitoring, followed by a call on June 22, 2022. July 2022 Provision of summary table on the status of flora, fauna, and habitat studies. Attempted to schedule a follow-up call. November 3, 2022 Meeting with EA Supervisor, EA Officer, and Business Relations Manager to present the Project, discussion around the work that has been done to prepare EA, as well as timing for registration. November 9, 2022 Meeting with Air Quality Protection Advisor to discuss expectations for the assessment of low frequency noise. November 15, 2022 Meeting with EA Officers and Business Relations Manager to discuss the

Government Departments, Agencies, & Regulators	Representative	Dates, Activities, Comments
		potential for using a real-case scenario for shadow flicker (seasonal receptors).
NSCCTH	Director of Special Places Protection	October 2022 Email exchanges regarding the confidentiality of archaeological and cultural resources information and approach for incorporating results into the EA.
Municipal Government		
MODG	Director of Economic Development	June and August 2022 Emails and meetings with Project Team about dates and locations for first and second round of open houses.
MODG	Councillor Mary Desmond (District 2: Lincolnville, Sunnyville, Upper Big Tracadie)	May 2022 Phone calls and emails to organize open house pre-meeting. May 30, 2022 Project Team representatives attended a pre-meeting in Lincolnville, as suggested by Councillor Mary Desmond. Seven members of the community attended this informal session with Councillor Desmond, who had also provided suggestions for community members for the Project Team to invite. Following round table introductions, the Project Team introduced the Project, sought questions, and requested guidance for organizing the Lincolnville open house. June – August 2022 Follow up emails regarding Lincolnville open houses.
MODG	Councillor Neil DeCoff (District 3: North Riverside, Boylston, Manchester, St. Francis Harbour, Melford and Auld's Cove)	June and August 2022 Emails and phone meeting with Project Team about dates and locations for first and second round of open houses.

6.1.1 Review of Government Concerns

Discussions with federal and provincial regulators primarily focused on ensuring component studies were scoped appropriately and identifying scenarios where additional study may be warranted (e.g., if wind turbines have tonal characteristics, additional modelling for low frequency sound is required). The MODG is supportive of the Project.

Discussions with government officials will continue throughout Project development.

6.2 Public and Stakeholder Engagement

The Project Team has been involved in engagement activities with the public and stakeholders to ensure the community was made aware of the Project and given multiple opportunities to receive information, ask questions, and share local knowledge.

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

Table 6.2: Stakeholder Engagement

Community/Stakeholder Organization	Engagement
Strait of Canso Superport	July 2022 Project Team presented at Superport Days Conference.
NCS Managed Services Inc.	September 2022 EMI study notification letter sent via email. January 2023 Updated layout to be submitted.
Guysborough Police	September 2022 EMI study notification letter sent via letter mail. January 2023 Updated layout to be submitted.
Port Hawkesbury Police	September 2022 EMI study notification letter sent via letter mail. January 2023 Updated layout to be submitted.
Mulgrave Volunteer Fire Department	September 2022 EMI study notification letter sent via letter mail. January 2023 Updated layout to be submitted.
Auld's Cove Fire Hall	September 2022 EMI study notification letter sent via email. January 2023 Updated layout to be submitted.

Community/Stakeholder Organization	Engagement
Tracadie & District Volunteer Fire Department	September 2022 EMI study notification letter sent via email. January 2023 Updated layout to be submitted.
Port Hawkesbury Volunteer Fire Department	September 2022 EMI study notification letter sent via letter mail January 2023 Updated layout to be submitted.

6.2.1 Digital Communications

The Project website launched on June 27, 2022, at https://www.phpwind.ca/. It includes information about the Project and Proponent, as well as the EA process. This publicly accessible website is updated regularly and includes an extensive list of responses to frequently asked questions. In addition, the Project Team has been gathering names (with permission) of those who have expressed an interest in the Project, or have emailed questions or attended the Open Houses, so that ongoing stakeholder updates may be emailed directly to them.

6.2.2 Public Open House Events

Five public open houses took place prior to EA registration. Representatives from the Project Team were present to provide information on the Project and answer any questions or concerns brought forward by community members. All events featured posters sharing information on the Project, benefits to the area, the EA process, and preliminary EA findings.

Open house #1 took place on Monday June 27, 2022, from 6-8 pm in the Lincolnville Community Hall. This event was advertised in the Upper Big Tracadie Seniors Action Club June 2022 newsletter, in the Guysborough Journal newspaper, on Avery's Independent Grocer's community board, and on 101.5 The Hawk radio station. A total of 11 people attended this open house (Figure 6.1).

Open house #2 was held on Wednesday, June 29, 2022, from 6-8 pm in St. Francis Harbor Hall. This event was advertised in the Guysborough Journal newspaper, in the Casket (Saltwire Network) newspaper, and on 101.5 The Hawk radio station. A total of 12 people attended this open house (Figure 6.2).

Open house #3 was held on Monday, August 29, 2022, from 6-8 pm in the Lincolnville Community Hall. This event was advertised in the Guysborough Journal newspaper and on the 989xfm radio station. Emails were also sent out to those who attended the first open house in Lincolnville. Three people attended this open house (Figure 6.3).

Open house #4 was held on Tuesday, August 30, 2022, from 6-8 pm at the Auld's Cove Fire Hall. This event was advertised in the Guysborough Journal newspaper and on the 989xfm radio station. Eight people attended this open house (Figure 6.4).

Open house #5 was held on Wednesday, August 31, 2022, from 6-8 pm at the Chedabucto Lifestyle Complex in the Town of Guysborough. This event was advertised in the Guysborough Journal newspaper and on the 989xfm radio station. Five people attended this open house (Figure 6.5).

Contact information was collected from participants for follow up. They were also able to provide written feedback through an exit survey, a summary of which can be found in Appendix C.

Figure 6.1: Open house #1 held on Wednesday, June 27, 2022 from 6-8 pm at Lincolnville Community Hall

Figure 6.2: Open house #2 held on Wednesday, June 29, 2022 from 6-8 pm at St. Francis Harbor Hall

Figure 6.3: Open house #3 held on Monday, August 29, 2022 from 6-8 pm in the Lincolnville Community Hall

Figure 6.4: Open house #4 held on Tuesday, August 30, 2022 from 6-8 pm in the Auld's Cove Fire Hall

Figure 6.5: Open house #5 was on Wednesday, August 31, 2022 from 6-8 pm at the Chedabucto Lifestyle Complex in the Town of Guysborough

6.2.3 Forestry Advisory Committee and Community Benefits

Forestry Advisory Committee (FAC)
As part of the Proponent's commitment to regular community engagement, and in keeping with its sister entity, PHP Woodland's, longstanding certified sustainable forest management public engagement process and active Forestry Advisory Committee (FAC) (since 2000), the FAC will expand its mandate to include Project. The objective of the FAC remains to provide an opportunity for on-going dialogue between the Project team, Proponent, and local communities.

The FAC will bring together neighbours, local community, First Nations, business and government representatives, and other key stakeholders to provide community views, advice, and guidance on Project plans and activities. The Basic Operating Procedures of the FAC are included in Appendix C.

The FAC, as an advisory body will:

- Represent community interest by providing an opportunity for a mutual exchange of information between the Project and the community.
- Provide a forum where FAC members can bring any issues of public concern to the attention of the Project, including any impacts or perceived impacts on the environment.
- Keep constituent organizations (i.e., MODG, Lincolnville Community Development Association, etc.) abreast of project plans, progress, and activities.
- Convey community perspectives and information to Project representatives.
- Offer Project representatives suggestions on how to enhance and communicate the Project's socioeconomic benefits.
- Have access to technical experts involved in the Project.

During the second round of Open Houses (August 2022), the Project Team shared flyers to create awareness around the recruitment process for local representatives to become involved in the Project's advisory and engagement initiative (Appendix C). Further recruitment will take place in early 2023.

Community Benefits
The region will benefit from the Project both during the development phase and once the Project is operational. During its development, the Project will generate approximately $300 million in investments and construction will create local employment opportunities, with approximately 150 temporary full-time jobs and up to five permanent jobs.

The Project's collective financial benefit to the region and province is projected to represent approximately $1.3 million per year. As part of this, property tax revenues of approximately $800,000 per year will be paid to the MODG and land lease costs paid to the province will be in the range of $500,000.

There are substantial economic benefits of the Project for the region over and above this amount in that the access to renewable cost-controlled energy will be critical to the continued viability of the PHP facility (including direct and indirect jobs).

6.2.4 Review of Concerns

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

Table 6.3: Comments Received from the Public

Key Issues	Proponent Response	Section of EA
	Human Impacts	
How loud will the wind turbines be?	Any residences, dwellings, cottages, schools, and campgrounds have been mapped and considered as potential sound receptors for sound modelling. Nova Scotia's EA branch has established a limit of 40 dBA for receptors and this has been taken into consideration in the Project configuration and choice of turbine locations. 40 dBA is commonly known as equivalent to a quiet library or refrigerator sound level. The Project's noise levels will not exceed these provincial regulatory standards. Ongoing engagement and communication with stakeholders near the Project will be maintained throughout the it's life and all concerns will be addressed.	Section 10.5 Sound
What will be the visual impact of the wind turbines?	Strum Consulting has conducted a visual assessment at key locations for the Project.	Section 10.4 Visual Impacts
How will this impact wetlands and waterways? (Residents in Lincolnville were particularly concerned about the ways in which this would impact the community's drinking water.)	Strum Consulting has conducted a series of environmental studies, which include surveys of the wetlands and watercourses.	Sections 7.3 Aquatic Environment
How are you partnering with or helping the Mi'kmaq community participate in the Project?	The Proponent is committed to meaningful and open engagement with the Mi'kmaq of Nova Scotia, particularly the communities located in the eastern portion of the province. The Proponent also completed a MEKS in collaboration with Membertou Geomatics Solutions.	Section 5 the Mi'kmaq of Nova Scotia

Key Issues	Proponent Response	Section of EA
How will this impact real estate value?	Research has consistently demonstrated that, in a variety of spatial settings and across a wide temporal scale, sale prices for homes surrounding wind energy facilities are not significantly different from those attained for homes sited away from wind energy facilities.	Section 8.2 Land Use and Value
How will our community benefit from this Project?	During its development, the Project will generate approximately $300 million in investments and construction will create local employment opportunities, with approximately 150 temporary full-time jobs and up to 5 permanent jobs. The Project's collective financial benefit to the region and province is projected to represent approximately $1.3 million per year. As part of this, property tax revenues of approximately $800,000 per year will be paid to the MODG and land lease costs paid to the province will be in the range of $500,000 annually	Section 8.0 Socio-Economic Environment 8.1.2 Effects Assessment [Economic] 8.4 Effects Assessment [Recreation and Tourism]
Will you focus on the local community with hiring?	The Proponent is committed to sharing economic opportunities with the local community throughout the development and lifespan of the Project via the use of local skills and labour where possible, municipal tax revenue, and on-going energy literacy/education. This will include holding job fairs in nearby communities such as Lincolnville. The Project Team is also expanding the mandate of the existing FAC to include the Project. This will help to identify Project-related opportunities and benefits for the local community.	Section 8.1 Economy
Environmental Impacts		
How will the Project affect fauna and flora?	Strum Consulting has conducted a series of environmental studies, which include surveys of the wetlands and watercourses, vegetation, species at risk, and wildlife populations, including birds and bats.	Section 7.4 Terrestrial Environment

Key Issues	Proponent Response	Section of EA
Will this Project result in the felling of acres of trees which would otherwise remove tonnes of carbon per year?	During the development phase of the Project, the Proponent is prioritizing the use of existing forest roads as well as recently cleared or younger forested zones to minimize tree cutting. The lands slated for wind farm development are currently under sustainable forest management licence to PHP. Any harvesting required for establishment of the wind farm will be accounted for in harvest planning and accounted for in the ongoing Annual Allowable Cut for the area in question. The effects of the small amount of land use conversion within the Project area will be offset by the transition from the usage of a non-renewable production to a renewable wind energy production. Each turbine will require a temporary laydown area of approximately 1 hectare, which will be reclaimed leaving only a crane pad for operation and maintenance, if needed. This will be in compliance with the province's land usage rules. By using state of the art turbine models, which generate more power per tower, this will contribute to minimizing the total Project footprint. The Proponent will also ensure that trees will be recycled and used as much as possible as part of its paper mill activities. There will be two temporary laydown areas approximately 10 acres each for receiving and staging of equipment/materials for the construction phase.	N/A
Some say that this type of Project adds asphalt, concrete, metal, fiberglass, and plastic to an ecosystem that has taken centuries to form and requires a lengthy time to regenerate. What will you do to Protect the area from such impacts?	The Proponent is committed to both minimize and mitigate potential impacts arising from this Project. The nature of a wind farm is that most of it exists in a vertical configuration. That is, much of the physical infrastructure exists in the air space over top of the physical environment. This significantly reduces the physical impact	N/A

Key Issues	Proponent Response	Section of EA
	to the relatively small footprint of the turbines, power collection system, roads, and substation. The Proponent has purposely developed the wind farm layout to utilize much of the existing roads within the lease area to minimize the need for further land clearing. For this Project, the additional lands to be utilized by the turbines, roads, and substation will be less than 5% of the lease area. Site construction activities will follow a NSECC-approved environmental management plan. The Proponent is committed to following best practices with respect to decommissioning and any associated recycling and/or disposal at the end of the useful life cycle of the various Project components. A decommissioning plan will be prepared and updated every 10 years during Project life. The plan will include the expected dismantling cost, a listing of the wind farm components and their expected treatments (using up-to-date technologies), either recycling, disposal or left in place. Visible components of the wind farm, such as turbines, transformers, and aboveground collector system will be removed from the site and either recycled or disposed of in accordance with regulations in place. It is expected and common practice that underground concrete structures will be excavated and crushed up to 1 m depth and left in place leaving only unharmful and inert material in the ground. No asphalt will be required for the Project, as the road will be graveled.	
General		
Why wind energy? Did you consider other energy solutions?	Currently, wind offers the most cost effective, appropriately sized renewable energy source available. The Project Team has and will continue to look at other energy solutions to	N/A

Key Issues	Proponent Response	Section of EA
	augment this Project, including large scale storage options. By diversifying PHP's energy mix, the Proponent will be operating in a more environmentally conscious manner, clearing the way for a healthy business that can continue to benefit the region's economy and provide well-paying jobs in rural Nova Scotia. This Project supports the province in proactively pursuing green energy sources and help us all move away from using coal.	
Where are your trail cams located?	A map of the trail cam locations can be found in Section 7.4.3	Section 7.4.3 Terrestrial Fauna
Why did you choose this particular area in Guysborough County? Why didn't you consider building the wind farm closer to Port Hawkesbury Paper?	The Project location was selected according to the main wind farm development drivers: Land Availability PHP has been operating in the area of the Project for 10 years and has a very good knowledge of the land. There is already an existing road network for site access which will minimize any required clearing. Wind Resource This area is located on a relatively high plateau and benefits from strong wind from the west. Proximity The energy produced by the Project will supply the nearby PHP facility. The closest area of contiguous land with the necessary attributes is the proposed Project area in Guysborough County.	N/A
How will this work when it's not windy?	The goal of this Project is to diversify the energy mix that powers PHP. Wind power is one tool of many that will allow the Proponent to support the province to proactively pursue green energy sources and help us all move away from a dependency on electricity predominantly generated using coal. The PHP facility will continue to complement wind power with other energy sources to ensure the effective and environmentally sustainable operation of PHP.	N/A

Key Issues	Proponent Response	Section of EA
How will the energy generated get from the wind farm to PHP across the Strait of Canso?	The Project Team is working on the option of securing a direct connection to the nearby existing NS Power system which will allow for the delivery of power through NS Power to the PHP facility.	Section 3.3 Project Phases

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

7.0 BIOPHYSICAL

7.1 Atmospheric Environment

7.1.1 Atmosphere and Air Quality

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

7.1.1.2 Regulatory Context
Relevant legislation includes:

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

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

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

7.1.1.4 Assessment Results

Weather and Climate
Nova Scotia's climate is quite varied and is largely governed by coastal influences and elevation (Davis & Browne, 1996). The Project is located within the Mulgrave Plateau Ecodistrict (360) of the Nova Scotia Uplands Ecoregion (Neily et al., 2017) (Drawing 7.1).

The Mulgrave Plateau is the most easterly ecodistrict in mainland Nova Scotia. It tends to experience cooler temperatures than the adjacent lowlands as it is partially bordered by

Chedabucto Bay on its eastern side and spans the entirety of the Strait of Canso to its northeast. The exposure of this ecodistrict to these two bodies of salt water results in a cooler and moister climate than adjacent lowlands. Additionally, this ecodistrict frequently experiences strong coastal winds. (Neily et al., 2017).

The local temperature and precipitation data were obtained from the Port Hawkesbury meteorological station (Climate ID 8204495) located approximately 16 km northwest of the Project at 45°39'24.000" N, 61°22'05.000" W (Table 7.1).

Table 7.1: Climate Data from the Port Hawkesbury Meteorological Station (2011-2021)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Temperature													
Daily Avg. (°C)	-4.6	-5.3	-2.5	3.1	8.5	13.3	18.0	18.7	14.7	9.4	4.1	-0.7	6.4
Daily Max. (°C)	-0.7	-1.1	1.8	7.5	13.8	18.3	23.2	24.1	20.0	13.9	8.1	2.8	11.0
Daily Min. (°C)	-8.6	-9.5	-6.9	-1.4	3.1	8.2	12.8	13.4	9.4	4.8	0.0	-4.2	1.8
Extreme Max. (°C)	12.8	13.6	23.7	20	31	32.5	33	32.7	30	24.4	23.2	15.6	-
Extreme Min. (°C)	-21.4	-24.3	-21.7	-11.1	-4	-1.5	4.6	4.2	-1.1	-3.6	-13.1	-18.5	-
Precipitation													
Precipitation (mm)	90.4	91.3	72.1	123.5	82.0	106.6	78.6	77.6	85.9	129.8	145.6	119.9	1,203.4

Source: ECCC 2022a

From 2011 to 2021, the mean annual temperature was 6.4°C, with a mean daily maximum of 11.0°C and a mean minimum of 1.8°C (ECCC, 2022a). January and February were the coldest months (mean daily average of -4.6°C and -5.3°C, respectively), while the warmest months were July and August (mean daily average of 18.0°C and 18.7°C, respectively). From 2011 to 2021, the meteorological station did not record mean annual snowfall and mean annual rainfall. However, data was recorded in terms of precipitation, with most occurring in October and November (129.8 mm and 145.6 mm, respectively) (ECCC, 2022a).

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

Table 7.2: Wind Data from the Port Hawkesbury Meteorological Station (2011-2021)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Maximum Hourly Speed (km/h)	98	105	109	94	78	78	76	91	84	98	102	117
Most Frequent Direction	NW	NW	NW	NW	NW	NW	NW	NW	NW	NW	NW	NW

Source: ECCC 2022a

The maximum hourly wind speeds recorded at the Port Hawkesbury meteorological station between 2011 and 2021 ranged from 76 kilometres per hour (km/h) to 117 km/h. The wind direction observed at the meteorological station is from the northwest. Note that wind directions may occur in all directions; however, during calm wind flows, the direction is not recorded at the meteorological station (ECCC, 2022a). A windrose plot provided for the Port Hawkesbury meteorological station by Iowa State University (2022) demonstrates the wind directions from 2011 to 2021 (Figure 7.1).

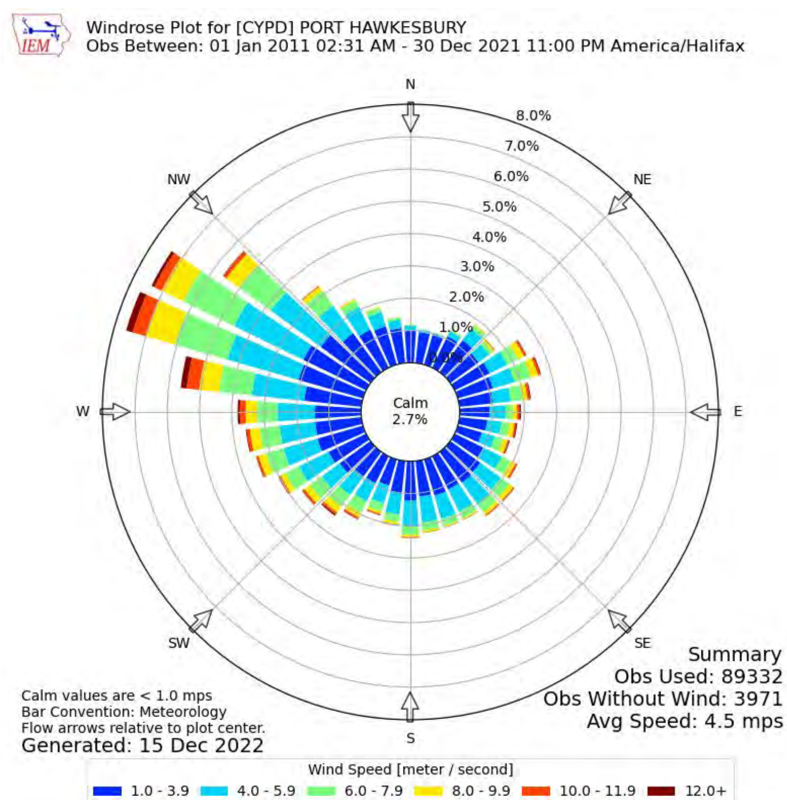

Figure 7.1: Windrose Plot for Port Hawkesbury Meteorological Station – January 1, 2011, through December 30, 2021 (Iowa State University, 2022)

Figure 7.1 demonstrates that between January 1, 2011, and December 30, 2021, wind speeds above 12 metres per second (m/s) [43.2 km/h] occurred the most frequently from the northwest.

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

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

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

Contaminant	Averaging Period	Regulatory Threshold (μg/m³)	
		Existing Provincial[1]	Proposed Provincial[2]
Carbon Monoxide (CO)	1-hour	34,600	35,000
	8-hour	12,700	10,000
Nitrogen Dioxide (NO_2)	1-hour	400	200
	24-hour	-	25
	Annual	100	10
Ozone (O_3)	1-hour	160	-[4]
$PM_{2.5}$	24-hour	-	15
	Annual	-	5
PM_{10}	24-hour	-	45
	Annual	-	15
Sulphur Dioxide (SO_2)	1-hour	900	-
	24-hour	300	40
	Annual	60	-
Total Suspended Particulate (TSP)	24-hour	120	100
	Annual	70[3]	60

[1] Current Ambient Air Quality Standards (NS AAQS) [Nova Scotia Air Quality Regulations, N.S. Reg. 8/2020].
[2] Proposed Ambient Air Quality Standards (subject to change) (NSECC, 2022b).
[3] Geometric mean.
[4] Ozone is no longer included as an ambient air quality standard in the proposed provincial guidelines.

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

- carbon monoxide (CO)
- ground-level ozone (O_3)
- nitrogen oxides (NO_x)
- nitric oxide (NO)
- nitrogen dioxide (NO_2)
- particulate matter ($PM_{2.5}$)
- sulphur dioxide (SO_2)
- total reduced sulphur (TRS)

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

The air quality monitoring station closest to the Project is in Port Hawkesbury, NS, approximately 13 km northwest of the Project at 45°36'50.501" N, 61°21'43.639" W.

Table 7.4 summarizes the current (baseline) maximum ambient air quality conditions observed at the Port Hawkesbury air quality monitoring station from 2017 to 2021. The monitored parameters are compared to the current NSAQR.

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

Parameter	Averaging Period	O_3 (ppb)	SO_2 (ppb)	NO_X (ppb)	NO (ppb)	NO_2 (ppb)	$PM_{2.5}$ (ug/m^3)	TSP (ug/m^3)	CO (ppb)	H_2S (ppb)
Port Hawkesbury Ambient Monitoring 2017-2021	1 hour	68.5	61.2	153.5	94.5	59.1	64.0	-	-	-
	24 hours	47.8	15.0	50.0	25.3	24.6	21.8	-	-	-
	Annual	29.6	0.7	4.1	1.4	2.7	5.5	-	-	-
NS AAQS Schedule A	1 hour	82	340	-	-	210	-	-	30,000	30
	24 hours	-	110	-	-	-	-	120	-	6
	Annual	-	20	-	-	50	-	70*	-	-
Fraction of NS AAQS Schedule A	1 hour	84%	18%	-	-	28%	-	-	-	-
	24 hours	-	14%	-	-	-	-	-	-	-
	Annual	-	4%	-	-	5%	-	-	-	-

Source: NSECC 2022a
*geometric mean

As seen in Table 7.4, existing air quality conditions (i.e., baseline data) indicate that most of the measured contaminants are well below their respective NS AAQS Schedule A limits except O_3, which is at 84% of the limit. In reviewing the available data for the Port Hawkesbury air quality monitoring station, the reported AQHI is typically scored 'low' at all times of the year (ECCC, 2022b).

7.1.1.5 Effects Assessment

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

Table 7.5: Potential Project-Atmospheric Interactions

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

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

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

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

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

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

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

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

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

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

The interaction with local receptors was assessed to determine environmental impacts on ambient air quality from fugitive dust emissions. The closest permanent residential receptors are located over 900 m from the Project (Drawings 7.2). These receptors are located beyond the extent to which fugitive dust emissions are expected to travel, and, as a result, no impacts are anticipated as fugitive dust emissions are considered short-term (construction), intermittent, and within the LAA.

Construction of the Project may result in an increase of combustion residuals and/or vehicle exhaust tailpipe emissions, primarily PM, NO_x, SO_2, and CO from vehicles (i.e., travel by Project personnel, transport/delivery activities) and heavy equipment. The closest permanent residential receptors are located over 900 m from the Project (Drawings 7.2). Exhaust emissions are primarily anticipated to be associated with local roadways and roads developed for the Project within the Project Area. Exhaust emissions are not anticipated to travel beyond the extent of the Project Area, and as such, impacts to local residential receptors are not anticipated. Overall exhaust emissions are considered short-term, intermittent, and within the LAA.

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

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

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

General mitigation measures for exhaust emissions include:

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

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

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

7.1.2 Climate Change (Greenhouse Gases)

7.1.2.1 Overview

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

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

7.1.2.2 Regulatory Context

The climate change assessment considered the following Acts and Regulations:

- *Environment Act*, SNS 1994-95, c. 1
  - Regulations Respecting Greenhouse Gas Emissions, NS Reg 260/2009
- *Environmental Goals and Sustainable Prosperity Act,* SNS 2007, c 7
- *Canadian Environmental Protection Act*, SC 1999, c. 33
  - Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations, SOR 2010-201
  - Heavy-duty Vehicle and Engine Greenhouse Gas Emission Regulations, SOR/2013-24
- Ozone-depleting Substances and Halocarbon Alternatives Regulations, SOR/2016-137

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

7.1.2.3 Assessment Methodology

The objectives of this assessment include the following:

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

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

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

Project-generated GHGs were quantified in accordance with the specifications described in the International Standard ISO 14064 (2019) and using published values found in the literature (sources provided in applicable sections that follow). GHG emissions and removal enhancements are stated in tonnes of carbon dioxide equivalent (tCO_2e).

7.1.2.4 Sources of Greenhouse Gas Emissions

The main GHGs of concern include:

- Carbon Dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Halocarbons
- Water Vapour

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

Carbon Dioxide

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

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

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

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

Methane

Methane (CH_4) is produced when fossil fuels are burned with insufficient oxygen to complete combustion (GOC, 2019b). Another source of methane is the decay of organic solid wastes and, indirectly, methane can also be released due to disturbances of wetlands (which act as methane sinks).

The Project's construction phase requires different heavy- and light-duty equipment, contributing to methane emissions. Alterations of wetlands for constructing access roads and wind turbine laydowns, and the decay of waste (i.e., decomposing cleared vegetation, workforce waste

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

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

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

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

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

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

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

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

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

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

7.1.2.5 Quantification of the GHG Baseline Conditions

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

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

The Project consists of 29 turbines (note the Project has identified 32 potential turbine locations) capable of generating 130.5 MW of renewable energy. Based on the wind turbine design capacity and a capacity rating of 45.1% (DNV Canada Ltd, 2022; RES, personal communication, January 13, 2023), the Project will be capable of producing approximately 516[1] Giga Watts per hour per year (GWh/year). The lifespan of the Project is estimated at a minimum of 25 years.

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

[1] $4.5\,\frac{MW}{Turbine} \times 29\,Turbines \times 0.451 \times 365\,\frac{days}{year} \times 24\,\frac{hours}{day}\,x\,0.001\,\frac{GW}{MW} = 516\,\frac{GWh}{year}$

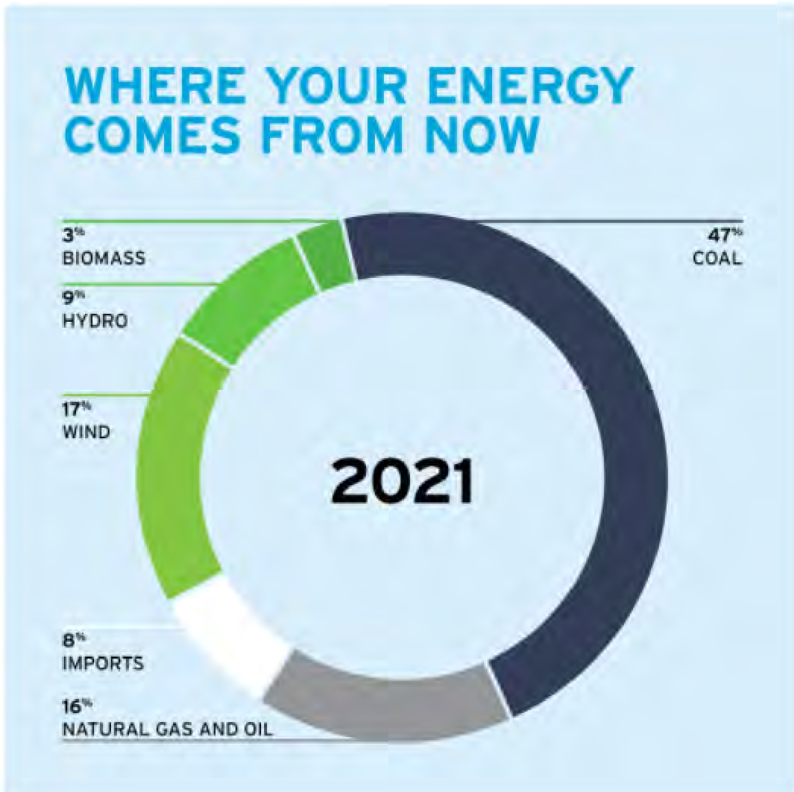

Figure 7.2: NS Power 2021 Energy Statistics

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

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

Most of the electricity generated is through coal, natural gas, and oil at 63%. Renewable sources account for 31% and the remaining 8% consists of imports. For the purpose of this assessment, the energy imports are distributed amongst coal (+2%), natural gas (+3%), and oil (+3%). Therefore, the fractions used for this assessment were: coal at 49%, natural gas at 11%, and oil at 11%. As the majority of renewable energy is generated from wind, quantification considered wind at 29%.

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

Table 7.6: Electricity Fuel Source Emission Factors

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

Source: USEIA, 2022

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

Table 7.7: Baseline Quantification Summary

Electricity Fuel Source	Electricity Generation (kWh/yr)	Emissions (tCO_2e)
Coal	252,631,348	258,977.20
Natural Gas	56,713,160	24,952.92
Oil	56,713,160	62,768.14
Wind	149,516,512	0
Total	**515,574,180**	**346,698.25**

The total annual GHG emissions generated in Nova Scotia for the same electrical capacity of the Project is **346,698.25 tCO_2e.**

Detailed CO_2e calculations are provided in Appendix D1.

7.1.2.6 Quantification of the Project-generated GHG Emissions

Construction Phase

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

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

Laydown Areas
Laydown areas (estimated area 60 m x 80 m = 4,800 m^2 each) are intended to store equipment temporarily, turbine foundation, and the crane pad. These areas will be prepared by removing the vegetation and overburden and placing competent gravels. Construction activities and

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

Concrete Foundation

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

An estimated 570 cubic meters (m^3) of concrete is required to construct a wind turbine foundation. That said, approximately 16,530 m^3 of concrete is required for all 29 wind turbines. According to ProMix Concrete Ltd. (2023), a typical concrete truck has a concrete capacity of 6 to 10 m^3. Based on an average capacity of 8 m^3, each wind turbine foundation will require approximately 72 truckloads. The quantification of the GHG emissions requires the following inputs:

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

Heavy duty diesel concrete trucks will be required to transport concrete to the Project Area. For the purposes of this assessment, transportation distances are based on the nearest known concrete supplier, which is located approximately 40 km from the Project Area. Given the turbine locations are scattered across the Project Area, transportation distances range from 43 km to 73 km (Table 7.8). Note, since there are 32 potential locations, but only 29 wind turbines, transportation distances were conservatively estimated based on the 29 longest distances.

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

Wind Turbine	Approximate Distance (km)
1	50.90
2	55.10
3	55.20
4	55.70
5	56.00
6	56.20
7	56.4056.20
8	57.1060.50
9	57.2062.60
10	57.4068.50

Wind Turbine	Approximate Distance (km)
11	57.5071.80
12	57.9070.10
13	59.2059.40
14	59.2060.90
15	59.4072.70
16	60.5067.10
17	60.9068.90
18	61.0070.90
19	62.6047.30
20	67.1057.10
21	68.5055.70
22	68.9055.20
23	69.6056.40
24	70.1057.90
25	70.9044.40
26	71.4043.80
27	71.8056.00
28	72.5061.00
29	72.7057.50
30	50.9055.10
31	55.1069.60
32	55.2072.50
Total	1934.401798.90

Based on Table 7.8, the total travel distance between the wind turbines and the nearest concrete supplier is 1934.40 km. Assuming 72 truckloads per wind turbine, the total one-way distance travelled is 129,520.80 km. GHG quantification considered travel to and from the nearest concrete supplier to the wind turbine locations.

It is assumed that each concrete truck will carry approximately 20 tonnes[2] of concrete per delivery for a total of 1,425 tonnes of concrete per wind turbine.

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

[2] $2{,}500\,\frac{Tonnes\ of\ Concrete}{Turbine} \div 72\,\frac{Trucks}{Turbine} = 20\,\frac{Tonnes\ of\ Concrete}{Truck}$

Table 7.9: Concrete Manufacturing and Transportation Emission Factors

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

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

Given the travelling distances, the quantity of concrete required for the Project, and the emission factors (Table 7.9), the CO_2e emissions are expected to be approximately **12,885.32 tCO_2e** for constructing all the tower foundations and pedestals.

Detailed CO_2e calculations are provided in Appendix D2.

Turbine

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

- The turbine materials and quantity.
- The turbine transportation distances from the manufacturer to the intended wind turbine laydown.
- The vehicle size and fuel type used to transport the wind turbines.

For quantification purposes, the assessment assumed the following:

- Manufacturing Material: Steel
- Manufacturing Location: Yantai-Penglai, China
- Nearest NS Shipping Port: Superport, Strait of Canso, NS, CA

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

- Blade (three)
- Drive Train
- Gearbox
- Generator
- Hub
- Nacelle
- Rotor
- Speed Shafts (low and high)
- Tower

According to the National Renewable Energy Laboratory (NREL) (2017), the total weight of manufacturing material is equivalent to approximately 120,000 kg/MW. Given the Project's wind turbine model capacity of 4.5 MW, the total weight of a wind turbine is approximately 540,000 kg. GHG emission factor for wind turbine manufacturing is provided in Table 7.10.

Table 7.10: Wind Turbine Manufacturing Emission Factor

Component	Emission Factor (tCO_2e/kg)
Wind Turbine Material (Steel)*	$2.6x10^{-3}$

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

Given the steel required to produce the wind turbines for the Project and the emission factor (Table 7.10), the CO_2eq emissions from the manufacturing of all the wind turbines are expected to be approximately **44,928.00 tCO_2e.**

The Project turbines will be manufactured in Yantai-Penglai, China, and shipped (via diesel cargo vessel) to the Superport, Strait of Canso, NS. From the Strait of Canso Superport, the turbines will be transported (via diesel heavy hauler) to each turbine location. Table 7.11 summarizes the transportation distances from the manufacturer to the Project.

Table 7.11: Wind Turbine Transportation Distances

Originating Destination	Final Destination	Distance (km)
Yantai-Penglai, China	Strait of Canso Superport, NS	11,213 (Marine)
Strait of Canso Superport, NS	Project	36 (Land)

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

- Each component will be individually transported via a single diesel heavy hauler.
  - 12 components per turbine to travel from Strait of Canso Superport, NS to turbine location (distance will vary from one turbine location to another).
- Each wind turbine (in its entirety) will be transported via a single diesel cargo vessel.
  - All turbine components (via one vessel) to travel from Tianjin, China to the Strait of Canso Superport (11,213 km per turbine).

Land transportation distances were calculated according to the distances in Table 7.12. Note, distances were conservatively estimated based on the 29 longest distances.

Table 7.12: Land Distance from the Strait of Canso Superport to Individual Wind Turbine Locations

Wind Turbine	Approximate Distance (km)
1	546.00
2	596.40
3	597.60
4	603.60
5	607.20
6	609.60
7	612.00
8	620.40
9	621.60

Wind Turbine	Approximate Distance (km)
10	624.00
11	625.20
12	630.00
13	645.60
14	645.60
15	648.00
16	661.20
17	666.00
18	667.20
19	686.40
20	740.40
21	757.20
22	762.00
23	770.40
24	776.40
25	786.00
26	792.00
27	796.80
28	805.20
29	807.60
30	546.00
31	596.40
32	597.60
Total	19,707.60

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

Based on Table 7.12, the total land transportation distance (all components for all turbines) between the Strait of Canso Superport and the wind turbine laydowns (not including marine transportation) is **19,707.60 km**. The total marine transportation distance associated with getting the wind turbines from Yantai-Penglai, China to the Strait of Canso Superport, NS, is **325,177.00 km**. The distances travelled consider travel from the manufacturer to the Project Area only; an equivalent return distance is not considered as the hauling companies would have commitments with other clients, and those GHG emissions would not be attributable to the Project.

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

Table 7.13: Wind Turbine Transportation Emission Factors

Component	Emission Factor (tCO_2e/tonne·km)
Heavy Duty Truck (Diesel) with freight	1.35×10^{-4}
Marine Cargo and Container Vessel (Diesel) with Freight	1.51×10^{-5}

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

Given the land transportation distances required to deliver the wind turbines to the Project and the emission factors (Table 7.13), the CO_2e emissions from land transportation of the wind turbines are expected to be approximately **119.72 tCO_2e**. In addition, the marine transportation distances required to deliver the wind turbines from the United States to Canada will contribute **2,651.49 tCO_2e**.

Detailed CO_2e calculations are provided in Appendix D2.

7.1.2.7 Operations Phase

Following the construction phase, the turbine will be operational, and the sinking of GHG emissions will begin. Based on the wind turbine design capacity and capacity rating of 45.1%, the Project will be capable of producing approximately 516 GWh/year. Therefore, the renewable energy produced will replace power production from fossil fuels and more intense generation methods described under baseline conditions (Section 7.1.2.5).

According to Padey et al. (2012), maintenance activities are the only contributor of GHGs during the operations phase. The maintenance typically includes replacing approximately 15% of the nacelle components and one blade during the wind turbine's lifetime. According to National Wind Watch Inc. (u.d.), nacelle weights range from 50,800 kg to 68,000 kg and blade assembly weights range from 32,700 kg to 38,100 kg. For the purposes of this assessment, a conservative estimation of 68,000 kg and 38,100 kg was assumed for the nacelle and blade weights, respectively. Given the replacement rates, nacelle material accounts for approximately 10,200 kg and blade replacement 12,700 kg throughout the wind turbine lifetime. The total emission from the replacement material for all the Project's wind turbines is **1,726.66 tCO_2e** (Appendix D3).

7.1.2.8 Effects Assessment

Project-GHG Interactions

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

Table 7.14: Potential Project-GHG Interactions

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

Assessment Boundaries
The LAA for GHGs is the Study Area (Drawing 2.2). The RAA for GHGs is not applicable.

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

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

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

Table 7.15: Project GHG Emission Summary

Component	Emissions (tCO_2e)
Baseline	
Electricity Generated from Coal	258,977.20
Electricity Generated from Natural Gas	24,952.92
Electricity Generated from Oil	62,768.14
Electricity Generated from Wind	0
Total	**346,698.25**
Construction Phase	
Concrete Production and Transportation	12,885.32
Wind Turbine Manufacturing	44,928.00
Wind Turbine Transportation	371.21
Total	**60,584.54**
Operations Phase	
Electricity Generated from Wind	0
Wind Turbine Maintenance	1,726.66*
Total	**1,726.66**

*Project lifespan emissions (single event)

As mentioned, the current GHG emissions for the quantity of electricity required by the Project using Nova Scotia Power's conventional generation methods contribute to **346,698.25tCO_2e**.

The Project's construction phase will generate the most GHGs from the manufacturing and transportation of the wind turbine, as well as the production and transport of the concrete for the tower foundation and pedestal. The total GHG emission contributions from the construction phase are **60,584.54 tCO_2e**.

The operations phase will generate GHGs from the wind turbines' maintenance (i.e., part replacements) as a one-time (Project lifespan) occurrence of **1,726.66 tCO_2e**.

Following the commissioning of the Project, the annual Project GHG emission reduction is expected to be **346,698.25 tCO_2e**. A one-time **1,726.66 tCO_2e** may be subtracted from any annual reduction; however, the annual reduction rate will be applied for the lifespan of the Project (25+ years). The Project is anticipating a 0.2-year[3] payback period to offset the construction-related GHG emissions. Following this period, the Project will positively offset GHG emissions that would typically be emitted from conventional production methods employed by NS Power.

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

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

- Use locally sourced materials, where possible, to reduce CO_2, CH_4, and NO_x emissions associated with transport.
- Incorporate the shortest construction/transport routes where possible to minimize the use of fossil fuels during construction.
- Recover and recycle construction and demolition waste, where possible.
- Recycle and compost workforce waste (i.e., food waste). Diverting this waste will reduce methane generated in landfills as it decomposes.
- Minimize deforestation during land clearing by only clearing the area that will be needed. This will reduce CH_4 and NO_x emissions associated with soil disturbance and limit the use of equipment (lowering emissions produced during equipment operations).
- Plan construction activities to reduce the double handling of materials, reducing GHG emissions associated with heavy equipment operations.

[3] (Construction Emissions) / (Offset Emissions) = 64,584.54tCO2e / (346,698.25tCO2e / year) = 0.2years

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

Monitoring
No monitoring programs are recommended.

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

7.2 Geophysical Environment

7.2.1 Overview

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

7.2.2 Regulatory Context

Relevant legislation includes:

- Sulphide Bearing Material Disposal Regulations, NS Reg. 57/95
- *Environment Act,* SNS 1994-95, c. 1 (protected watershed areas)

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

7.2.3 Assessment Methodology

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

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

7.2.4 Assessment Results

Topography

The Study Area is located within the Mulgrave Plateau Ecodistrict (360), which is part of the Nova Scotia Uplands Ecoregion (Neily et al., 2017). Covering approximately 1028 km^2, the Mulgrave Plateau Ecodistrict extends from Chedabucto Bay to the Strait of Canso. The ecodistrict consists of two plateaus which are separated by the Chedabucto Fault, a 300 km fault line dividing southern and northern Nova Scotia. Both plateaus are comprised of imperfectly drained hummocky to level topography. Topography in the Mulgrave Plateau Ecodistrict predominantly consists of a flat till plain with a mean elevation of approximately 130 metres above sea level (masl). Lower elevations within this ecodistrict are largely restricted to coastal areas (Neily et al., 2017).

The Study Area is located west of Mulgrave, NS in a high elevation flat to strongly rolling region ranging between approximately 100 masl to 190 masl (Neily et al., 2017). Topography in the Study Area ranges from smooth to hummocky (NSNRR, 2021a) (Drawing 7.3).

Surficial Geology

Surficial geology within the Study Area is very complex, dominated by glacially scoured basins and knobs overlain by a thin surficial layer of glacial till (Drawing 7.4) (NSNRR, 2021a). In areas where till is discontinuous, bedrock is exposed creating ridges of hard rock. Other surficial geology units within the Study Area include:

- Silty till plain
- Silty drumlin
- Organic deposits
- Stony till plain

Silty till plains are compact silty material that form as a result of local/distant material being released at the base of melting ice sheets. The silty till plain present within the Study Area ranges in thickness between 3 m and 30 m, which is sufficient to cover underlying bedrock. These areas contain moderate drainage and calcareous bedrock components which buffer acid rain (NSNRR, 2021a).

There is an abundance of silty drumlins sporadically throughout the Study Area. These drumlins range between 4 m and 30 m in thickness and are dominated by silty material with a high percentage of red clay material from distant sources. Silty drumlins are formed as a result of glacial deposition (NSNRR, 2021a).

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

Stony till plains are accumulations of stony-sandy material deposited at the base of melting ice sheets. The stony till plain located within the southeastern extent of the Study Area ranges in thickness between 2 m and 20 m. The stoniness, shallowness, and high water table associated with these plains can pose limitations for construction (NSNRR, 2021a).

Bedrock Geology

The Study Area is underlain by late Devonian to early Carboniferous bedrock belonging to the Horton Group (LD - ECH) (NSNRR, 2021a) (Drawing 7.5). The Horton Group Formation is generally composed of sandstone, siltstone, conglomerate, and shale. In Nova Scotia, shale has the potential to contain sulphide-bearing material/acid generating rock. Shale concentrations in the Horton Group are considered minor, regardless, the presence of sulfide bearing minerals will be assessed during geotechnical investigations.

General Hydrogeologic Conditions

Within the Mulgrave Plateau Ecodistrict, drainage is highly variable over short distances and a result of bedrock controlled drainage. In areas with thin till deposits and/or exposed bedrock, pooled drainage has resulted in the formation of hydric soils. In thicker till areas (such as drumlin fields), soils silty/stony and are moderately drained.

The nearest protected water area is the Port Hawkesbury Watershed located across the Strait of Canso on Cape Breton Island near the community of Port Hawkesbury/Point Tupper (Drawing 7.6). The Port Hawkesbury Watershed provides water to the community of Port Hawkesbury and is defined, designated, and protected under the *Environment Act*, SNS 1994-95, c 1, specifically the Port Hawkesbury Watershed, NS Reg 149/82.

Groundwater Quality and Quantity
The Study Area is underlain by sedimentary rocks which carry groundwater through pores and fractures present within the bedrock. Groundwater sourced from sedimentary rock is typically associated with higher well yields compared to other regions, as water can flow easily and readily through the bedrock. The porosity, fracturing, and high water yields associated with sedimentary bedrock make these regions ideal for drilling groundwater wells. Wells located in sedimentary rock typically have higher dissolved solids/hardness due to the groundwater dissolving the bedrock (NSECC & NSNRR, 2009).

Groundwater Wells
According to the NSECC Well Logs Database (2022c), 38 individually drilled wells are located within 2 km of the Study Area. Water well use for these wells is classified as domestic (33), industrial (one), public (not municipal) (one), or unspecified (three). A summary of well properties within 2 km of the Study Area is presented in Table 7.16, and a complete characterization log of wells within 2 km is provided in Appendix E.

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

	Drilled Date (year)	Well Depth (m)	Casing Depth (m)	Depth to Bedrock (m)	Static (m)	Estimated Yield (Lpm)
Minimum	1965	28.93	6.09	0.61	0.91	1.14
Maximum	2002	121.80	28.93	26.49	51.76	803.58
Average	n/a	65.29	10.50	6.43	7.06	35.88

Source: NSECC Well Logs Database (2022c).

Based on short term driller's estimates for the wells located within 2 km of the Study Area, the average yield is approximately 35.88 Lpm (litres per minute) with an average well depth of approximately 65.29 m. These measurements represent very short-term yields estimated by the driller at the completion of well construction (NSECC, 2022c).

None of the 38 water wells identified are located within the Study Area or within the Assessment Area.

The NSNRR Pumping Test Database (2022a) provides longer term yields for select wells throughout the province. There are several pumping test sites located within proximity to the Study Area including several to the east near Mulgrave and to the northwest near Monastery, NS. The pumping test well that has the most recent data available is near the community of Riverside, NS, located 9.4 km south of the Study Area. Conducted in 1990, this test indicates a long-term safe yield (Q20) of 386.81 Lpm, average pumping rate of 150.36 m^3/day, hydraulic conductivity of 0.404 m/day, and an apparent transmissivity of 0.25 m^2/day (NSNRR, 2022a).

NSECC maintains the Nova Scotia Groundwater Observation Well Network (2015a). The nearest provincial observation well to the Study Area is Monastery Station (028) located approximately 8.7 km northwest, near Monastery, NS. This observation well was drilled to a depth of 158.4 m through sandstone bedrock of the Canso Group. Monitoring at this well location began in 1976 and is on-going. In 2020, the average annual water elevation was 12.77 m masl and the annual water level fluctuation was approximately 1.11 m. The average depth to water in this well was 10.35 m below the top of casing in 2020 (NSECC, 2015a).

7.2.5 Effects Assessment

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

Table 7.17: Potential Project-Geophysical Interactions

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

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

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

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

- High – changes to local topography or geology are anticipated due to the presence of geologic hazards within the Assessment Area; impacts to the quality/quantity of groundwater wells are anticipated (wells present within Assessment Area).

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

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

In Nova Scotia, several bedrock formations are known to contain acid generating rock (sulphide minerals such as pyrite, pyrrhotite) that, when disturbed, can result in the production of acid rock drainage (ARD). ARD occurs when sulphide-bearing rocks are disrupted and exposed to air or water, producing sulphuric acid and metal oxides that are subsequently mobilized/leached through freshwater systems (NSNRR, 2021c). Sulphide-bearing slates are considered to be minor within the Horton Group Formation (NSNRR, 2002). The presence of sulphide-bearing minerals and likelihood of ARD will be determined following the results of the geotechnical evaluation.

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

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

Construction activities, primarily blasting (if required), have the potential to impact the quality and quantity of surrounding groundwater supply depending on the proximity to drinking water wells and extent of disturbance caused by construction activities. Disturbance of arsenic and/or uranium containing bedrock can mobilize arsenic/uranium within groundwater, and subsequently degrade nearby groundwater well quality. Risk mapping shows that the Assessment Area is situated in a region that has a “High Risk” of arsenic (Drawing 7.10) and “Low Risk” of uranium containing bedrock (NSNRR, 2021b). In addition to water quality, groundwater quantity can potentially be impacted if blasting activities (as required) alter local hydrogeological flow regimes, resulting in groundwater draining from or flowing towards existing wells. As a result of potential impacts to groundwater quality and quantity, wells located within 800 m of blasting activities require monitoring per NSECC’s Procedure for Conducting a Pre-Blast Survey (1993). No wells are within the Assessment Area and only two groundwater wells are within 800 m of the Assessment Area (both located near the intersection of the Project’s access road and Old Mulgrave Road, see Drawing 7.7). The requirement for blasting and pre-blast surveys will be confirmed and assessed further during geotechnical investigations.

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

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

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

on-site or removed and sent to an approved facility.
- Install erosion and sedimentation control measures prior to excavation activities and inspect controls on a regular basis.
- Remove temporary erosion and sedimentation controls once backfilled material has stabilized. Attention will be paid during site reinstatement to ensure areas will promote wildlife return to the area, to the extent possible.

Monitoring
If geologic hazards are identified during geotechnical investigations (e.g., sulphide bearing slates), monitoring programs will be developed as required by applicable regulations/standards.

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

Conclusion
Results are characterized as moderate magnitude, within the LAA, short-term duration, intermittent, reversible, and not significant.

7.3 Aquatic Environment

7.3.1 Waterbodies and Watercourses

7.3.1.1 Overview
The objective of the waterbody and watercourse assessment was to inform the Project's design and collect the information necessary for a general assessment of watercourses, waterbodies, and fish habitat (assessed separately in Section 7.3.2). This was accomplished using the following approaches:

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

7.3.1.2 Regulatory Context
Under the Nova Scotia *Environment Act,* SNS 1994-95, c. 1 NSECC has the authority to promote the sustainable management of water resources in Nova Scotia. More specifically, as per section 5A of the Activities Designation Regulations, NS Reg 47/95 the alteration of a watercourse or the flow of water within a watercourse is an activity that requires an approval

from NSECC, or a notification to NSECC if the work will be completed in accordance with the Nova Scotia Watercourse Alterations Standards.

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

7.3.1.3 Desktop Review

Watercourses

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

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

A review of the NS Topographic Database – Water Features (GeoNOVA, 2022) identified 310 watercourse feature segments within the Study Area and 983 features within 5 km of the Study Area. Five named watercourses were identified within the Study Area, including Clam Harbour River, East Branch Tracadie River, Silvey Brook, St. Francis Harbour River, and Hurlburt Brook. Furthermore, several named watercourses were identified within 5 km of the Study Area, including:

- Tracadie River
- Meaghers Brook
- Three Mile Brook
- Meadow Brook
- Melford Brook
- Murray Brook
- Brymer Brook
- Barrys River
- Two Mile Brook
- Wrights River
- Little Tracadie River
- East Brook
- McNairs Brook
- Tates Brook
- Colin Chisholm Brook
- Carey Brook

- Leets Brook
- Monastery Brook
- Millers Brook
- Byers Brook
- Mile Brook
- Steep Creek

With the centre of the Project situated at one of the higher points in the surrounding catchment area, the Study Area is split across two primary watersheds: the Tracadie River (1DS) and the Clam Harbour/St. Francis River (1ER) (Drawing 7.13). The Study Area is further subdivided into four secondary watersheds: Tracadie River (1DS-4), Clam Harbour River (1ER-4), St. Francis Harbour River (1ER-3), and Mill Creek (1DS-7). All drainage eventually discharges into the Atlantic Ocean, primarily via the Clam Harbour River, Hurlburt Brook, and the East Branch Tracadie River (NSNRR, 2021b).

The Nova Scotia Significant Species and Habitats Database identified 89 records pertaining to fish/fish habitat within 100 km of the Study Area (Section 7.3.2). The WAM layer identified potential wet areas and predicted flow within the Study Area based on the assumed depth-to-water generated from digital elevation data (Drawing 7.14). The depth-to-water ranged from 0 m to >10 m from the surface across the Study Area, with the majority of the Study Area being well to moderately-well drained.

Waterbodies
A review of the federal CanVec Database – Hydrographic Features (NRCan, 2022a) identified 13 named and 37 unnamed waterbodies within the Study Area, along with 36 named (Table 7.18) and 45 unnamed waterbody features within 5 km of the Study Area. Clam Harbour Lake is the largest open body of water within the Study Area, approximately 94 ha in size, located near the southwest extent of the Study Area.

Table 7.18: Named Waterbodies Within 5 km of Study Area

Name of Waterbody	Distance (km)
Waterbodies Within the Study Area	
Clam Harbour Lake	--
West Lakes	--
Sunset Lake	--
Dead Raven Pond	--
Sundown Lake	--
Hopes Lake	--
Summers Lake	--
Long Lake	--
West Lakes	--
Matties Lake	--
Halfmoon Lake	--

Name of Waterbody	Distance (km)
Five Mile Lake	--
Guthros Lake	--
Waterbodies Within 5 km of Study Area*	
Goose Harbour Lake	0.00
St. Francis Harbour River	0.12
Shepherd Lake	0.19
Hunsons Lake	0.20
Neds Lake	0.33
Grant Lake	0.34
Mary Lake	0.38
Birchtown Lake	0.46
West Lake	0.56
Butlers Lake	0.58
Carters Lake	0.62
Chisholms Lake	1.09
Levi Harts Pond	1.14
Archies Lake	1.55
Tracadieur Lake	1.75
Haydens Lake	2.14
Nerissa Round Lake	2.21
Brymer Lake	2.54
Half Moon Lake	2.76
Wheatons Lake	2.96
Morrisons Lake	3.07
Leets Lake	3.08
Critchetts Lake	3.12
Harveys Lake	3.54
Meaghers Lake	3.54
Englands Lake	3.66
MacMillans Lake	3.68
Simpsons Lake	3.85
Doreys Lake	4.13
Englands Lake	4.28
Dans Lake	4.33
Walsh Lake	4.74
Hart Lake	4.81
Milford Haven River	4.87

*Measurement from the nearest point of the Study Area.

The Mulgrave Municipal Water Supply Area is a 2094 ha surficial water supply area managed by the Mulgrave Water Utility, which supplies raw water to PHP and drinking water to the Town of

Mulgrave. Four waterbodies (along with their associated tributaries) are located within this Water Supply Area including: Grant Lake, Mary Lake, Summers Lake, and Matties Lake. Grant Lake is a constructed reservoir where drinking water is pulled and treated by the Mulgrave Water Treatment Plant (located east of Grant Lake) or transported via pipeline across the Strait of Canso to Port Hawkesbury Paper. Summers Lake and Matties Lake are also constructed reservoirs which control recharge of Grant Lake located downstream.

Although there will be no direct Project-waterbody interactions, approximately 563 ha (27%) of the Mulgrave Municipal Water Supply Area overlaps with the Project Area (Drawing 7.6). The overlapped area includes an existing road that will require upgrading and two turbine locations. Conversations with municipal officials indicated that development within the Mulgrave Municipal Water Supply Area will be reviewed as part of the municipal development agreement process.

7.3.1.4 Field Assessment Methodology

The results of the desktop review were used to inform the Project design (e.g., avoid/minimize impacts to watercourses and water bodies) and identify features that may potentially interact with the Project. Given that no waterbodies were identified to have potential Project interactions, field assessment efforts focused on potential Project-watercourse interactions.

Watercourse assessments were completed during the summer months of 2022. As such, desktop-identified watercourses, along with WAM and predicted flow data, were provided to field staff to guide the ground-truthing and assessment of potentially impacted watercourses within the Assessment Area.

Field crews assessed the Assessment Area, which included a 25 m area on either side of existing/proposed roadways, 10 m area on either side of proposed interconnection corridor, and a 100 m radius around the center of proposed turbine locations. Watercourses identified were delineated (until their extent reached the buffer/boundary end or the watercourse terminated) and assessed for general watercourse characteristics. Supplementary information on fish/fish habitat and incidental observations of SAR/SOCI were also recorded during the surveys (Section 7.3.2). Information collected included:

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

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

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

7.3.1.5 Field Assessment Results

A total of 39 watercourses were identified within the Assessment Area (Appendix F; Drawings 7.12A-7.12Q), including large permanent (five), small permanent (28), intermittent (three) and ephemeral (three) features ranging in bankfull width from 0.89 m to 6.75 m.

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

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

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

A total of 54 drainage features were also identified within the Assessment Area. Despite a confined overland flow similar to ephemeral features, these topographical features lack a hydroperiod sufficient for the creation of a riverine environment. The data for these features will be provided to Project engineers to facilitate Project Area refinement, providing a better understanding of the hydrological tendencies of the area, and an increased awareness of overland flow.

Of the 39 identified watercourses, 33 are located along pre-existing roads and have evidence of alteration including metal culverts, plastic culverts, and clear span bridges. The remaining six watercourses do not have crossing structures along the surveyed reaches. There were no incidental observations of aquatic SAR identified during the watercourse assessment.

7.3.1.6 Effects Assessment

A geographic information system (GIS) suitability analysis was conducted to design a Project Area that would minimize the placement of Project infrastructure within or near watercourses and waterbodies. To further meet this goal, the Project design utilizes as many pre-existing roads as possible. The detailed design phase will use this data and further refine the final Project Area to avoid as much of the field-identified aquatic habitat within the Assessment Area as the design requirements will allow.

Project-Watercourse Interactions

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

Table 7.19: Potential Project-Watercourse Interactions

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

Assessment Boundaries

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

Assessment Criteria

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

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

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

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

Altered Hydrology
Many of the watercourses within the Assessment Area contain pre-existing crossings that have declined in efficiency since being installed. Therefore, some areas will see improved hydrology and fish passage with the upgraded crossings.

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

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

Table 7.20: Watercourse Alteration Summary

Watercourse	Existing Crossing Structure	Forecasted Alteration
WC1	None observed.	No alteration expected as watercourse can be avoided.
WC2	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC3	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.

Watercourse	Existing Crossing Structure	Forecasted Alteration
WC4	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC5	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC6	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC7	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC8	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC9	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC10	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC11	Yes, clear span bridge structure for road crossing.	Bridge to be assessed and potentially replaced with road upgrades.
WC12	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC13	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC14	None observed	No alteration expected as watercourse can be avoided.
WC15	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC16	Yes, two culverts installed for road crossing.	Culverts to be assessed and potentially replaced with road upgrades.
WC17	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC18	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC19	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC20	Yes, two large culverts present, covered by land bridge.	Culverts to be assessed and potentially replaced with road upgrades.
WC21	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC22	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC23	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC24	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.

Watercourse	Existing Crossing Structure	Forecasted Alteration
WC25	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC26	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC27	None observed.	Crossing to be installed with road construction.
WC28	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC29	None observed.	Crossing to be installed with road construction.
WC30	None observed.	Crossing to be installed with road construction.
WC31	None observed.	Crossing to be installed with road construction.
WC32	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC33	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC34	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC35	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC36	Yes, clear span bridge structure for road crossing.	Bridge to be assessed and potentially replaced with road upgrades.
WC37	Yes, clear span bridge structure for road crossing.	Bridge to be assessed and potentially replaced with road upgrades.
WC38	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC39	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.

Road Upgrades

If determined to be required, most of the forecasted alterations (30/37) will be culvert upgrades to pre-existing alterations and will take place during the road upgrading process. Many of the current watercourse crossings have flow being directed through decaying infrastructure such as rusted culverts. Furthermore, when paired with the current buildup of sediment, organic material, and both natural and artificial debris, many of the observed crossings may be seen as a barrier to fish passage in their current state.

Additional alterations may arise from upgrades to a series of bridges (three) located throughout the Project Area (WC11, WC36, and WC37). Given that these bridges provide safe crossing for logging machinery and logging trucks, it is expected the bridges will be sufficient for Project developments, as they exist in their current state. Furthermore, should the bridges need to be replaced, open-bottom structures will be utilized to ensure watercourse characteristics stay as true to pre-construction conditions as possible. Project engineers will make this determination during the detailed design phase.

Road Construction
The construction of new roads will require the installation of (four) new watercourse crossings (WC27, WC29, WC30, and WC31). Each of these crossings will be designed to avoid any permanent diversion, restriction, or blockage of natural flow, such that the hydrologic function of the watercourse is maintained. Specific details of each crossing will be finalized during the detailed design phase and will be included in any necessary applications for alteration or notifications to NSECC.

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

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

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

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

Mitigation
The following specific mitigative measures will be implemented to avoid and mitigate any

potential effects on watercourses. In addition, a site-specific EPP will be developed to further inform mitigation measures. This EPP will act as a "living document" that incorporates an adaptive management approach to environmental protection and mitigation. Further, the EPP will incorporate proven BMPs that have demonstrated success in mitigating such effects.

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

Habitat Loss

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

Erosion and Sedimentation

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

Changes in Surface Water Quantity

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

Changes in Surface Water Quality

- Leave riparian vegetation as intact as Project developments will allow.

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

Monitoring

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

A watercourse monitoring plan, if required as part of the permitting phase, may include hydrological, sediment, and stability assessments upstream, downstream, and at the crossing of the watercourse. An example is included in Table 7.21.

Table 7.21: General Watercourse Monitoring Parameters and Methods of Assessment

Monitoring Parameter	Tasks	Method of Assessment	
		General Monitoring	Detailed Monitoring
Erosion and Sedimentation	Examine stability of watercourse banks both upstream and downstream of the crossing. Examine grade of slope at the crossing, taking note of any erosive channeling in substrate that would indicate the slope may be too steep.	Yes	Yes
	Inspect sediment control measures for effectiveness and look for evidence of sedimentation within the watercourse.	Yes	No
Water Quantity	Examine flow velocity, taking note of any undercutting or abrasive channeling, leftover construction debris, or obstruction to flow resulting from alteration activities.	No	Yes
	Preserve ability for fish passage by maintaining flow and adequate water levels.	No	Yes
	Examine water management systems (e.g., drainage channels) for effectiveness, taking note of any blockages, washouts, or unfavorable conditions.	Yes	No
Water Quality	Record of basic water quality parameters and evaluate whether alteration activities have drastically disrupted natural conditions.	Yes	Yes
	Note physical characteristics of watercourse, including colour, odour, cloudiness, or presence of algae.	Yes	Yes

Monitoring Parameter	Tasks	Method of Assessment	
		General Monitoring	Detailed Monitoring
Habitat Loss	Conduct stream assessments equivalent to those completed prior to alteration. Examine substrate, taking note of any obvious sediment mobilization, residual slash, or a build-up of fines/muck.	Yes	Yes
	Examine crossing for visual observance of fish, and/or any obvious signs of deteriorated fish habitat (e.g., desiccation of riparian vegetation, channel infill, etc.) or diversified fish habitat (e.g., pools, woody debris, etc.).	Yes	No

Conclusion

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

7.3.2 Fish and Fish Habitat

7.3.2.1 Overview

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

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

7.3.2.2 Regulatory Context

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

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

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

Federally, DFO has a responsibility to oversee the protection of fish and fish habitat in accordance with the *Fisheries Act.* The *Fisheries Act* provides additional protection to fish and fish habitat through means such as permitting, licensing, regulations, habitat restoration, marine refuge, and fish stocks. Provincially, wetland and watercourse alteration application processes assess alterations/activities that have the potential to impact fish and fish habitat.

7.3.2.3 Desktop Review

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

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

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

Based on the desktop review, there are no freshwater fish SOCI or associated habitat identified within 5 km of the Study Area. The NSNRR Significant Species and Habitats Database (2018) identified 89 records pertaining to fish/fish habitat within 100 km of the Study Area. These records include:

- A total of 85 “Species at Risk” records relating to Yellow lampmussel (*Lampsilis cariosa*) (25), Delicate lampmussel (*Lampsilis ochracea*) (25), and Brook floater (*Alasmidonta varicosa*) (35).
- Four “Species of Concern” records relating to Brook floater (one) and Triangle floater (*Alasmidonta undulata*) (three).

There were also three records of marine mammals relating to the Gray seal (*Halichoerus grypus*). Marine mammals are not assessed as part of this EA as the Project is located inland and is not anticipated to have any impacts on the marine environment (NSNRR, 2018).

The ACCDC database identified 13 fish and aquatic invertebrate SOCI within 100 km radius of the Study Area (Table 7.22). A complete list of SOCI up to 100 km from the Study Area is found in the ACCDC Data Report (2022b) in Appendix G.

Table 7.22: Fish and Aquatic Invertebrate SOCI Within a 100 km Radius of the Study Area

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
Fish					
Alewife	*Alosa pseudoharengus*	---	---	---	S3B
American eel	*Anguilla rostrata*	Threatened	---	---	S2
Atlantic salmon – eastern Cape Breton pop	*Salmo salar pop. 4*	Endangered	---	---	S1
Atlantic salmon – Gaspe/southern gulf of St. Lawrence pop	*Salmo salar pop. 12*	Special Concern	---	---	S1
Atlantic salmon – NS southern upland pop.	*Salmo salar pop. 6*	Endangered	---	---	S1
Atlantic sturgeon	*Acipenser oxyrinchus*	Threatened	---	---	S2S3N
Brook trout	*Salvelinus fontinalis*	---	---	---	S3
Striped bass	*Morone saxatilis*	Endangered, Special Concern	---	---	S2S3B, S2S3N
Striped bass – southern gulf of St. Lawrence pop	*Morone saxatilis pop. 1*	Special Concern	---	---	S2S3N
Aquatic Invertebrates					
Brook floater	*Alasmidonta varicosa*	Special Concern	Special Concern	Threatened	S3
Eastern pearlshell	*Margaritifera margaritifera*	---	---	---	S2
Triangle floater	*Alasmidonta undulata*	---	---	---	S2S3

Source: ACCDC 2022b; [1] Government of Canada 2022; [2] Government of Canada 202; [3] Government of NS, 2022; [4] ACCDC 2022a

The ACCDC data report identified five observations of aquatic mammals within 100 km of the Study Area. These species are not included or discussed further as the entire Project Area is contained inland and is not expected to impact the marine environment. No fish or aquatic invertebrate SOCI have ACCDC documented observations within 5 km of the Study Area (ACCDC, 2022b).

The Aquatic Species at Risk Map is a federal database showing the distribution of SAR and their associated critical habitat within Canadian waters (DFO, 2022b). A review of this database determined that there are no water features within the Study Area that contain SAR. The nearest

SAR watercourse is the Milford Haven River (marine, approximately 7.1 km south) and Strait of Canso (marine, approximately 6.2 km east). Milford Haven River and the Strait of Canso are known to contain Northern wolffish and other non-fish SAR including Fin whale, Blue whale, North Atlantic right whale, Leatherback sea turtle, and White shark (DFO, 2022b). Again, based on the inland nature of the Project and distance from the coastline, impacts on marine species are not assessed further.

7.3.2.4 Field Assessment Methodology

Fish presence and existing habitat were documented as part of the watercourse surveys conducted within the Study Area (Section 7.3.1). For each watercourse, notes on the visual observance of fish were recorded along with any habitat characteristics that may influence fish presence such as pool/riffle sequences, barriers to fish passage, and substrate composition. This information, along with the results of the desktop review, was then used to select ideal watercourses for detailed fish habitat assessments and qualitative electrofishing (Drawing 7.15). Locations selected also considered the position of the watercourse within the watershed and attempted to utilize notable, permanent features that offer a representation of the surficial hydrology across the entire Study Area.

Fish Habitat Assessment

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

- *Physical Makeup*

  Substrate Percent

  When assessing the substrate makeup of a watercourse, field staff evaluated the watercourse based on the presence of bedrock, boulders, rubble, cobble, gravel, sand, and fines/muck. Each of these seven parameters was given a percentage, with the sum of the seven equating to 100%. This data was then used for the assessment of habitat potential based on the presence/absence of suitable area for various fish life stages, including spawning, rearing, and overwintering.

  In-stream Habitat Types

  Each watercourse was assessed for the presence/absence of in-stream habitat diversity along each evaluated reach. Field staff studied the feature, taking note of any identified pools, riffles, runs, flat sections, rapids, or cascades. Different aquatic species will seek out different in-stream habitat depending on their needs as they correspond with their life cycle. As such, a diverse selection of in-stream habitat can cater to a diverse assemblage of species.

In-stream Cover
In-stream cover was assessed based on the presence of physical characteristics that provide fish refuge, including boulders, overhanging vegetation, large woody debris, small woody debris, deep pools, undercut banks, and instream vegetation. These parameters were ranked as being present in either trace, moderate, or abundant amounts, and were used to determine the suitability of an area based on its physical makeup.

Bank Characteristics
For each inspected segment of watercourse, the conditions of its banks were evaluated for evidence of siltation, erosion, stability, and undercutting. These conditions were ranked as being present in either trace, moderate, or abundant amounts, with the results providing a better understanding of the history, morphology, and suitability of the watercourse in question.

Barriers to Fish Passage
Field staff identified any potential barriers to fish passage located within each watercourse. Barriers may include any physical structure or feature that hinders the ability of fish to navigate throughout the watercourse, or through the watercourse to neighboring aquatic environments.

- *Water Chemistry*

Temperature
Water temperature is a crucial factor in the habitat of fish and aquatic organisms. This is because most fish are considered ectotherms, meaning their internal mechanisms are incapable of providing body warming. As such, extreme temperature changes can have adverse effects on critical processes including rate of metabolism, energy levels, behavior, and nutrient uptake (Volkoff & Rønnestad, 2020). Furthermore, changes in water temperature can have adverse effects on other aspects of the water chemistry, including dissolved oxygen, conductivity, and pH. While the ideal temperature range is mostly species-specific, a conservative approach as per the DFO requirements for electrofishing is that any temperature above 22°C is considered stress-inducing, and potentially fatal, and no electrofishing is to be done in these conditions.

Dissolved Oxygen
Dissolved oxygen is the presence of atmospheric oxygen that dissolves into the water column and is essential for fish and other aquatic species to breathe. Dissolved oxygen fluctuates in response to several factors, including plant biomass, substrate composition, stream velocity, and temperature. It is important to consider dissolved oxygen levels when assessing fish habitat, as anoxic conditions may result in mortality via suffocation. As such, to be characterized as “healthy water”, dissolved oxygen concentrations should be greater than 6.5-8 mg/L, and subsequent dissolved oxygen saturation should be around 80-120% (DataStream Initiative, 2021).

Conductivity

Conductivity is a measure of how easily water can conduct electricity. By measuring conductivity, an indirect estimate of the water's salt concentration can be determined. Conductivity is an important measurement when assessing fish habitat as freshwater species are unable to survive in waters of high salinity. This is because high concentrations of salt prevent them from holding water within their bodies unless they have otherwise adapted to such conditions. Furthermore, conductivity typically increases as water temperature increases. To that end, conductivity is often categorized by the following hierarchy:

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

pH

The term pH refers to the acidity or basicity of the water column and is measured on a 0-14 scale. For a waterbody to be considered low pH (high acidity), the pH typically registers below 6 or 6.5. Similarly, for a waterbody to be considered high pH (low acidity), the pH typically registers above 9 for extended periods of time. It is important to take pH into consideration when assessing fish habitat, as aquatic species typically have an optimum pH range, and fluctuation away from this range can cause stress in the form of reduced hatching rates, deteriorating health conditions, or ultimately mortality. Furthermore, extreme pH levels can facilitate the mobilization of certain toxic elements and compounds (US EPA, 2022b).

Electrofishing Surveys

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

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

7.3.2.5 *Field Assessment* Results

Fish Habitat Assessment

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

Habitat assessments were also conducted during electrofishing surveys. Detailed results are in Appendix H, with a summary shown in Table 7.23.

Table 7.23: Fish and Fish Habitat Assessment Results Collected During Electrofishing Events

Watercourse	Surveyed Reach	Possible Barriers to Passage	Fish Seen	Habitat Characteristics			Ranking of Fish Presence
				Spawning [1]	Rearing [2]	Overwintering [3]	
WC7	Downstream	No	Yes	Yes	No	No	High
	Crossing	No	Yes	No	Yes	No	High
	Upstream	No	Yes	No	No	No	High
WC11	Downstream	No	Yes	Yes	No	No	High
	Crossing	No	Yes	No	Yes	Yes	High
	Upstream	No	Yes	No	No	No	High
WC20	Downstream	Yes	Yes	Yes	Yes	No	High
	Crossing	Yes	Yes	Yes	No	Yes	High
	Upstream	Yes	Yes	Yes	Yes	No	High
WC30	Downstream	No	Yes	No	No	Yes	High
	Crossing	No	Yes	No	Yes	No	High
	Upstream	No	Yes	No	No	No	High
WC36	Downstream	No	Yes	Yes	Yes	No	High
	Crossing	No	Yes	Yes	No	Yes	High
	Upstream	No	Yes	Yes	Yes	No	High

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

Electrofishing Surveys

Electrofishing was conducted during summer 2022 along WC7, WC11, WC20, WC30, and WC36 (Drawing 7.15). The electrofishing surveys resulted in 32 individual fish being caught across all five of the surveyed watercourses. Detailed results of the electrofishing survey are provided in Appendix H, with a summary provided in Table 7.24.

Table 7.24: Electrofishing Survey Results

Watercourse	Count	Common Name	Scientific Name	COSEWIC Rank[1]	*SARA* Rank[2]	NS *ESA*[3]	S-Rank[4]
WC7	3	Brook trout	*Salvelinus fontinalis*	---	---	---	S3
WC11	4	Brook trout	*Salvelinus fontinalis*	---	---	---	S3
WC20	5	Brook trout	*Salvelinus fontinalis*	---	---	---	S3
	5	Lake chub	*Couesius plumbeus*	---	---	---	S5
	1	American eel	*Anguilla rostrata*	Threatened	---	---	S3N

Watercourse	Count	Common Name	Scientific Name	COSEWIC Rank[1]	*SARA* Rank[2]	NS *ESA*[3]	S-Rank[4]
WC30	11	American eel	*Anguilla rostrata*	Threatened	---	---	S3N
	2	Threespine stickleback	*Gasterosteus aculeatus*	---	---	---	S5
WC36	1	American eel	*Anguilla rostrata*	Threatened	---	---	S3N

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

Priority Species

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

Brook trout (*Salvelinus fontinalis*)

Brook trout are not listed under federal (*SARA*) or provincial (NS *ESA*) legislation as species at risk; however, are listed as 'S3' by ACCDC (2022a). This species of trout is typically found in cold, clear, and well oxygenated rivers and lakes with plenty of shade and gravel substrate (US Fish and Wildlife Service, 2021). They prefer water temperatures that do not exceed 20° C, though adult fish can tolerate temperatures of up to 25° C for short periods of time. Furthermore, despite being able to reproduce in waters with a pH as low as 4.5, they do best in a pH range of 5.0 to 7.5 (Maryland Department of Natural Resources, 2012).

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

The closest observation of Brook trout is within the Assessment Area, where field staff recorded 12 individuals during electrofishing surveys.

American Eel

The American eel is listed as 'Threatened' under COSEWIC and 'S3N' by ACCDC (2022a). American eels are a migratory species with life stages in freshwater, estuary, and marine environments (COSEWIC, 2012). Though much is still unknown about the American eel, several studies have shown a temperature preference of around 16.7° C (Blakeslee et al., 2018). Spawning and maturation occurs in the marine environment, where adults migrate inland to freshwater habitats. Within freshwater habitats, this species of eel is typically found in rivers and lakes, and will readily burrow into mud, sand, fine gravel, cobble, and woody debris. Within marine environments, American eels are commonly associated with protected shallow waters containing submerged vegetation (e.g., eelgrass) and woody debris (COSEWIC, 2012).

The closest observation of American eel is within the Assessment Area, where field staff recorded 13 individuals during electrofishing surveys.

Atlantic salmon
The Atlantic salmon – Nova Scotia southern upland (NSSU) subspecies is listed as 'Endangered' by COSEWIC and as "S1" by ACCDC (2022a). NSSU Atlantic salmon are a genetically distinct population of Atlantic salmon that occupy rivers in both the Eastern Shore and South Shore, draining into the Atlantic, as well as Bay of Fundy Rivers south of Cape Split (DFO, 2013). The exact number of rivers that contain NSSU Atlantic salmon is unknown; however, they have been historically considered present in 72 of the regions 585 watersheds. They are managed under Salmon Fishing Area 20, 21, and part of 22 (DFO, 2013).

In general, the freshwater habitat preference of Atlantic salmon includes clear, well-oxygenated waters in streams with bottoms of gravel, cobble, and boulder. Atlantic salmon prefer cool waters, with spawning typically observed in the 4.4 to 10° C range, and growth typically observed in the 5 to 19° C range (US Fish and Wildlife Service, 2021). Atlantic salmon smolts migrate seaward from rivers during May-July and adults return to the rivers in the late fall to spawn.

As temperatures rise above 23° C, habitat potential decreases, and Atlantic salmon will search for cooler waters. Riffles, rapids, and pools are also necessary components for various life stages, with the preferred depth being in the 10 to 40 cm range (US Fish and Wildlife Service, 2021). Furthermore, Atlantic salmon prefer a circumneutral pH ranging from 6.5-7.5 (Maine Department of Environmental Protection, 2022).

The closest observation of Atlantic salmon NSSU subspecies is 13.7 ± 1.0 km from the Study Area (ACCDC, 2022b).
Note that the Atlantic salmon – eastern Cape Breton subspecies is another population of Atlantic salmon listed as 'Endangered' by COSEWIC and as "S1" by ACCDC (2022a). Eastern Cape Breton Atlantic salmon are a genetically distinct population of Atlantic salmon that encompass 46 rivers in Eastern Cape Breton. These rivers drain south from Victoria County, into the Bras d'Or Lakes and eventually into the Atlantic Ocean (DFO, 2014). As this subspecies is said to be contained to the waterways of Cape Breton East (SFA 19), it is unlikely that the population would interact with the Project (DFO, 2014).

The closest observation of Atlantic salmon – eastern Cape Breton subspecies is 20.6 ± 0.0 km from the Study Area (ACCDC, 2022b).

7.3.2.6 Effects Assessment

Project-Fish and Fish Habitat Interactions
Project activities, primarily those that involve watercourse crossing, earth moving, or vegetation removal, have the potential to impact fish and fish habitat (Table 7.25). These potential impacts

could include habitat removal, disruptions to hydrology, and/or displacement of sediment.

Table 7.25: Potential Project-Fish and Fish Habitat Interactions

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

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

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

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

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

Habitat Loss
The spatial arrangement of the Project development will be confined to areas that will result in the minimum number of interactions with watercourses and wetlands, to the extent possible. However, in areas where watercourse/wetland interactions are unavoidable, there is a potential for habitat loss.

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

As detailed in Section 7.3.1, there is a potential for 37 watercourse alterations to facilitate Project developments (Table 7.26). These alterations include upgrades to existing roads and associated crossings (30), and the construction of new roads and accompanying crossings (four). Many of the current watercourse crossings have flow being directed through decaying infrastructure such as rusted culverts. Furthermore, when paired with the current buildup of sediment, organic material, and both natural and artificial debris, many of the observed crossings may be seen as a barrier to fish passage in their current state. Therefore, for many of these crossings, proposed upgrades will improve flow and fish passage.

The number of new crossings has been minimized through the use of the existing road network. New crossings will be designed to avoid any permanent diversion, restriction, or blockage of natural flow, such that the hydrologic function of the watercourse is maintained. The design and installation will adhere to the mitigation measures described below, with specific mitigation provided for the protection of salmonids. New crossings are expected to be low risk and have low complexity due to the size of the watercourses at the crossing location and the expected length of the crossings. The details of each crossing will be finalized during the detailed design phase and will be included in any necessary applications for alteration or notifications to NSECC. Crossing structures will be selected and designed to be protective of fish and may include the use of open-bottom culverts or clear-span bridges, as appropriate.

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

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

Based on the wetland assessments, it is possible that seven of the 95 wetlands within the Assessment Area may offer some form of fish habitat (Table 7.26). In these situations, habitat loss may come in the form of either partial or total infill, thus altering wetland functionality such as water cooling, sediment stabilization, or stream flow support, and therefore shifting the suitability of the area for fish species. All seven of these wetlands are contiguous with identified and delineated watercourses, with four of the wetland alterations associated with existing road crossings (and associated watercourse crossings), and the remaining three in undisturbed areas. As such, any potential effects to fish and fish habitat stemming from Project-wetland interactions will be addressed through the watercourse notification or alteration permitting process.

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

Feature ID	Existing Alteration	Forecasted Alteration
Watercourses		
WC2	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC3	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC4	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC5	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC6	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC7	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC8	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC9	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC10	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC11	Yes, clear span bridge structure for road crossing.	Bridge to be assessed and potentially replaced with road upgrades.
WC12	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC13	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC15	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC16	Yes, two culverts installed for road crossing.	Culverts to be assessed and potentially replaced with road upgrades.
WC17	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.

Feature ID	Existing Alteration	Forecasted Alteration
WC18	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC19	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC20	Yes, two large culverts present, covered by land bridge.	Culverts to be assessed and potentially replaced with road upgrades.
WC21	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC22	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC23	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC24	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC25	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC26	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC27	None observed.	Crossing to be installed with road construction.
WC28	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC29	None observed.	Crossing to be installed with road construction.
WC30	None observed.	Crossing to be installed with road construction.
WC31	None observed.	Crossing to be installed with road construction.
WC32	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC33	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC34	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC35	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
WC36	Yes, clear span bridge structure for road crossing.	Bridge to be assessed and potentially replaced with road upgrades.
WC37	Yes, clear span bridge structure for road crossing.	Bridge to be assessed and potentially replaced with road upgrades.
WC38	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.

Feature ID	Existing Alteration	Forecasted Alteration
WC39	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced with road upgrades.
	Wetlands	
WL29	Yes, gravel road cuts through WL29 and WC4.	Partial infill for road upgrades.
WL39	Yes, gravel road cuts through WL39 and WC7.	Partial infill for road upgrades.
WL53	Yes, gravel road cuts through WL53 and WC18.	Partial infill for road upgrades.
WL61	Yes, gravel road cuts through and WC24.	Partial infill for road upgrades.
WL67	None observed. Contiguous with WC27.	Partial infill for road construction.
WL78	None observed. Contiguous with WC31.	Partial infill for road construction.
WL79	None observed. Contiguous with WC31.	Partial infill for road construction.

Indirect Effects
The temporal and spatial extent of indirect effects can be farther reaching, but are often foreseeable, and research based, standardized BMPs can be implemented to mitigate the resulting outcomes.

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

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

Changes in Surface Water Quality
Changes in the quality of surface water can arise from alterations to the surrounding

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

Mitigation
The primary mitigation measure to protect fish and fish habitat is maximizing the use of existing roads to minimize the number of new watercourse crossings, which has been incorporated into the Project's design. In addition, a site-specific EPP will be developed to further inform mitigation measures. This EPP will act as a "living document" that incorporates an adaptive management approach to environmental protection and mitigation. Further, the EPP will incorporate proven BMPs that have demonstrated success in mitigating such effects.

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

In addition, the following mitigative measures will be implemented to avoid and mitigate any potential effects on fish and fish habitat.

Habitat Loss

- Ensure watercourses and wetlands are clearly marked and avoid impacts to the area and adjacent riparian habitat to the extent possible.
- Ensure all crossings are installed by a certified Watercourse Alteration Installer/Sizer, and designed to avoid any permanent diversion, restriction or blockage of natural flow, such that the hydrologic function of the watercourse is maintained.
- Revegetate along the watercourse edge and above the ordinary high-water mark to facilitate the stabilization of the area, and restoration of fish habitat, where required.
- Redesign existing watercourse crossings to facilitate habitat upgrades, including unblocking culverts and making waterways more conducive to fish passage.
- Locate new crossings away from potential salmonid spawning areas, such as pools with a dominant substrate of small-to-medium sized gravel (DFO, 2022a).
- Avoid impacts to wetlands to the extent possible.
    - Where unavoidable, complete wetland alterations in accordance with the NS Wetland Conservation Policy (NSECC, 2019) and the wetland alteration process during the permitting stage, which includes a requirement to compensate for lost wetland habitat and functions.
    - Design wetland crossings to occur at the narrow part of the wetland or the wetland's edges, to the extent possible.
- Conduct work between June 1 and September 30 to avoid sensitive periods in the life cycles of fish, to facilitate a better control of water flow, and to allow for a faster revegetation period (NSECC, 2015b).

Erosion and Sedimentation

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

Changes in Surface Water Quantity

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

Changes in Surface Water Quality

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

Monitoring

A site-specific monitoring plan will be developed and executed in tandem with watercourse monitoring during the construction phase. This will consist of detailed monitoring and general spot checks. Detailed monitoring will include hydrological, sediment, and stability assessments upstream, downstream, and at the crossing of the watercourse, as well as detailed vegetative, hydrological, and soil assessments within the wetland habitat adjacent to the infill site. Spot checks will involve a general overview of vegetative, hydrological, and substrate conditions, focusing on evidence of significant hydrologic alterations, sedimentation, and degradation of fish habitat (Table 7.27).

Table 7.27: General Fish Habitat Monitoring Parameters and Methods of Assessment

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

Conclusion

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

7.3.3 Wetlands

7.3.3.1 Overview

Wetland assessments were conducted to identify and quantify wetland habitat so that impacts to wetland area and function could be avoided and minimized, to the extent possible. This was achieved by first taking a broad assessment approach across the entire Study Area. The findings of the Study Area assessment were then used to directly inform the layout of the Project, with surveys becoming more rigorous and in-depth in the areas more likely to experience direct or indirect impact. Key steps are listed below with further details provided in the sections that follow:

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

7.3.3.2 Regulatory Context

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

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

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

7.3.3.3 Desktop Review

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

- Satellite and Aerial Photography
- Provincial Landscape Viewer (NSNRR, 2017)
- Wetlands Inventory (NSNRR, 2021d)
- Nova Scotia Hydrographic Network (Open Data NS, 2022)
- WSS Database (NSNRR, 2014)
- Nova Scotia WAM Database (NSNRR, 2012a)

The NSNRR Wetland Inventory (2021d) identified 278 wetlands located within the Study Area. The 278 mapped wetlands were classified as either a swamp (201), bog or fen (63), marsh (11), or fen (three), all ranging in size between 0.16 and 122 ha (Drawing 7.16). According to the WSS database (2014), there are no WSS located within the Study Area.

The WAM layer identified potential wet areas and predicted flow within the Study Area based on the assumed depth-to-water generated from digital elevation data (Drawing 7.14) (NSNRR, 2002). The depth-to-water ranged from 0 m to >10 m from the surface across the Study Area, with the majority of the Study Area being well to moderately-well drained.

The results of the desktop review were subsequently used to refine turbine/road siting locations to avoid known wetland features and prospective wet areas, thus forming the Assessment Area as a means to scope and allocate field study efforts.

7.3.3.4 Field Assessment Methodology

General

Wetland field assessments were completed across the entirety of the Assessment Area. This included high-level assessments for hydrology, complimented by in-depth wetland delineations and functional assessments. Wetland surveys were done in conjunction with watercourse assessment surveys. Field assessments aimed to minimize wetland alteration by establishing areas to be avoided for potential turbine siting and road placement.

To accompany wetland field surveys, a list of SAR/SOCI known to occur within the general area of the Project was compiled to help with incidental identifications. Throughout the surveys, all incidental observations of SAR/SOCI were noted and recorded for inclusion in reporting as detailed in their respective sections.

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

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

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

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

Dominant plant species observed in each wetland were classified according to indicator status (probability of occurrence in wetlands), in accordance with the U.S. Fish and Wildlife Service National List of Vascular Plant Species that Occur in Wetlands: NE Region (Region 1) (Reed, 1988) (Table 7.28). These indicators are used as this region most closely resembles the flora and climate regime of Nova Scotia. Further relevant information was reviewed in Flora of Nova Scotia (Zinck, 1998).

Table 7.28: Classification of Wetland-Associated Plant Species[1]

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

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

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

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

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

Determination of Wetland Hydrology
Wetland habitat, by definition, either periodically or permanently has a water table at, near, or above the land surface. To be classified as a wetland, a site should have at least one primary indicator or two secondary indicators of wetland hydrology (Table 7.29). Wetland habitat is assessed for signs of hydrology via visual observations across the area and through the assessment of soil pits.

Table 7.29: Indicators of Wetland Hydrology

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

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

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

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

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

7.3.3.5 Field Assessment Results

General
Field surveys completed during the summer of 2021 and 2022 identified 95 wetlands either partially or fully within the Assessment Area (Drawings 7.12A-7.12Q). Detailed results are found in Appendix I.

Of the 95 identified wetlands, the most prominent wetland type was treed swamps (34). Treed swamps are characterized by an environment that is not as waterlogged as other wetland types, such as shrub swamps or marshes, and typically experience their highest hydroperiod during spring and fall precipitation events (Province of NS, 2018). As a result, treed swamps offer deciduous trees (e.g., red maple and yellow birch) and coniferous trees (e.g., black spruce and balsam fir) the opportunity to establish themselves and adapt to the inconsistent inundation periods (Province of NS, 2018).

Most treed swamps were situated in a basin landscape position that showed signs of historic forestry activity (i.e., moss covered tree stumps). Typical species composition consisted of cinnamon fern (*Oundastrum cinnamomeum*), Canada goldenrod (*Solidago canadensis*), bunchberry (*Cornus canadensis*), black spruce (*Picea mariana*), and balsam fir (*Abies balsamea*). Surface water was typically not observed, though saturation was often present, as identified through the excavation of small soil pits.

Another prominent wetland type identified within the Assessment Area was shrub swamps (30). Shrub swamps tend to form in permanently or seasonally flooded areas where the surface is moist from ground saturation. In many cases, shrub swamps eventually transition into treed swamps via succession (Province of NS, 2018). The typical species composition of shrub swamps identified within the Assessment Area included common woolly bullrush (*Scirpus cyperinus*), Canada goldenrod (*Solidago canadensis*), white meadowsweet (*Spiraea alba*), speckled alder (*Alnus incana*), and balsam fir (*Abies balsamea*). Surface water was more common than within treed swamps, though the temporal extent of the surficial hydroperiod seemed to be seasonal.

A number of bogs (16) were also observed throughout the Assessment Area. These wetlands are characterized by their poor drainage, accumulation of peat, and dense coverage of either sphagnum moss or grass-like sedges (NSNRR, 2018).Typical species composition observed included tawny cottongrass (*Eriophorum virginicum*), bunchberry (*Cornus canadensis*), sheep laurel (*Kalmia angustifolia*), balsam fir (*Abies balsamea*), and black spruce (*Picea mariana*). A large portion of the observed bogs were in a basin landform that had been intersected by a roadway, as could be observed by the continuation of bog habitat extending laterally from the adjacent side of the roadway, and the pooling of water near roadway shoulders. Trees, when present, were often stunted and scattered.

Marshes (13) were also observed throughout the Assessment Area. These wetlands often display more persistent surface water areas that tend to shrink as the growing season progresses. Furthermore, the lack of canopy cover and high water table in marshes often facilitate vigorous growth of herbaceous vegetation (Province of NS, 2018).Such was the case for many of the marshes observed within the Assessment Area, with evidence of herbaceous encroachment along the edges of sparsely vegetated concave surfaces. Typical vegetation within marshes throughout the Assessment Area included common woolly bulrush (*Scirpus cyperinus*), sensitive fern (*Onoclea sensibilis*), broad-leaved cattail (*Typha latifolia*), and red spruce (*Picea rubens*).

Two vernal pools were observed within the Assessment Area. These wetland features often lack a clear inlet or outlet and appear as an ephemeral pool that is typically less than 0.5 ha (Province of NS, 2018).Vernal pools serve as important habitat for herpetofauna such as the red-spotted newt (*Notophthalmus viridescens viridescens*) and the Northern green frog (*Lithobates clamitans*). Species composition included crested tawny cottongrass (*Eriophorum virginicum*), common woolly bulrush (*Scirpus cyperinus*), tamarack (*Larix laricina*), and red maple (*Acer rubrum*).

Functional Assessments

Functional assessments were completed during summer 2022 for 10 representative wetlands within the Assessment Area (Drawings 7.12A-7.12Q). This selection of wetlands offers an overview of the ecological condition and inherent risk of wetland habitat within the Assessment Area. As the detailed design phase will see the refinement of the Project Area to avoid many of the 95 identified wetlands, more in-depth analysis and functional assessments will be completed for any wetland deemed to require alteration. Detailed WESP-AC results are found in Appendix I, and a summary is provided in Table 7.30.

None of the wetlands were determined to be WSS, as dictated by the Functional WSS Interpretation Results within the WESP-AC spreadsheet calculator. All but two wetlands were determined to be in higher ecological condition, with eight of 10 wetlands receiving this result. However, all 10 wetlands were determined to be at a higher wetland risk, based on an average of their respective sensitivity and stressors. This is likely due to many of the wetlands being previously impacted by anthropogenic disturbance (i.e., road building, forestry activities, etc.) both directly and within the greater catchment area, resulting in a potential lack of intrinsic resistance and resilience to future stressors.

As previously mentioned, wetlands known to support at-risk species as designated under *SARA* or the NS *ESA* are considered WSS under the NS Wetland Conservation Policy. The results of the desktop and field assessments show no at-risk lichen or plant species within field-delineated wetlands within the Assessment Area. Furthermore, the results of the wetland field assessments were also cross referenced with breeding bird survey (BBS) results, specifically for avian SAR/SOCI with wetland habitat requirements. Although no avian SAR/SOCI were recorded directly within the delineated wetlands, three point count locations recorded the presence of Canada Warbler (*Cardellina canadensis)* near delineated wetlands within the Assessment Area:

- Wetland 53 (marsh) – Two records of singing males. One male to the northeast of the wetland, one male to the west of the wetland.
- Wetland 69 (shrub swamp) – Two records of singing males. One male to the north of the wetland, one male to the northwest of the wetland.
- Wetland 83 (marsh) – Three records of singing males, one record of an agitated male who was calling. The singing males were located to the east, west, and south of the wetland. The agitated male was located to the north of the wetland.

Canada Warbler prefer wet, mixed wood forest with a dense understory of shrubs (COSEWIC, 2020). Given the characteristics of WL53 and WL83, it is unlikely that these wetlands provide adequate habitat for Canada Warbler breeding pairs. Both marshes lack the dense shrub layers of which the species is known to target. Although WL69 is likely to provide sufficient breeding habitat for Canada Warbler, the singing males were noted to be north and northwest of WL69, in another, unconnected wetland north of WL69 (which will not be impacted by the Project). Therefore, no WSS were identified within the Assessment Area. In addition, WL53, WL69, and WL83 are all located along pre-existing roadways. Wetland alterations, if necessary, will be confined to the outer edge of the wetland, such that impacts to wetland habitat and functionality will be minimized to the extent possible.

Table 7.30: Summary of WESP-AC Assessments for Wetlands within the Assessment Area

Wetland ID	Tertiary Watershed	Wetland Type(s)	WSS[1] (Yes/No)	Condition[2]	Risk[3]
WL1	1DS-4-B	Treed swamp, Bog, Marsh	No	Higher	Higher
WL5	1DS-4-D	Shrub swamp, Vernal pool, Treed swamp	No	Higher	Higher
WL18	1DS-4-F	Bog	No	Higher	Higher
WL22	1DS-4-F	Bog	No	Higher	Higher
WL31	1DS-4-F	Treed swamp	No	Higher	Higher
WL39	1ER-4-C	Treed swamp	No	Lower	Higher
WL43	1ER-4-C	Shrub swamp	No	Lower	Higher
WL57	1ER-3-B	Treed Swamp; Bog	No	Higher	Higher
WL75	1ER-3-D	Treed swamp	No	Higher	Higher
WL88	1ER-3-B	Treed swamp	No	Higher	Higher

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

7.3.3.6 Effects Assessment

A GIS suitability analysis was conducted to design a Project Area that would minimize the possible net loss of wetland area and function. To further meet this goal, the Assessment Area was designed with a 50 m lateral buffer to accommodate future iterations for the Project Area. As such, even though the entirety of the Assessment Area was ground-truthed for the presence of wetland habitat, the detailed design phase will see further refinement of the Project Area to avoid additional wetland habitat identified within the Assessment Area.

In areas where direct contact with wetland habitat cannot be avoided, the layout will be designed to interact with wetland edges or narrow portions of the wetland to minimize the impacts to wetland habitat and function. Furthermore, all necessary wetland crossings will be designed to avoid any permanent diversion, restriction or blockage of natural flow, such that the hydrologic function of the wetland is maintained. Specific details of each crossing will be finalized during the detailed design phase and will be included in the application for alteration.

Project-Wetland Interactions

Project activities, primarily those that involve earth moving or vegetation removal, have the potential to impact wetlands through habitat removal, disruptions to hydrology, and/or displacement of sediment (Table 7.31).

Table 7.31: Potential Project-Wetland Interactions

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

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

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

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

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

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

Hydrological Effects

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

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

Table 7.32: Habitat Alteration for Wetlands within the Assessment Area

Wetland ID	Wetland Type	Delineated Area (m^2)	Area Of Potential Alteration (m^2)*	Activity
WL1	Treed swamp, Bog, Marsh	2566.50	0	Road upgrade – no impact expected
WL2	Shrub swamp	204.55	0	Road upgrade – no impact expected
WL3	Treed swamp	229.29	0	No activity
WL4	Vernal pool	89.47	0	Road upgrade – no impact expected
WL5	Shrub swamp, Vernal pool, Treed swamp	1074.62	884.66	Road upgrade
WL6	Shrub swamp, Treed swamp	5663.28	4173.23	Road upgrade
WL7	Treed swamp	240.37	0	Road upgrade – no impact expected
WL8	Shrub Swamp	6376.22	0	Turbine pad – no impact expected
WL9	Treed swamp, Bog	3779.74	2515.87	Road upgrade
WL10	Shrub swamp	3326.97	2737.55	New road
WL11	Treed Swamp	8346.80	0	New road – no impact expected
WL12	Shrub swamp	1543.04	1391.84	Road upgrade
WL13	Shrub swamp	194.19	0	Road upgrade – no impact expected
WL14	Shrub swamp, Bog	2189.63	2189.63	Road upgrade
WL15	Marsh	502.34	0	Road upgrade – no impact expected
WL16	Bog	712.20	712.20	New road
WL17	Shrub swamp, Treed swamp	908.10	908.10	New road
WL18	Bog	3964.08	2292.33	New road
WL19	Shrub swamp	1217.99	546.80	New road

Wetland ID	Wetland Type	Delineated Area (m^2)	Area Of Potential Alteration (m^2)*	Activity
WL20	Shrub swamp, Treed swamp	11427.13	9151.36	New road
WL21	Shrub Swamp	3317.72	0	New road – no impact expected
WL22	Bog	32846.83	0	Road upgrade – no impact expected
WL23	Shrub swamp	445.80	0	Road upgrade – no impact expected
WL24	Bog, Marsh	2538.34	0	No activity – no impact expected
WL25	Bog	15760.55	2075.51	Road upgrade
WL26	Bog	11343.33	0	Laydown area – no impact expected
WL27	Treed Swamp	11280.38	5270.37	Road upgrade
WL28	Bog	754.29	754.29	Road upgrade
WL29	Bog	163.86	0	Road upgrade – no impact expected
WL30	Shrub swamp, Treed swamp	805.61	570.95	New road
WL31	Treed Swamp	5533.69	2425.19	Road upgrade
WL32	Marsh	485.04	0	Road upgrade – no impact expected
WL33	Treed swamp	197.31	0	Turbine pad – no impact expected
WL34	Shrub swamp, Treed swamp	2471.75	1824.07	New road
WL35	Bog, Treed swamp	1059.84	0	No activity – no impact expected
WL36	Marsh, Bog	4273.79	3697.69	New road
WL37	Treed swamp, Bog	253.46	0	Road upgrade – no impact expected
WL38	Shrub swamp	3449.48	2195.79	Road upgrade
WL39	Treed swamp	4588.54	0	Road upgrade – no impact expected
WL40	Shrub swamp	746.58	746.58	Road upgrade
WL41	Bog	508.28	0	No activity – no impact expected
WL42	Bog	102.02	0	Road upgrade – no impact expected
WL43	Shrub swamp	168.13	0	Road upgrade – no impact expected
WL44	Shrub swamp	162.77	0	Road upgrade – no impact expected
WL45	Treed swamp	781.70	0	Road upgrade – no impact expected
WL46	Shrub swamp	191.73	0	No activity – no impact expected

Wetland ID	Wetland Type	Delineated Area (m^2)	Area Of Potential Alteration (m^2)*	Activity
WL47	Treed Swamp	427.37	0	Road upgrade – no impact expected
WL48	Treed Swamp; Bog	3327.85	0	Road upgrade – no impact expected
WL49	Shrub swamp	277.76	0	Road upgrade – no impact expected
WL50	Shrub swamp	810.29	810.29	Road upgrade
WL51	Treed Swamp; Floodplain	474.69	0	Turbine pad – no impact expected
WL52	Treed swamp; Shrub swamp	857.69	807.35	Road upgrade
WL53	Marsh	39461.63	5152.35	Road upgrade
WL54	Shrub swamp, Treed swamp	1608.08	0	Road upgrade – no impact expected
WL55	Treed swamp	119.10	0	No activity – no impact expected
WL56	Marsh	15775.49	0	No activity – no impact expected
WL57	Treed Swamp; Bog	9042.36	3826.33	Road upgrade
WL58	Shrub Swamp	631.81	0	New road – no impact expected
WL59	Treed Swamp	1806.93	0	Turbine pad – no impact expected
WL60	Shrub Swamp; Treed Swamp	87393.25	15027.85	New road
WL61	Treed Swamp	1939.17	0	Road upgrade – no impact expected
WL62	Shrub swamp	389.65	389.65	Road upgrade
WL63	Treed Swamp	389.70	0	No activity – no impact expected
WL64	Bog	296.98	0	Road upgrade – no impact expected
WL65	Treed Swamp	138611.58	0	Turbine pad – no impact expected
WL66	Treed Swamp	5793.86	2958.77	New road
WL67	Treed Swamp; Shrub Swamp	27612.39	10361.49	New road
WL68	Bog	1425.32	0	Road upgrade – no impact expected
WL69	Shrub swamp	1462.30	1243.78	Road upgrade
WL70	Bog; Shrub Swamp	288.88	288.88	New road
WL71	Treed Swamp	522.54	0	Turbine pad – no impact expected
WL72	Marsh	171.74	0	Road upgrade – no impact expected
WL73	Treed Swamp	14814.24	8411.53	Road upgrade
WL74	Bog	1600.17	1552.75	New road

Wetland ID	Wetland Type	Delineated Area (m^2)	Area Of Potential Alteration (m^2)*	Activity
WL75	Treed swamp	5593.72	4104.97	Road upgrade
WL76	Bog	678.20	0	No activity – no impact expected
WL77	Treed Swamp	2105.05	0	New road – no impact expected
WL78	Shrub swamp	8433.94	5266.43	New road
WL79	Treed Swamp	5309.22	3806.20	New road
WL80	Marsh	946.98	946.98	Road upgrade
WL81	Marsh	505.00	0	Road upgrade – no impact expected
WL82	Treed swamp, Bog	1777.74	0	Road upgrade – no impact expected
WL83	Marsh	143.90	143.90	Road upgrade
WL84	Marsh	91.37	91.37	Road upgrade
WL85	Vernal pool	124.62	0	Road upgrade – no impact expected
WL86	Shrub swamp	1062.88	1062.88	Road upgrade
WL87	Treed swamp	1589.33	1589.33	Road upgrade
WL88	Treed Swamp	2091.57	0	Road upgrade – no impact expected
WL89	Treed Swamp; Marsh	2742.45	1672.01	New road
WL90	Shrub Swamp; Bog	44086.96	2191.49	Road upgrade
WL91	Marsh	876.37	0	Road upgrade – no impact expected
WL92	Marsh	59.62	59.62	Road upgrade
WL93	Treed swamp	1525.73	0	Road upgrade – no impact expected
WL94	Marsh	847.36	0	Road upgrade – no impact expected
WL95	Treed Swamp; Bog	10341.62	0	New road – no impact expected

* If a wetland is deemed to be avoidable, no impact is expected as no alteration will be necessary. Project Area configuration and associated impacts will be finalized and confirmed during the detailed design phase.

The results of the desktop analysis and field assessments indicate a total of 11.89 ha of delineated wetland habitat that may be directly altered by Project developments. Significant effort was made to maximize existing disturbed areas, with only 12 km of new road being constructed, and 53 km of previously existing road being utilized. As such, only 44 of the 95 delineated wetlands may require alteration, and 26 of those 44 wetland alterations would be from upgrades to existing roads (if determined to be required during the detailed design phase).

Provincial wetland data supplied by NSNRR (2021d) was used to estimate the total amount of wetland habitat within the 9,428 ha Study Area. An estimated 1,630 ha of wetland habitat was identified, which equates to approximately 17.3% of the total Study Area. Field delineated wetland habitat that may be directly impacted comprises approximately 0.13% of the total area within the Study Area, approximately 0.73% of the potential wetland habitat within the Study Area, and approximately 2.91% of the total area within the 408 ha Assessment Area. The final Project Area and subsequent area of impact will be determined following the detailed design phase.

Indirect Effects

The temporal and spatial extent of indirect effects can be farther reaching, but are often foreseeable, and research based, standardized BMPs can be implemented to mitigate the resulting outcomes.

Erosion and Sedimentation

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

Dust

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

Invasive Species

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

Compaction

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

Mitigation Measures

The following specific mitigative measures will be implemented to avoid and mitigate any potential effects on wetlands. In addition, a site-specific EPP will be developed to further inform mitigation measures. This EPP will act as a "living document" that incorporates an adaptive management approach to environmental protection and mitigation. Further, the EPP will incorporate proven BMPs that have demonstrated success in mitigating such effects.

Habitat Loss

- Ensure wetlands are clearly marked to avoid interference with wetland habitat to the extent possible.
- Avoid impacts to wetlands to the extent possible.
    - Where unavoidable, complete wetland alterations in accordance with the NS Wetland Conservation Policy and the wetland alteration process during the permitting stage, which includes a requirement to compensate for lost wetland habitat and functions.
    - Design wetland crossings to occur at the narrow part of the wetland or the wetland's edges, to the extent possible.

Hydrology

- Ensure wetland crossings will not result in permanent diversion, restriction or blockage of natural flow, such that hydrologic function of wetlands will be maintained.

Erosion and Sedimentation

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

Dust deposition

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

Invasive Species

- Use of quarried, crushed materials for road construction to reduce the introduction of

invasive vascular plant species.
- Clean and inspect work vehicles prior to use to prevent the introduction of invasive/non-native species.

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

Monitoring
A site-specific post-construction wetland monitoring plan will be developed to facilitate adaptive management and contribute to the safeguarding of ecological integrity and environmental stability. The plan will be provided to NSECC as part of the permitting process and will consist of detailed monitoring and general spot checks. Detailed monitoring will include vegetative, hydrological, and soil assessments within the wetland habitat adjacent to the infill site. Spot checks will involve a general overview of vegetative, hydrological, and soil conditions, focusing on evidence of significant hydrologic alterations and sedimentation (Table 7.33).

Table 7.33: General Wetland Monitoring Parameters and Methods of Assessment

Monitoring Parameter	Tasks	Method of Assessment	
		General Monitoring	Detailed Monitoring
Hydrology	A shallow monitoring well will be installed within the remaining wetland habitat of the partially infilled wetland.	No	Yes
	Standing water depth measurements will be noted within the existing wetland (if applicable).	No	Yes
	Evidence of other positive indicators of hydrology (e.g., drainage patterns, water-stained leaves, saturated surfaces, raised tree roots, development of a hydrogen sulphide odour in soils, water marks etc.) will be noted.	Yes	Yes
	An assessment of the general hydrologic condition and hydrologic connectivity will be made, including evidence of drier/wetter conditions, impeded water drainage, and upland flooding.	Yes	Yes
Vegetation	Vegetation assessments will be completed within plots along a vegetative transect throughout the remaining wetland habitat of the partially infilled wetlands. An assessment of the potential changes in composition, species, health, and presence/absence of invasive plants will be evaluated.	No	Yes

Monitoring Parameter	Tasks	Method of Assessment	
		General Monitoring	Detailed Monitoring
	Photographs will be taken of individual vegetation plots for comparison with future monitoring events.		
	General assessment of the above variables throughout existing wetland habitat will be completed.	Yes	Yes
	Photographs will be taken of the existing wetland habitat from a fixed location for comparison with future monitoring events.	Yes	Yes
Soils	Assessment of surface soils within the remaining wetland habitat will be completed via hand digging of test pits. An assessment of potential shifts in soil characteristics will be evaluated.	Yes	Yes
	Assessment of potential changes in soil conditions throughout the remaining wetland habitat will be evaluated, including evidence of sedimentation and siltation.	Yes	Yes

Conclusion
Effects to wetland habitat and functionality are expected to be of moderate magnitude such that there will be a direct loss of wetland habitat and impact to wetland functions, but wetland area lost will not impact the hydrology of the wetland's watershed, nor are the impacted wetland areas part of a WSS. This loss of wetland habitat and functionality can be minimized through the implementation of effect-specific active management, mitigation measures, and wetland compensation. Timing and seasonality of effects is expected to be applicable, with a potential for the effects to be exasperated by high precipitation events in the spring and fall. Effects will be restricted to the LAA, occurring as a short-term, single event during the construction phase, and are reversible. Therefore, effects to wetlands are considered not significant.

7.4 Terrestrial Environment

7.4.1 Terrestrial Habitat

7.4.1.1 Overview
The terrestrial habitat assessment focused on the identification of sensitive and important habitats through a combination of desktop review and field surveys, with the goal of avoiding these habitats. Note that wetlands are addressed in Section 7.3.3, and habitat assessment related to specific fish, fauna, bats, and bird species are addressed in Sections 7.3.2, and 7.4.3-7.4.5.

The Study Area is a relatively remote swathe of land that is most frequently used for forestry operations and light recreation during all months of the year. These activities have established a relatively expansive road and trail network that allows for access to most areas of the Assessment Area.

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

Results of the desktop and field studies informed the placement of wind turbines and associated roads. This was an iterative process, with the layout being refined as additional field data was available to ultimately avoid sensitive habitat. The results were also used to develop targeted mitigation and best management practices.

7.4.1.2 Regulatory Context

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

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

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

7.4.1.3 Desktop Review

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

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

The Study Area is mainly located in the Nova Scotia Uplands Ecoregion with small sections in the Northumberland/Bras d’Or Ecoregion, and more specifically, within the Mulgrave Plateau Ecodistrict, with western stretches into the St. George’s Bay Ecodistrict (Neily et al., 2017).

The Mulgrave Plateau Ecodistrict is the most easterly physiographic feature in mainland Nova Scotia, with non-coastal areas characterized by relatively level to hummocky, imperfectly drained soils. The eastern portion of this ecodistrict is generally much wetter than the western portion. This ecodistrict contains a variety of forest types, including red spruce (*Picea rubens)* and eastern hemlock (*Tsuga canadensis)* dominated riparian zones, mixed wood forests growing in deep, rich soils, and open woodlands occurring on shallow soils. There are also many large, treeless wetlands across the ecodistrict. Forested areas on imperfectly drained soils are likely within the Spruce Pine Forest Group, and are subject to frequent disturbances from wind, fire, and senescence which limits the potential for the development of old-growth conditions. Tolerant hardwood forests, however, experience gap dynamics and are more likely to become uneven-aged stands with old-growth forest characteristics.

The St. George's Bay Ecodistrict extends inland into the Mulgrave Plateau Ecodistrict at an elevation of approximately 150 masl. These elevated areas are generally composed of rolling hills that have historically been used for agricultural purposes. As such, much of this ecodistrict became vegetated with old field forests which have since been harvested and regenerated into early successional forest stands containing species such as aspen (*Populus spp.)*, white birch (*Betula papyrifera)*, red maple, grey birch (*Betula populifolia)*, and pin cherry (*Prunus pensylvanica*). Forestry activities in hardwood and mixed wood forests of this area have also resulted in a higher abundance of early successional species.
The Provincial Landscape Viewer was reviewed to identify the land cover within the Study Area (Table 7.34; Drawing 7.17). Land cover within the Study Area is varied, including wet areas, built infrastructure, and forested area. The majority of the Study Area is composed of untreated (i.e., not treated silviculturally) natural forest stands according to the Nova Scotia Forest Inventory Forest Groupings (59.6% cover) (Province of NS, 2021). The Nova Scotia Forest Inventory is based on aerial imagery from 2007, and more recent imagery shows that the majority of these previously natural forest stands have since been harvested. Therefore, the percentage of land cover made up of natural, untreated forest stands is much lower.

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

Land Cover Type	Percent Cover (%)
Softwood	40.42
Hardwood	11.68
Mixed Wood	18.48
Blueberries or Barren	3.58
Bog or Wetland	14.84
Harvests	7.87
Utility Corridor	0.074
Water	2.86
Urban, Landfill, Quarry, or Transport Corridor	0.0026

The Old-Growth Policy layer and an Old-Growth Potential Index layer provided by NSNRR through a data sharing agreement were also reviewed (Province of NS, 2022). There are eight forest stands containing 25 ha of protected forest under the Old-Growth Forest Policy (2022) within the Study Area (Drawing 7.18). Of these stands, five are within 100 m of the Assessment Area.

The Old-Growth Potential Index ranks forest stands to determine where with the highest potential for old-growth can be found. Several high-ranking stands were found to intersect with the Assessment Area, and qualified forest technicians subsequently conducted old-growth forest scoring in these stands (results in Section 7.4.1.5).

A review of the NSNRR Significant Species and Habitat Database (2018) within 100 km of the Study Area identified 24 feature records:

- Nine records classified as 'Other Habitat' which relate to caves (four), islands (three), a ledge (one), and a cove (one).
- One record classified as 'Species at Risk' which relates to dunes.
- 14 records classified as 'Species of Concern' which relate to caves (13) and an ecological monitoring and assessment network site.

None of these records are located within the Study Area; the closest record is a ledge 17 km from the Study Area.

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

- Hurlburt Brook Nature Reserve (Pending designation)
- Mulgrave Hills Nature Reserve (Pending designation)
- Tracadie River Wilderness Area (Designated)

All pending and designated areas noted above are outside the Study Area and will therefore have no direct interactions with the Project. The pending Hurlburt Brook Nature Reserve is located directly outside of the Study Area, less than 1 km from the nearest Project-related infrastructure. The Tracadie Wilderness Area is also within 1 km of the nearest Project-related infrastructure; however, this area is across Highway 16 and therefore no indirect impacts are expected.

7.4.1.4 Field Assessment Methodology

Terrestrial habitats were confirmed through field investigations targeting watercourses, wetlands, rare plants and lichen, moose, birds, and bats. Terrestrial habitats of note that were searched for during the field surveys include potential mature/old-growth forest, caves/mines, and concentrations of species (i.e., maternity colonies or other nesting sites). In forest stands where high index scores for old-growth were noted, the Old Forest Assessment protocol (NSNRR, 2022c) was undertaken by qualified forest technicians.

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

7.4.1.5 Field Assessment Results

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

Primary native tree species include sugar maple (*Acer saccharum*), red maple, red spruce, American beech (*Fagus grandifolia*), and black spruce. Softwood forests were observed in greatest abundance, followed by mixed wood forests of varying ages, including regenerating stands and selectively cut patches. Balsam fir and black spruce dominate the poorly drained slopes, while black spruce, tamarack, and yellow birch dominate the treed swamps and riparian zones around watercourses and wetlands. Well drained regions of the Study Area comprised the small regions of hardwood forest, which were noted as both young and mature stands and some have been classified as old growth. Beaver activity is present along several of the watercourses and waterbodies, which has resulted in a shift to more hydrophytic vegetation in previously upland/terrestrial areas.

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

The province defines old-growth forest as “an area where 20% or more of the basal area is in trees greater than or equal to the reference age for that forest (ecosystem classification vegetation) type” (NSNRR, 2022b). The Policy protects these forest stands on Crown land. The field assessment of forest stands identified by desktop resources to have a high potential for old-growth characteristics confirmed some stands to be old-growth, while others were determined to not be old-growth. This data set has been shared with NSNRR to facilitate the protection of these stands, and the Project design was modified to avoid old-growth forests.

7.4.1.6 Effects Assessment

Project-Terrestrial Habitat Interactions
Project activities, primarily those that involve earth moving or vegetation removal, have the potential to impact terrestrial habitat (Table 7.35). These activities could result in habitat removal or alteration.

Table 7.35: Potential Project-Terrestrial Habitat Interactions

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

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

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

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

Effects

Habitat Loss and Fragmentation
The loss or conversion of undisturbed habitat to construct roads, transmission line corridors, and turbine pads is the most recognizable effect associated with the terrestrial habitat. Habitat to consider includes critical habitat for flora SOCI, old-growth forest, priority habitat features, areas of special concern for conservation or protection, and unfragmented, undisturbed areas.

No habitat for flora SOCI was identified within the Assessment Area through the NSNRR Significant Species and Habitat Database (2018) and field surveys; however, old-growth forest stands were found through desktop review and field surveys. These areas have been largely avoided by adjusting the Project Area. In areas where old-growth forest stands are within 100 m of the Assessment Area, the Project Area will remain confined to pre-existing infrastructure or previously harvested areas to avoid any Project-related disturbance to these stands. Therefore, no old-growth forest will be impacted by the Project. No pending or designated conservation areas, wilderness areas, or otherwise protected areas are found within the Study Area.

The majority of land cover within the Study Area is softwood, mixed wood, and hardwood forests, including natural and treated stands, as determined by desktop review and confirmed through field surveys. The extent of treated and cleared areas were found to be greater than aerial imagery suggested. In addition, a large amount of forested habitat exists within 25 m of a pre-existing road or otherwise cleared area. The Project Area will consist of 12 km of new roads and utilize 53 km of pre-existing roads. Therefore, impacts to undisturbed and unfragmented habitat will be low and although there will be small losses to terrestrial habitat associated with the Project, habitat functionality will remain intact relative to pre-construction conditions.

Habitat Creation
The terrestrial habitat within the Assessment Area, and more generally across the Study Area, will undergo changes. Although the majority of the Project Area consists of existing roads, these roads may require widening and additional infrastructure added in the rights-of-way (ditches, transmission line). New gravel roadsides may become preferred nesting habitat for herpetofauna, and the new and widened roads may become basking habitat for snakes or wildlife corridors for terrestrial mammals. New and widened road rights-of-way may become new habitat for nesting birds who prefer rocky or grassy surfaces to nest in. Roadside ditches and cleared rights-of-way will be revegetated through mitigation measures and naturally over time. This process may lead to the creation of different habitat types than were previously present, including wetlands and early successional forests. Although succession will be induced by anthropogenic factors, the natural process will, in time, persist, and this new habitat will be used by a variety of species. Mitigation measures will be designed to ensure the process can proceed as naturally as possible, and that any new habitat created has a low magnitude of effects on the terrestrial environment.

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

Habitat Loss

- Minimize overall area to be cleared, habitat fragmentation, and habitat isolation by utilizing pre-existing roads and previously altered areas (i.e., clearcuts).
    - Desktop and field assessments identified important habitat features, particularly old-growth forest, to be avoided during the design phase.
- Restore cleared areas as much as possible to reduce impacts from habitat loss, primarily through revegetation of road rights-of-way.

Habitat Creation

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

Monitoring

No monitoring programs specific to the terrestrial habitat are recommended.

Conclusion

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

7.4.2 Terrestrial Flora

7.4.2.1 Overview

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

- Classify habitat that supports terrestrial flora SOCI in the Study Area using available desktop resources (see Section 7.3.2.2 for definition of SOCI species).
- Identify important and sensitive habitat features that support terrestrial flora SOCI on/near the Project.
- Target field program efforts at collecting information on the diversity of terrestrial flora within the Assessment Area, and to identify locations of terrestrial flora SOCI within the Assessment Area.
- Ground truth and collect more information on terrestrial flora SOCI present during field programs.
- Use the information collected to inform and refine project design – i.e., avoid known locations of terrestrial flora SOCI or the habitat that supports them through constraints assessment.
- Use the information collected to inform mitigation and management practices.

7.4.2.2 Regulatory Context

The following section describes terrestrial flora resources with the potential to occur in the Study Area, with a focus on vascular plant and lichen SAR/SOCI, that may be potentially impacted by Project activities. Plant and lichen species at risk receive protection under *SARA* and/or NS *ESA* which prohibits their disturbance and destruction. Special management practices are required around occurrences of certain rare lichen, as prescribed in the At-Risk Lichens–Special

Management Practices (NSNRR, 2018). Additional regulations discussed in Section 7.4.1 aim to protect important habitat features, such as old-growth forests or wetlands, that support many plant and lichen SOCI in Nova Scotia.

7.4.2.3 Desktop Review

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

- ACCDC Data Report (2022b)
- Boreal Felt Lichen Habitat Layer (NSNRR, 2012b)

ACCDC records (2022b) identified 349 flora species within 100 km of the Study Area (Appendix G). Of the 349 species, 228 are vascular plants and 121 are non-vascular plants. A summary of plant and lichen SAR/SOCI identified by the ACCDC records as being known to occur within the Study Area is provided in Table 7.36 (Drawing 7.19A-7.19C).

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

Common Name	Scientific Name	COSEWIC[1]	*SARA*[2]	NS *ESA*[3]	S-Rank[4]
Plants (Vascular)					
North american white adder's-mouth	*Malaxis monophyllos var. brachypoda*	---	---	---	S1
Small yellow lady's-slipper	*Cypripedium parviflorum var. makasin*	---	---	---	S2
Black ash	*Fraxinus nigra*				
Lichens and moss (Non-vascular)					
Blue felt lichen	*Pectenia plumbea*	Special Concern	Special Concern	Vulnerable	S3
Frosted glass-whiskers (Atlantic population)	*Sclerophora peronella (Atlantic pop.)*	Special Concern	Special Concern	---	S3S4
Waterside rockshag lichen	*Ephebe lanata*				S3
Tree pelt lichen	*Peltigera collina*				S3
A moss	*Anacamptodon splachnoides*	---	---	---	S2?

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

The two plant species found within the Study Area are over 100 m away from the Assessment Area and will therefore have no direct impacts from the Project. Because black ash is a location sensitive species, the location of this record within the Study Area is unknown. All records of frosted glass-whiskers lichen (*Sclerophora peronella Atlantic pop.*), waterside rockshag lichen (*Ephebe lanata*), tree pelt lichen (*Peltigera collina*), and *Anacamptodon splachnoides* are over 100 m from the Assessment Area and will therefore have no direct impacts from the Project.

Blue felt lichen (*Pectenia plumbea)* was designated as Nova Scotia's provincial lichen in 2022 (CBC News, 2022). Just under half of the North American population of this lichen occurs in Nova Scotia. Blue felt lichen require mature hardwood or mixed wood trees with high humidity, where several successional stages are present. Air pollution and acid rain are major threats to the survival of this species, and many areas of Nova Scotia currently receive acid deposition greater than the critical load for blue felt lichen. The construction of roads and logging associated with wind farm construction are also considered threats to this species, for the potential to remove the lichen itself, to remove the availability of host trees, and to alter hydrology and therefore impose edge effects such as drying and blow down (ECCC, 2022c). There was one record of blue felt lichen within 100 m of the Assessment Area from 2016 (ACCDC, 2022b). This area has since been harvested and the habitat supporting lichen is no longer present. Concerted efforts were made to survey habitat that may support blue felt lichen within the Assessment Area to identify any additional occurrences of this species, as discussed in Section 7.4.2.5.

The Boreal Felt Lichen Layer (provided to Strum by NSNRR) was reviewed to identify potential habitat for boreal felt lichen within the Study Area. The habitat model is based on the known distribution of boreal felt lichen; which is known to grow on the trunks of balsam fir trees in peatland and in close proximity (<30 km) to the Atlantic Ocean (NSNRR, 2012b). Boreal felt lichen – Atlantic population (*Erioderma pedicellatum*) is a rare species listed as "Endangered" under Schedule 1 of *SARA* and NS *ESA* and is also listed as "S1" by ACCDC. The Boreal Felt Lichen Layer identified 617 ha of suitable boreal felt lichen habitat across the Study Area, and 14 ha of suitable habitat overlapping with the Assessment Area (Drawing 7.20).

7.4.2.4 Field Assessment Methodology

Plant and lichen surveys were completed across the Assessment Area on July 20, 2022. Targeted transects were conducted by Mr. Chris Pepper, an expert botanist with extensive experience in Nova Scotia botany. The transects were spaced out through different habitats and positioned evenly throughout the Assessment Area to ensure survey coverage of all representative habitats was obtained. Habitat types surveyed included vernal pools, clear-cuts, river valleys, mature hardwood stands, regenerating softwood stands, and treed swamps. If important habitat types such as wetlands or fringe habitat were identified adjacent to transects, these areas were searched as well (Drawing 7.21).

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

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

7.4.2.5 Field Assessment Results

During the plant and lichen surveys, 301 flora species were identified, which included four plant SOCI, and three lichen SOCI (Drawings 7.12A-7.12Q). A complete list of plant species identified during targeted surveys and incidental observations is provided in Appendix J. Additional species were added to this list from observations made in summer 2021 during migratory and breeding bird surveys, as well as wetland plants observed in summer 2022 during wetland surveys. All SOCI plants and lichen are summarized in Table 7.37. A total of 30 exotic plants were encountered during surveys (Table 7.38).

Table 7.37: Flora SOCI Encountered during Flora Surveys

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]	Habitat
American beech	*Fagus grandifolia*	---	---	---	S3S4	Understory of hardwood and mixed wood stands
Blue felt lichen	*Pectenia plumbea*	Special Concern	Special Concern	Vulnerable	S1	Mixed wood forest with red maple and red spruce dominant
Frosted glass-whiskers lichen	*Sclerophora peronella*	Special Concern	Special Concern	---	S3S4	Mixed wood forest with red maple and yellow birch dominant
Large purple fringed orchid	*Platanthera grandiflora*	---	---	---	S3	Wet meadows in areas of high elevation
Small round-leaved orchid	*Platanthera orbiculata*	---	---	---	S3S4	Softwood forest with black spruce dominant followed by red maple
Tree pelt lichen	*Peltigera collina*	---	---	---	S3	Softwood forest with Black spruce dominant followed by red maple
Yellow lady's-slipper	*Cypripedium parviflorum*	---	---	---	S3	Roadside ditch with pooling water

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

Table 7.38: Exotic Flora Encountered during Flora Surveys

Common Name	Scientific Name	Exotic Status[1]	S-Rank[2]
Autumn hawkbit	*Scorzoneroides autumnalis*	Widespread	SNA
Black knapweed	*Centaurea nigra*	Widespread	SNA
Bull thistle	*Cirsium vulgare*	Widespread	SNA
Coltsfoot	*Tussilago farfara*	Widespread	SNA
Common dandelion	*Taraxacum officinale*	Widespread	SNA
Common eyebright	*Euphrasia nemorosa*	---	SNA
Common hawkweed	*Hieracium lachenalii*	Widespread	SNA
Common plantain	*Plantago major*	Widespread	SNA
Common speedwell	*Veronica officinalis*	Widespread	SNA
Common st john's wort	*Hypericum perforatum*	Widespread	SNA
Creeping buttercup	*Ranunculus repens*	Widespread	SNA
Four-seeded vetch	*Vicia tetrasperma*	Fairly Common	SNA
Garden bird’s-foot trefoil	*Lotus corniculatus*	Widespread	SNA
Helleborine orchid	*Epipactis helleborine*	Fairly Common	SNA
Little yellow rattle	*Rhinanthus minor*	---	SNA
Low hop clover	*Trifolium campestre*	Widespread	SNA
Marsh cudweed	*Gnaphalium uliginosum*	Widespread	SNA
Meadow hawkweed	*Pilosella caespitosa*	Widespread	SNA
Mouse-ear hawkweed	*Pilosella officinarum*	Fairly Common	SNA
Oxeye daisy	*Leucanthemum vulgare*	Widespread	SNA
Purple loosestrife	*Lythrum salicaria*	Widespread	SNA
Queen anne’s lace	*Daucus carota*	Widespread	SNA
Rabbit's-foot clover	*Trifolium arvense*	Widespread	SNA
Red clover	*Trifolium pratense*	Widespread	SNA
Spotted lady's-thumb	*Persicaria maculosa*	Widespread	SNA
Tall hawkweed	*Pilosella piloselloides*	Widespread	SNA
Tufted vetch	*Vicia cracca*	Widespread	SNA
White clover	*Trifolium repens*	Widespread	SNA
White sweet-clover	*Melilotus albus*	Widespread	SNA
Yellow clover	*Trifolium aureum*	Widespread	SNA

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

American beech (*Fagus grandifolia*) was assigned an S-Rank of ‘S3S4’ in March 2022, indicating that it is uncommon in the province and/or widespread, common, and apparently secure in the province (ACCDC, 2022b). Although historically a common tree species in Nova Scotia, the quality and mass production of American beech trees have been devastated by beech scale disease. While still present across the province, the ecological role that this tree has played in tolerant hardwood forest has changed in recent years, shifting from an overstory tree to an intermediate or understory species (NSNRR, 2021e). Because of the commonality of this species, locations of observations were not recorded.

Three orchid SOCI were identified during field surveys. Yellow lady's-slipper can be found growing in dry to mesic forests, fens, and meadows. It may also be found in disturbed areas, as it was found along a roadside within the Assessment Area.

The large purple fringed orchid is a wetland species, found in moist forests or fields, marshes, bogs, and swamps. This species was found in one location within the Study Area, west of a pre-existing road in a marsh.

Small round-leaved orchid was identified outside of the Assessment Area, within a softwood-dominant mixed wood forest. This species can be found in a variety of habitats, including mesic to moist softwood or hardwood forests or well-shaded bogs (NAOCC, 2022).

Three lichen SOCI were observed during field surveys (Table 7.37). Many common species of lichen were also observed throughout the Study Area but individual locations were not recorded due to their abundance.

Blue felt lichen was found in one location during vegetation surveys, in addition to the known location from ACCDC records. Three thalli were found on two maple trees during targeted plant surveys. These lichen were found over 100 m from the Assessment Area, north of a pre-existing road. Two additional known locations provided by the Proponent are over 100 m from the Assessment Area.

Tree pelt lichen was found in one location in the Study Area, over 100 m from the Assessment Area, directly east of an old logging road. This species can be found among mosses on tree bark or occasionally rocks, and prefers habitat with high humidity at a moderate to high elevation (Nash et al., 2004).

Frosted glass-whiskers lichen is a rare, cryptic lichen species designated as 'Special Concern' under COSEWIC in 2014 and *SARA* in 2006, and has an S-Rank of 'S3S4' (ACCDC, 2021a; Government of Canada, 2022). There were 13 known occurrences of this species in Nova Scotia as of 2013, and these observations were in upland deciduous forests and forested wetlands. This species is thought to only be found on trees where previous damage has allowed the heartwood to be exposed yet protected within cracks and crevices, which is where the lichen will colonize. Observations of this species have only been found on such exposed heartwood of red maple trees (COSEWIC, 2013a). Forestry and land clearing, particularly in old-growth forests, poses a serious threat to the survival of this species. One observation of this lichen was made within the Study Area, in a small wooded riparian area between a road and a cutblock. This species of lichen was found within 100 m of the north side of the Assessment Area; therefore, construction will be limited to the south side of the existing road, should road widening be required. An additional known location of Frosted glass-whiskers lichen was provided by the Proponent and is over 100 m from the Assessment Area.

Of the exotic species encountered, one invasive species was found. Purple loosestrife (*Lythrum salicaria)* was introduced to North American in the early 1800's through a variety of pathways. The plant's generalist requirements have allowed it to colonize a wide variety of habitats; in some areas, purple loosestrife has replaced over half of the species that once naturally inhabited the area (MTRI, 2022). Successful control of purple loosestrife has occurred; however, preventative measures to control the spread of this plant are preferred.

Given the sensitivity of some plant and lichen SAR/SOCI, avoiding locations where these species are known to occur, along with establishing a vegetation buffer around these locations, is recommended. The results of flora studies have been incorporated into the design phase of the Project. Protection of flora SAR/SOCI will continue to be employed throughout operation and decommissioning phases through the use of targeted mitigation and best management practices.

7.4.2.6 Effects Assessment

Project-Terrestrial Flora Interactions
Project activities, primarily those that involve earth moving or vegetation removal, have the potential to impact terrestrial flora (Table 7.39). These activities could result in changes to or loss of habitat used by SOCI, loss of plant or lichen SOCI, or introduction of non-native species that may become invasive in the environment.

Table 7.39: Potential Project-Flora Interactions

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

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

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

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

Effects

Loss of SOCI
Targeted plant surveys were conducted by a qualified biologist to identify locations of plant and lichen SOCI across the Study Area. The Project design was modified to avoid areas where plant and lichen SOCI were found, and in areas where the Assessment Area still overlaps with flora SOCI records, the Project Area will be constricted to pre-existing infrastructure or areas on the opposite side of the road from flora SOCI records. Therefore, loss of plant and lichen SOCI is expected to be negligible to low.

Habitat Loss
Rare plants often become rare because they require specialized habitats (BCECC, 2018; CPC, 2020). Although most of the Project Area is on pre-existing roads (approximately 12 km of new roads will be required compared to 53 km or pre-existing road), road widening may be required. The habitat to be removed for these upgrades may be suitable to support rare plants and lichen. A targeted approach was used when conducting field assessments for terrestrial flora to survey habitat that may host rare flora. For example, Boreal felt lichen polygons and habitat that may be suitable to support blue felt lichen were surveyed; three thalli of blue felt lichen were identified through this approach. The Project design has avoided habitat that is known to support plant and lichen SOCI within the Study Area to the extent possible, and the design has also incorporated relevant buffers for known locations of individual species, if applicable. Effects to terrestrial flora from habitat loss is therefore expected to be negligible to low.

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

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

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

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

Loss of SOCI
- Minimize overall area to be cleared by utilizing pre-existing roads and previously altered areas (i.e., clearcuts).
- Minimize loss of flora SOCI from areas with known occurrences during the design phase.
    - Desktop and field assessments identified important habitat features with terrestrial flora SOCI locations to be avoided during the design phase.
    - As required, buffers will be enforced around known locations of terrestrial flora SOCI within close proximity to the Assessment Area.
    - Where flora SOCI or their buffers overlap with the Assessment Area, the Project Area will utilize only the pre-existing road and the area opposite the road from the flora/buffer.
- Educate Project personnel about the potential for plant or lichen SOCI during construction.
    - Guidance will be provided to Project personnel to raise awareness of terrestrial flora SOCI that are known to exist within the Study Area to increase the number of trained eyes looking for these species.
- Consult with NSNRR if an unexpected flora SAR/SOCI is encountered.
    - Transplantation or seed collection will be suggested as a contingency plan during consultation if flora SOCI are unexpectedly encountered and cannot be avoided.
    - A separate plan for transplantation will be developed along with a monitoring protocol to determine the success of this mitigation measure if it is determined to be required.

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

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

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

- Ensure that if purple loosestrife is being removed during clearing, care should be taken to dispose of the plants appropriately
  - o Burning or composting will increase the spread of the plant.
  - o Once removed, plants should be double-bagged and left in the sun to rot before disposing.

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

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

7.4.3 Terrestrial Fauna

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

- Inventory fauna species present within/near the Study Area and Assessment Area.
- Identify locations of fauna SAR/SOCI and use that information to identify additional habitat features and types where additional SAR/SOCI may exist (see Section 7.3.2.2 for definition of SOCI species).
- Use information collected to inform and refine the Project design (i.e., avoidance of fauna SAR/SOCI and associated habitats).
- Use information and data collected to inform mitigation and best management practices.

7.4.3.2 Regulatory Context
Applicable laws and regulations relating to the protection of fauna (i.e., mammals, herpetofauna, butterflies, and Odonates (dragonflies and damselflies) include the following:

- *SARA*
- NS *ESA*
- *Canada Wildlife Act*

- *Wildlife Act,* RSNS. 1989, c. 504
- NS *Biodiversity Act*
- *Canadian Environmental Protection Act (CEPA)*
- *Environment Act,* SNS 1994-95, c. 1

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

7.4.3.3 Desktop Review

The desktop component included a review of the NSNRR Significant Species and Habitat Database (2018) and ACCDC data (2022b) for mammal, herpetofauna, butterfly, and Odonates species recorded within a 100 km radius of the Study Area. A comparison of habitat mapping data to known habitat requirements for species expected to occur within the area, and for all SAR/SOCI, was also completed. Specifically, habitat suitability modelling for Mainland moose (*Alces alces americanus)* was conducted to identify important moose habitat within the Study Area.

Mammals

The NSNRR Significant Species and Habitat Database (2018) contains 278 unique species and/or habitat records pertaining to terrestrial mammals within a 100 km radius of the Study Area. These records include:

- 250 records of “Deer Wintering” related to white-tailed deer (*Odocoileus virginianus*).
- Three records of “Migratory Birds” relating to gray seals (*Halichoerus grypus*).
- Four records of “Other Habitat” relating to a black bear (*Ursus americanus*) (two) and river otter (*Lontra canadensis*) (two).
- Nine records of “Species of Concern” relating to Rock vole (*Microtus chrotorrhinus*) (five), Southern bog lemming (*Synaptomys cooperi*) (two), and Gaspe shrew (*Sorex gaspensis*) (one), and a Fisher (*Pekania pennanti*) (one).
- Twelve records of “Species at Risk” relating to an American marten (*Martes americana*) (seven), Moose (*Aces americanus*) (three), Gaspe shrew (*Sorex gaspensis*) (one), and Rock vole (*Microtus chrotorrhinus*) (one).

None of the aforementioned “Species at Risk” or “Species of Concern” habitat records are located within the Study Area. The nearest record is a deer wintering area 6 km from the Study

Area, and the nearest "species at risk" record is for Moose, 35 km from the Study Area.

The ACCDC database (2022b) indicates that seven terrestrial mammal SOCI (excluding birds and bats) have been recorded within a 100 km radius of the Study Area (Table 7.40). None of the identified SOCI have records within the Study Area.

Table 7.40: Mammal Species Recorded within a 100 km Radius of the Study Area

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
American marten	*Martes americana*	---	---	Endangered	S2S3
Canada lynx	*Lynx canadensis*	Not at Risk	---	Endangered	S2S3
Fisher	*Pekania pennanti*	---	---	---	S3
Rock vole	*Microtus chrotorrhinus*	---	---	---	S2
Long-tailed shrew	*Sorex dispar*	Not at Risk	---	---	S2
Mainland moose*	*Alces alces americanus*	---	---	Endangered	S1
Southern bog lemming	*Synaptomys cooperi*	---	---	---	S3

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

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

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

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

Mainland moose are considered a generalist species, which indicates that they are able to survive in wide variety of habitats outside of their preferred habitat types. The Mainland Moose Recovery Plan (NSNRR, 2021f) defines suitable moose habitat as areas where a maximum distance of 200 m separates a mixed wood forest from a wetland. To account for generalist behaviours, and to showcase the connectivity of the habitat identified by the model, a 500 m buffer was used around any area defined as a wet area or mixed wood stand. Shorter distances between mixed wood forests and wetlands were given a higher score in the weighting scheme to account for the greater suitability of these areas (i.e., a distance of up to 100 m between mixed wood forest and wetland receives the highest score, whereas a distance of over 400 m but no more than 500 m between mixed wood forest and wetland receives the lowest score). An area with a distance of over 500 m between mixed wood forest and wetland was not considered suitable moose habitat in this model. Upon running this model with the abovementioned criteria, the analysis displays the habitat of Mainland moose ranked from suitable to high quality, based on the weighted criteria (Table 7.41), in 5 ha hexagons spanning the RAA.

Table 7.41: Moose Habitat Suitability Model Weighting Scheme

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

This model determined that the majority of the Study Area contains suitable habitat for Mainland moose. Furthermore, the areas surrounding the Project Area feature a gradient of habitat quality, indicating important areas requiring connectivity. Potential impacts to this habitat and connectivity are discussed in Section 7.4.3.6.

Herpetofauna

The Nova Scotia Significant Species and Habitat Database (NSNNR, 2018) contains 68 unique species and/or habitat records pertaining to reptiles and amphibians within a 100 km radius of the Study Area. These records include:

- Sixty-six records of "Species at Risk" relating to Wood turtle (*Glyptemys insculpta*) (65) and Snapping turtle (*Chelydra serpentina*) (one).
- Two records of "Species of Concern" relating to Green frog (*Rana clamitans*) and Mink frog (*Lithobates septentrionalis*).

None of the aforementioned habitat records for herpetofauna are located within the Study Area, and the closest record is of a Wood turtle 8 km from the Study Area.

Data from the ACCDC (2022b) indicate that four herpetofauna SOCI have been recorded within a 100 km radius of the Study Area (Table 7.42).

Table 7.42: Herpetofauna Species Recorded by ACCDC within a 100 km Radius of the Study Area

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

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

One marine turtle was also recorded within 100 km of the Study Area: the Leatherback sea turtle – Atlantic population (*Dermochelys coriacea - Atlantic pop.*) (ACCDC, 2022b). This species will not be assessed as part of this EA, as the Project is contained inland and is not expected to impact the marine environment.

One record of Four-toed salamander occurs within the Study Area according to ACCDC records (2022b; Drawing 7.19A-7.19C). This record is 2 km away from the nearest Project-related infrastructure, which is a pre-existing road.

Butterflies and Odonates

The NSNRR Significant Species and Habitats (2018) database identifies 13 significant habitat features relating to butterflies and Odonates within a 100 km radius of the Study Area. These records include:

- Four records of "Other Habitat" relating to a Subarctic bluet (*Coenagrion interrogatum*) (one), Clamp-tipped emerald (*Somatochlora tenebrosa*) (one), and Williamson's emerald (*Somatochlora williamsoni*) (two).
- Nine of "Species of Concern" relating to a Muskeg emerald (*Somatochlora*

septentrionalis) (four), Northern bluet (*Enallagma annexum*) (one), Black meadowhawk (*Sympetrum danae*) (one), and Sphagnum sprite (*Nehalennia gracilis*) (one), Little bluet (*Enallagma minusculum*) (one), and Semirelict underwing (*Catocala semirelicta*) (one).

None of the aforementioned habitat records for butterflies and Odonates are located within the Study Area, and the nearest record is the Northern bluet, 51 km from the Study Area (NSNRR, 2018).

The ACCDC report (2022b) contains records of 41 unique butterfly and Odonate SOCI within a 100 km radius of the Study Area (Table 7.43), none of which have been recorded within the Study Area.

Table 7.43: Unique Butterfly and Odonate Species Recorded within a 100 km Radius of the Study Area

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
Acadian hairstreak	*Satyrium acadica*	---	---	---	S2
Aphrodite fritillary	*Speyeria aphrodite*	---	---	---	S3S4
Arctic fritillary	*Boloria chariclea*	---	---	---	S1S2
Banded hairstreak	*Satyrium calanus*	---	---	---	S3
Black meadowhawk	*Sympetrum danae*	---	---	---	S3S4
Bog elfin	*Callophrys lanoraieensis*	---	---	---	S3
Broad-tailed shadowdragon	*Neurocordulia michaeli*	---	---	---	S2
Brook snaketail	*Ophiogomphus aspersus*	---	---	---	S3
Compton tortoiseshell	*Nymphalis l-album*	---	---	---	S2S3
Dorcas copper	*Lycaena dorcas*	---	---	---	S3
Eastern red damsel	*Amphiagrion saucium*	---	---	---	S3S4
Eastern tailed blue	*Cupido comyntas*	---	---	---	S3S4
Elfin skimmer	*Nannothemis bella*	---	---	---	S3S4
Forcipate emerald	*Somatochlora forcipata*	---	---	---	S3
Gray hairstreak	*Strymon melinus*	---	---	---	S3
Green comma	*Polygonia faunus*	---	---	---	S3S4
Greenish blue	*Icaricia saepiolus*	---	---	---	SH
Harlequin darner	*Gomphaeschna furcillata*	---	---	---	S3S4
Harpoon clubtail	*Gomphus descriptus*	---	---	---	S3
Hoary comma	*Polygonia gracilis*	---	---	---	SH
Jutta arctic	*Oeneis jutta*	---	---	---	S3S4
Lance-tipped darner	*Aeshna constricta*	---	---	---	S3S4
Maine snaketail	*Ophiogomphus mainensis*	---	---	---	S3
Maritime copper	*Tharsalea dospassosi*	---	---	---	S2
Maritime copper	*Tharsalea dospassosi*	---	---	---	S2
Milbert's tortoiseshell	*Aglais milberti*	---	---	---	S2S3

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
Monarch	*Danaus plexippus*	Endangered	Special Concern	Endangered	S2?B, S3M
Mottled darner	*Aeshna clepsydra*	---	---	---	S3S4
Muskeg emerald	*Somatochlora septentrionalis*	---	---	---	S2
Northern cloudywing	*Cecropterus pylades*	---	---	---	S3S4
Ocellated darner	*Boyeria grafiana*	---	---	---	S3S4
Pepper and salt skipper	*Amblyscirtes hegon*	---	---	---	S3S4
Question mark	*Polygonia interrogationis*	---	---	---	S3B
Rusty snaketail	*Ophiogomphus rupinsulensis*	---	---	---	S3
Satyr comma	*Polygonia satyrus*	---	---	---	S1?
Short-tailed swallowtail	*Papilio brevicauda bretonensis*	---	---	---	S1
Southern pygmy clubtail	*Lanthus vernalis*	---	---	---	S2S3
Spot-winged glider	*Pantala hymenaea*	---	---	---	S2?B
Two-spotted skipper	*Euphyes bimacula*	---	---	---	S1S2
Vernal bluet	*Enallagma vernale*	---	---	---	S3
Williamson's emerald	*Somatochlora williamsoni*	---	---	---	S2S3

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

7.4.3.4 Field Assessment Methodology

Mammals

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

Table 7.44: Mammal Assessment Survey Information

Survey Type	Dates	Transect Number/Location	Transect Length (km)
Winter Tracking	02/10/2022	4	3
		8	2
		5	3
		6	3
		7	2
		3	1.5
	02/11/2022	1	3
		2	4.5
	03/01/2022	6	3
		5	2.2
		3	1.5
	03/09/2022	2	3
		4	2.5
	03/10/2022	3 (cont.)	1.5
		7	2
		1	3
		8	2
Pellet Surveys	04/06/2022	1	4.7
		2	5.5
		5	4.71
		7	2.88
		6	7.23
	04/07/2022	3	5.55
		4	5.78
		8	2.23
	04/25/2022	3	2.75
		8	2
		1	5
		6	6.7
Trail Camera Deployment	06/2021-05/2022	Five Mile Lake Road	N/A
	12/2021-05/2022	Long Lake	N/A
	06/2021-05/2022	Stillwater Brook	N/A

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

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

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

Concurrently, and in addition to wildlife surveys, trail cameras were deployed at various locations across the Study Area from June 2021 to May 2022. Locations were selected to include various habitat types, and to capture more information from locations previously found to have signs of wildlife (Drawing 7.21). Trail cameras were targeted to areas that provide natural corridors for wildlife movement throughout the landscape. Many large mammals commonly use old roads, trails, or natural corridors such as riparian zones to travel throughout a landscape, and thus cameras were used in these areas to capture their movements. Riparian areas are often preferred by these mammals as this habitat represents some of the only remaining intact forest within the Assessment Area.Trail cameras were visited regularly to replace storage cards and batteries, and occasionally the trail camera itself was removed from one location and relocated to increase site coverage. All photos/videos were then assessed for signs of wildlife.

Herpetofauna

Targeted wood turtle surveys were conducted on June 8, 2022, before temperatures became too high. A desktop review of the Study Area was undertaken before conducting field surveys to identify areas of preferred turtle habitat. No records of wood turtles within 5 km of the Study Area were identified, and so survey locations were selected based on presence of appropriate habitat. Habitat types targeted included clear, meandering watercourses with a moderate flow; sandy or sand-gravel areas; and artificial nesting sites which may include gravel pits, road shoulders, and residential sites (Flanagan et al., 2013; McLean, 2018). Also considered was the habitat surrounding watercourses, which may be riparian or forested areas, or open areas such as flood plains, meadows, agricultural fields, river oxbows, and beaver ponds (McLean, 2018).

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

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

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

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

7.4.3.5 Field Assessment Results

Mammals
A total of 11 species were identified during the course of field assessments (including incidental observations) conducted within the Study Area (Table 7.45); of these species, six were captured by trail cameras (Table 7.46; Drawing 7.21) (photo log provided in Appendix K).

Table 7.45: Summary Results of the Mammal Field Assessments

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
American black bear	*Ursus americanus*	Not at Risk	---	---	S5
Bobcat	*Lynx rufus*	---	---	---	S5
Eastern coyote	*Canis latrans*	---	---	---	S5
Fisher	*Pekania pennanti*	---	---	---	S3
Mainland moose	*Alces alces americana*	---	---	Endangered	S1
North American beaver	*Castor canadensis*	---	---	---	S5

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
North American porcupine	*Erethizon dorsatum*	---	---	---	S5
Red squirrel	*Tamiasciurus hudsonicus*	---	---	---	S5
Snowshoe hare	*Lepus americanus*	---	---	---	S5
Striped skunk	*Mephitis mephitis*	---	---	---	S5
Unknown rodent species	*N/A*	N/A	N/A	N/A	N/A
White-tailed deer	*Odocoileus virginianus*	---	---	---	S5

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

Table 7.46: Summary of Trail Camera Results

Trail Camera Location	Dates Employed	Animals Observed	Number of Observations*
5 Mile Lake Road	June 18, 2021 – May 18, 2022	White-tailed deer	16
		American black bear	7
		North American porcupine	26
		Eastern coyote	45
		Bobcat	3
		Striped skunk	4
Long Lake	December 8, 2021 – May 17, 2022	White-tailed deer	2
Stillwater Brook	June 18, 2021 – May 17, 2022	White-tailed deer	8
		American black bear	1
		Eastern coyote	3

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

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

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

Mainland moose are a SOCI listed as "Endangered" under the NS *ESA* with a subnational ranking of S1 (highest priority) (ACCDC, 2022a). In 2021, NSNRR published a recovery plan for Moose in mainland Nova Scotia, thereby assigning the common name 'Mainland moose'. Threats to Mainland moose include habitat loss and fragmentation, particularly resulting from industrial activities; loss of habitat connectivity due to the increased placement; and density of roads (NSNRR, 2021f). Renewable energy projects were described as medium level threat, as the nature of wind projects usually requires the construction or expansion of road networks and loss of forested habitat.

The highly fragmented nature of the Study Area's landscape has resulted in a habitat patchwork that is able to provide for the varied requirements of Mainland moose. Mid-aged forest stands in the Study Area's interior provide escape cover and relief from deep snows and hot summer temperatures, especially along south facing slopes, while regenerating cutovers provide suitable forage as they age. Evidence of Mainland moose was observed in the Study Area during fall bird surveys in October 2021. Tracks were observed along a road in the southern extent of the Assessment Area, in an area of moderate habitat quality as determined by the moose habitat suitability model. As Mainland moose are considered a 'location-sensitive' species, the locations of the tracks are not included in the EA and were provided directly to NSNRR. No other evidence of moose activity was observed.

The Fisher prefers dense, mature to old-growth forests with continuous overhead cover (Allen 1983). Generally considered a forest-interior species (OMNR, 2000), fishers require large tracts of well-connected habitat (Meyer, 2007). Fishers are distributed throughout mainland Nova Scotia, and trapping data suggests the population is concentrated in Cumberland, Colchester, and Pictou counties. A total of 37 Fishers have been harvested from Guysborough County since 2010, representing just 2.36% of the provincial total during that time (NSNRR, 2021h). Snow tracks belonging to a Fisher were observed during winter 2022 in a young hardwood stand that has been previously harvested. Mature and old-growth forest stands nearby may provide suitable canopy closure and coarse woody debris of sufficient diameter for Fishers on site, and these areas will not be directly impacted by the Project.

Herpetofauna
There were no herpetofauna SOCI identified in the Study Area during field studies, although adequate wood turtle habitat was observed in a number of streams throughout the Study Area. Based on desktop results and field surveys, one priority herpetofauna species was identified: the Four-toed salamander.

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

No indication of Four-toed salamander was observed during field studies despite the presence of bogs within the Assessment Area. ACCDC data indicate that the closest observation of this species to the Assessment Area was ~2 km away. The bog closest to the ACCDC record that may be impacted is over 9 km from the Project Area. It is unlikely that Four-toed salamander will be impacted by Project activities (ACCDC, 2022b).

Butterflies and Odonates

There were no records of butterfly and Odonate SOCI occurring within Study Area (ACCDC, 2022b). There was, however, one observation of the monarch butterfly (*Danaus plexippus*) on September 7, 2021. Based on the results of the field and desktop assessments, the following species was identified as priority species and is discussed in further detail below:

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

Monarch

The monarch can be found in open habitats with abundant wildflower growth. Milkweed (*Asclepias sp.*) is a critical element of breeding habitat, whereas asters (*Asteraciae sp.*) and goldenrods (*Solidago sp.*) provide necessary food resources during migration (MTRI, 2008). Nova Scotia falls within the breeding range of this migratory species (COSEWIC, 2010), and individuals can be found throughout the province from May to October (Maritime Butterfly Atlas, 2012). Open habitat at the Project site is prevalent, particularly in cutover areas and along roadsides. The monarch was observed along a road during the migratory period (late summer/early fall) amongst hairy flat-top white aster (*Doellingeria umbellate*), purple-stemmed aster (*Symphyotrichum puniceum*), and Canada goldenrod (*Solidago canadensis*).

7.4.3.6 Effects Assessment

Project-Terrestrial Fauna Interactions

Project activities, primarily those that involve earth moving or vegetation removal, have the potential to impact terrestrial fauna (Table 7.47). These activities could result in habitat removal, alterations to wildlife corridors, and reductions in food availability. Other Project related activities, including during construction and operation, may impact terrestrial fauna behaviours, such as increased traffic and noise.

Table 7.47: Potential Project-Terrestrial Fauna Interactions

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

Assessment Boundaries
For the purposes of this assessment, the LAA for terrestrial fauna includes the Assessment Area. The RAA for terrestrial fauna includes surrounding regions that may fall within the habitat range of each species, bounded by pre-existing infrastructure and roads or other large crossing areas (Drawing 7.22).

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

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

Effects

Mainland Moose

Habitat Loss
The Mainland Moose Recovery Plan (NSNRR, 2021f) identifies three localized groups of Mainland moose within the province, one of which being the Pictou/Antigonish/Guysborough Group. The Recovery Plan has defined Core Habitat of each group through habitat suitability modeling and found that the Pictou/Antigonish/Guysborough group requires an area of ~6,300 km^2 of Core Habitat to meet recovery objectives. This area overlaps with the Study Area, and is slightly smaller than the current amount of modelled Core Habitat in the Recovery Plan. Mainland moose Core Habitat is dependent on a number of biophysical parameters to satisfy different habitat requirements, including but not limited to:

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

Road construction is defined as one of the main activities likely to result in destruction of important moose habitat (NSNRR, 2021f). Renewable energy is included as a potential threat to Mainland moose in the Recovery Plan due to potential habitat loss, conversion, and degradation caused by vegetation clearing for infrastructure associated with wind farms.

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

A Mainland moose habitat analysis was developed to assess the quality of Mainland moose habitat within the RAA. As Mainland moose are considered a 'location-sensitive' species, the specific results of this analysis were provided directly to NSNRR for review. Of the 16,936 ha of habitat determined to be suitable for Mainland moose within the RAA, 409 ha lie within the Assessment Area, representing 2.41% of suitable moose habitat within the RAA. Most of this area is associated with upgrading the 53 km of existing roads that have been incorporated into the Project design. Only 12 km of new road construction will be required. The creation of wider road rights-of-way will increase the space for early successional vegetation, creating new foraging opportunities for moose adjacent to this built infrastructure that may eventually become suitable habitat. The Mainland moose tracks observed during field surveys were found along a road, indicating that existing road construction has not excluded moose from the Project Area or restricted movement across the Study Area.

The majority of turbines have been located in previously disturbed areas, thus further minimizing new habitat loss. Furthermore, following turbine construction, most of the vegetation around the turbine base will be allowed to naturally regenerate.

The Mainland moose habitat analysis also indicates that the majority of suitable habitat within the RAA is considered high quality. The average habitat score within the RAA is 83.12, while the average score within the LAA is 83.62. The Project Area will therefore be located in areas of statistically average quality for moose habitat, as the Project design has maximized the use of pre-existing roads, thereby avoiding areas of particularly high-quality habitat. Therefore, the availability of and connectivity to alternative areas of high-quality habitat will remain high.

Although some area considered to be high quality Mainland moose habitat will require alteration or removal to construct the Project, the design has maximized the use of existing infrastructure and disturbed areas such that the overall area of habitat loss is small and the direct impacts to moose habitat are expected to be low.

Habitat Fragmentation
The Recovery Plan identifies habitat fragmentation as another key threat to Mainland moose (NSNRR, 2021f). Habitat fragmentation is directly related to habitat connectivity which is a major concern for the longevity of Mainland moose in Nova Scotia, where communities are already highly localized to three areas of the province. Road placement and road density are the main drivers of reduced habitat connectivity. Wildlife corridors are often cited as a mitigation strategy

for improving habitat connectivity; however, effective maintenance of these corridors requires an understanding of natural wildlife corridors and Mainland moose movement patterns on the landscape.

The majority of the Project Area will utilize pre-existing roads, though approximately 12 km of new roads will need to be constructed. The length of roads will increase slightly in the LAA, and the Project may have a small effect on habitat fragmentation in the LAA. Additionally, the size of habitat gaps may increase for roads requiring widening. Areas requiring upgrading to facilitate developments (e.g., the widening of a turn to accommodate a radius sufficient for turbine blade transport) are likely to see more impact, whereas areas with roadways large enough to accommodate forestry equipment will remain as true to their current state as Project developments will allow.

There is an abundance of high-quality moose habitat (i.e., habitat with a mean distance of less than 140 m between mixed wood forest and wetland) that will remain unfragmented due to the limited construction of new roads. The Mainland moose habitat analysis also identifies high-quality habitat surrounding all pre-existing roads. During field surveys, Mainland moose were observed only in the south of the Study Area, in an area with multiple pre-existing roads. Based on the abundance of high-quality moose habitat, low density of moose evidence, and high density of pre-existing roads, it can be inferred that the magnitude in which habitat fragmentation will affect Mainland moose within the LAA and RAA is low.

Disruption of Life History
Direct effects to Mainland moose from wind farms may include sensory disturbance and stress from anthropogenic light sources or human presence resulting in behavioural changes. Mitigation strategies to avoid direct impacts resulting in behavioural changes during sensitive windows and in important habitat are described below. Indirect effects may include removal of adequate calving habitat through conversion of the landscape to support new project-related infrastructure and reducing areas with enough seclusion or cover to protect calves from predators. Mainland moose breeding season takes place between September and October, with calving generally occurring in late May to early June, where one to two calves are born. Cows may require specific habitat types for calving, such as secluded islands, peninsulas, and shorelines. Seclusion is an important factor for protecting calves from predators. The cow and calf/calves remain together for one year until the calf/calves become mature enough for independence (NSNRR, 2021f).

There was no evidence of age or sex diversity within the Study Area, nor was there any indication of reproduction being supported by or occurring in the Study Area. An analysis of Mainland moose habitat quality within the RAA has shown that large areas of suitable habitat exist around the Assessment Area and will not be directly impacted (a maximum of 2.41% of suitable habitat within the RAA will be impacted by the Project).

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

The Study Area is already accessible to white-tailed deer, and numerous signs of deer were seen throughout the Study Area during all survey periods. It is unlikely that the new and upgraded roads will increase access for white-tailed deer. Furthermore, there was only one sign of Mainland moose in the Study Area, so there is little concern that the Project will lead to increased disease prevalence in moose. Effects to Mainland moose from disease are expected to be negligible.

Poaching
Poaching has been identified as a potential threat facing Mainland moose in the Recovery Plan (NSNRR, 2021f). Increased human access may increase the risk of poaching for rare, sought-after animals. The Project Area is already highly accessible to the public, including local hunters and recreational users. Due to the pre-existing access and minimal evidence of Mainland moose in the Study Area, poaching is not expected to affect Mainland moose within the LAA or RAA as a result of this Project.

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

Fisher

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

There is very little mature hardwood cover within the Assessment Area, and the observed Fisher was found along a road within a young hardwood stand surrounded by large patches of regenerating forest. In addition, concerted efforts have been made to avoid potential and confirmed old-growth forest within the Study Area, thus conserving high quality Fisher habitat.

Habitat Fragmentation

Fishers have large home ranges, and are capable of moving long distances; however, they may exhibit sensitivity to habitat fragmentation. When suitable habitat is bisected by a large tract (10-20 km) of unsuitable habitat, Fishers may be unable to cross this distance and therefore be excluded from this neighbouring habitat. Unsuitable habitat generally refers to open or clear-cut forests which are avoided by Fishers. The degree of habitat connectivity may also influence genetic dispersal, as large distances between populations may reduce chances of dispersal (Meyer, 2007). Because the Project Area will mainly use pre-existing roads, and infrastructure to be constructed in intact habitats will be smaller than 10 km in length, effects of habitat fragmentation for Fishers resulting from the Project are expected to be low.

General Effects to Terrestrial Mammals

Road Traffic

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

Habitat Loss and Fragmentation

Other non-priority species were observed within the Study Area and make use of various habitat types across this area. The footprint of the Project, particularly the area that will impact intact habitat, is relatively small compared to other developments in the natural resource sector. Only 12 km of new road will be constructed within the Study Area, and upgrades to pre-existing roads will be removing small areas of habitat in an area that has already been disturbed. Habitat alteration may result in the removal of refugia which may increase predation risks and disrupt the ecological balance within a community. Patterns of movement/migration across the landscape may also be disrupted by habitat alteration and fragmentation. Evidence of animals using these roads through wildlife surveys and trail camera photos indicate that the creation of additional roads may in fact be creating usable habitat. These linear features allow for easier access across the Study Area, and terrestrial fauna will continue to use these roads post-construction. Direct habitat loss and fragmentation within the LAA will therefore be small and can be mitigated through various strategies to reduce the effects of habitat loss.

Disruption of Life History
Reproduction and survival strategies of terrestrial mammals may be directly or indirectly impacted by Project construction and operation. Many species have sensitive windows for breeding and birthing, and any small disruption to these activities may reduce reproductive success in the population. Disruptions may result from sound/vibration, excess light, removal of habitat required for breeding, and reduced habitat connectivity separating interbreeding populations. Lovich and Ennen (2013) stress the importance of turbine siting relative to the needs of wildlife to minimize effects. The iterative Project design process has allowed for the consideration of potential concerns associated with wildlife and how these can be minimized, such as by reducing the amount of wetland and mature forest habitat to be altered or removed.

Project-related noise may impact habitat use, patterns of activity, stress levels, immune response, reproductive success, risk of predation, communication with conspecifics and antipredator predator behaviours, and hearing damage (Rabin et al., 2006; Lovich & Ennen, 2013). The extent that noise associated with wind farms may impact terrestrial mammals is not well studied, and results have been inconclusive thus far (Lovich & Ennen, 2013). The Study Area is, however, already subject to noise from forestry activities and recreation vehicles (snowmobiles, ATVs). Despite the pre-existing noise, different mammal species were still observed across the Study Area. Through appropriate mitigation measures, impacts to the life history of terrestrial mammals will be minimized.

Herpetofauna

Road Traffic
Increased road density and traffic may affect herpetofauna within the LAA. Turtles, salamanders, and snakes may cross roads daily in search of food, or seasonally during migration to find nesting habitat or to escape uninhabitable climatic conditions (Wills, 2021). As stated previously, the pre-existing traffic load and the minimal traffic to be associated with the Project both indicate that road traffic is not expected to have a significant effect on terrestrial herpetofauna in the LAA.

Habitat Loss
Terrestrial habitat utilized by herpetofauna includes riparian areas along wetlands and watercourses, forested areas near watercourses, and rocky or gravelly areas such as roadsides. These different habitat types support different biological needs of species, and relate directly to life history strategies. The Project layout aims to reduce impacts to intact habitat and has been specifically designed to minimize interactions with riparian areas and intact forest. Because additional roads will be constructed, new habitat may be created in the form of gravel roadsides. Although this new habitat may serve as a potential benefit to herpetofauna species, it may also increase the risk of traffic collisions. Because no herpetofauna SOCI were identified within the Study Area during desktop review and field surveys, no direct impacts resulting from habitat loss within the LAA are expected.

Habitat Fragmentation
Terrestrial herpetofauna utilize the terrestrial environment to move across the landscape, particularly between wetlands and watercourses. The alteration of these habitats and conversion of intact forest to roads may result in a fragmented landscape, preventing natural patterns of movement across the landscape. Habitat fragmentation has been minimized through the Project design, which prioritized the use of pre-existing roads or otherwise disturbed habitats. No herpetofauna SOCI were observed within the Study Area during field surveys, and only one record of herpetofauna SOCI exists within the Study Area. This record, for Four-toed salamander, is ~2 km away from the nearest Project-related infrastructure. Therefore, minimal direct effects to herpetofauna related to habitat fragmentation are expected within the LAA.

Disruption of Life History
Sensitive windows for herpetofauna may relate to migration or nesting periods, and interference with these animals' activities during these windows may disrupt their natural life history. Interference may be both temporal and spatial; Project related activities occurring during sensitive windows may impact migratory or breeding behaviours, and habitat removal or fragmentation may create a physical barrier to herpetofauna species from reaching important habitat. Limited impacts to fragmentation and life history are expected due to the small Project footprint and minimized interactions with important habitat features such as wetlands and watercourses. Given the pre-existing traffic load and the minimal traffic to be associated with the Project, sound and light impacts are expected to be low.

Butterflies and Odonates

Turbine Collision-Induced Mortality
Swarming and migrating insects, including butterflies and Odonates, are susceptible to mortality from collisions with wind turbines. There are a number of hypotheses as to whether, or why, these insects are attracted to wind turbines (Long et al., 2011; Rydell et al., 2010; Jansson et al., 2020). Questions remain in the literature concerning how this potential attraction affects mortality rates; whether insect fatalities at wind turbines are contributing to population declines; and how these fatalities are impacting ecological functions (Voigt, 2021). No significant effects to butterfly and Odonate SOCI are expected as a result of this Project based on current insect population and ecology research.

Mitigation Measures
To address the abovementioned effects to terrestrial fauna, the following mitigation measures will be implemented:

Habitat Loss

- Minimize overall area to be cleared by utilizing pre-existing roads and previously altered areas (i.e., clearcuts).
- Continue to review habitat modelling results, field survey results, and guidance from NSNRR through the detail design phase.
- Revegetate roadsides and cleared areas to minimize lost habitat as much as possible.

Habitat Fragmentation

- Minimize fragmentation and habitat isolation by utilizing pre-existing roads and previously altered areas during the design phase.
- Augment connectivity by creating semi-artificial pathways such as wildlife corridors, greenbelts, and vegetated buffers around wetlands and watercourses, where possible.
- Revegetate as much cleared area as possible to limit effects of fragmentation.

Road traffic

- Design the Project footprint to minimize road density and utilize pre-existing roads to the greatest extent possible.
- Install traffic signs to alert road users of speed limits and the presence of wildlife in the area.
    - Inform all Project-related staff working on the site of dangers to wildlife and create awareness around wildlife hotspots on the site.
- Minimize Project-related traffic to reduce chances of wildlife collisions and traffic-related stress to wildlife.
- Impose restrictions to site access if deemed necessary due to a substantial increase in wildlife collisions and mortality.

Disease

- Use seed mixes that do not contain clover to avoid attracting deer to the area when revegetating road rights-of-way and other cleared areas requiring revegetation.

Disruption of Life History

- Avoid removal of vegetation/habitat alteration in key habitat areas during sensitive windows for priority species, where possible, including:
    - Mainland moose – late May to early June (birthing season) and September to October (breeding season)
    - Fisher – March to April
    - Four-toed salamander – March to April (nesting) and autumn (mating)
    - Monarch – late summer to early fall (migratory period)
- Minimize loss of important habitat required by priority species for reproduction events, including:
    - Mainland moose – wetlands and isolated islands/peninsulas
    - Fisher – large snags, large woody debris, or live standing trees in intact forests
    - Four-toed salamander – sphagnum bogs
- Minimize overall area to be cleared to maintain refugia and cover for protection from predators.
- Maintain all equipment and machinery on site so that a level of good working condition is kept to reduce noise and vibration emissions. Where practical, install vehicles and machinery with noise muffling equipment to limit disturbance.
- Restrict on-site lighting, especially at night, to limit disturbance.
- Prohibit harassment and feeding of wildlife by Project personnel.

Monitoring
A site-specific post-construction Wildlife Management Plan may be developed in consultation with NSECC, NSNRR, the Mi'kmaq of Nova Scotia, and all other relevant parties. The management plan will inform monitoring activities that will take place to ensure continued protection of known SOCI in the LAA and RAA. Some preliminary monitoring activities may include:

- Install trail cameras in areas identified through field surveys as supporting high biodiversity to identify and understand how Project-related activities such as construction, vehicular traffic, and turbine operation, as well as changes to the landscape in the Study Area are impacting species of concern.
    - Placing trail cameras in areas that have been identified through geospatial modelling as high-quality habitat to Mainland moose or important wildlife corridors through can allow for ground truthing and improvement of these models.
- Conduct snow tracking and pellet surveys to continue monitoring the presence of priority wildlife species.
    - Pellet surveys will be prioritized over winter tracking, as evidence of moose activity in the Study Area has only been found outside of winter to date.
    - Winter tracking and pellet surveys will be important tools to monitor the presence of deer in the Study Area, and provide insight regarding the potential for disease to spread to moose in the Study Area.
- Monitor changes to habitat within the Study Area and greater RAA that may occur as an indirect result of the Project.

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

Conclusion
While effects to mammals, herpetofauna, and insects differ, the effects considered to be of greatest concern include habitat loss, habitat fragmentation, and associated disruption of the life history of populations within these groups. Based on this assessment and through the implementation of proposed mitigation and monitoring activities, effects to terrestrial fauna are expected to be of low magnitude within the RAA. Residual effects are expected to be long-term (i.e., for habitat), continuous, reversible, and not significant.

7.4.4 Bats

7.4.4.1 Overview
A desktop review and field studies were undertaken to gather information on bat species and associated habitat in the Study Area. Objectives were as follows:

- Assess observations, species diversity and habitat utilization of bats within the Study

Area during the active bat periods (spring to fall).
- Assess nearby hibernacula for bat activity.
- Assess for summer roosting activity in the suitable areas of the Study Area (e.g., mature hardwood forests).
- Use the information collected to inform and refine the Project design (i.e., avoid impacts to SOCI and their habitats; see Section 7.3.2.2 for definition of SOCI species).
- Use the information collected to inform mitigation and management practices.

7.4.4.2 Regulatory Context

There are six species of bats in Nova Scotia, of which three are resident species that reside in the province year-round and three migratory species that overwinter in the southern United States. Resident species include the Little brown myotis (*Myotis luci*fugus), Northern myotis (*Myotis septentrionalis*), and Tri-colored bat (*Perimyotis subflavus*). Migratory species include the Eastern red bat (*Lasiurus borealis*), Hoary bat (*Lasiurus cinereus*), and Silver-haired bat (*Lasionycteris noctivagans*).

All three resident species are protected at both the federal and provincial level under *SARA* and the NS *ESA*. The Little brown myotis, Northern myotis, and Tri-colored bat were added to the NS *ESA* list as "endangered" species on July 11, 2013 and were declared as "endangered" under Schedule 1 of *SARA* on November 26, 2014. In Nova Scotia, a 90% population decline of resident bat species has been attributed to a disease called White-nose syndrome, caused by the fungus *Geomyces destructans*, which was first detected in Canada in 2010. White-nose syndrome is lethal and affects bat species that congregate in caves and abandoned mines during winter hibernation (COSEWIC, 2013b).

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

7.4.4.3 Desktop Review

Databases and online resources referenced as part of this desktop review include:

- Terrestrial Habitat Mapping (Section 7.4.1)
- Locations of Known Bat Hibernacula in NS (Moseley, 2007)
- Nova Scotia Geoscience Atlas - Abandoned Mine Openings (NSNRR, 2021a)
- Nova Scotia Significant Species and Habitats Database (NSNRR, 2018)
- ACCDC Data Report (ACCDC, 2022b)

Terrestrial Habitat Mapping

Terrestrial habitat mapping from Section 7.4.1 was used to identify locations of ideal bat foraging and over-day habitat (i.e., day roosts) within the Study Area. Ideal habitats for bat foraging and over-day habitat include lakes, wetlands, watercourses, forest edges, cliffs, rock outcrops, talus slopes, and mature hardwood forests. Identification of ideal habitats from terrestrial mapping was subsequently used to guide field surveys for bats/bat habitat.

There are three habitat features considered to be significant for bats: hibernacula for overwintering, maternity roosts for birthing and raising young, and migratory stopovers for rest periods during spring/fall migration. Hibernacula are overwintering sites that are typically located in abandoned mines or caves and can support hundreds of bats.

Maternity colonies are poorly documented in Nova Scotia, with limited desktop information regarding the location and use of these sites (ECCC, 2015; NSNRR, 2020). As a result, information on potential maternity roosts near the Project was supplemented through field studies.

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

Locations of Known Bat Hibernacula
Moseley (2007) provides an overview of the known and recorded bat hibernacula located within Nova Scotia. This research indicates four known hibernacula within a 100 km radius of the Study Area (Table 7.48).

Table 7.48: Known Bat Hibernacula within 100 km of the Study Area

Hibernaculum	Approximate Distance to Study Area (km)*	Direction
Hirschefield Galena Prospect	51	SW
McLellan's Brook Cave	80	W
New Laing Adit #1	98	W
New Laing Adit #2	98	W

*Distance measured to the nearest point of the Study Area.
Source: Moseley (2007)

No known hibernacula are located within 25 km of the Study Area as per the recommended buffer provided in the Guide to Preparing an EA Registration Document for Wind Power Projects in Nova Scotia (NSECC, 2021).

Hirschefield Galena Prospect, the closest known hibernaculum, is considered a significant hibernaculum which is suspected to support approximately 200 to 300+ over-wintering bats (Moseley, 2007). This approximation was established prior to White-nose syndrome and, therefore, populations are likely significantly less than originally estimated. The species composition of this hibernaculum has not been confirmed, but is suspected to be predominantly Little brown myotis (Moseley, 2007).

McLellan's Brook Cave is a dissolutional stream cave system carved through limestone bedrock. This hibernaculum is considered minor and is suspected to support <10 bats. There have been recorded observations of Northern myotis near the opening the cave; however, there have been no underground records of bats (Moseley, 2007).

New Laing Mine #1 and #2 are minor abandoned mine systems that have documented bat activity near the entrances; however, have no underground records of bats. It is suspected that these abandoned mines support <10 over-wintering bats (Moseley, 2007).

Abandoned Mine Openings
Abandoned mine openings serve as potential roosting or over-wintering habitat for various bat species. There are several recorded abandoned mine openings located within/near the Study Area, concentrated towards the northwest region (NSNRR, 2021a) (Drawing 7.23). These recorded abandoned mine openings are listed as shafts, open cuts, or pits for either gold or iron.

Significant Species and Habitat Records
The Significant Species and Habitats Database contains 69 unique species/habitat records pertaining to bats and associated habitat within 100 km radius of the Study Area (NSNRR, 2018). These records include:

- 39 “Species at Risk” records related to Little brown bat.
- 14 “Species at Risk” records related to Northern bat.
- Three “Species at Risk” records related to Tri-colored bat.
- Six “Species at Risk” records related to Eastern red bat.
- Two “Species at Risk” records related to Big brown bat.
- Three “Species at Risk” records related to Silver-haired bat.
- Two “Species at Risk” records related to Hoary bat.

None of the aforementioned records are located within the Study Area.

ACCDC Records
A search of the ACCDC database indicated two bat species of concern recorded within 100 km of the Study Area (Table 7.49).

Table 7.49: Bat Species Recorded within a 100 km radius of the Study Area

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
bat species	*Vespertilionidae sp.*	Not Listed	Not Listed	Not Listed	S1S2
Little brown myotis	*Myotis lucifugus*	Endangered	Endangered	Endangered	S1

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

According the ACCDC Report (2022b), no “bat hibernaculum or bat species occurrence” are known to exist within the Study Area.

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

- Little brown myotis
- Northern myotis
- Tri-colored bat or Eastern pipistrelle

The Little brown myotis is the most common species in Nova Scotia and is likely ubiquitous throughout the province (Broders et al., 2003). During the day, the Little brown myotis will roost in buildings, trees, under rocks, in wood piles, and in caves, congregating in tight spaces to roost at night (Fenton & Barclay, 1980). As a non-migratory species, Little brown myotis over-winters from September to early or mid-May in abandoned mines or caves (Fenton & Barclay, 1980; Mosely, 2007). ACCDC data indicates that the closest Little brown myotis observation to the Study Area is 11 ± 0.0 km away (ACCDC, 2022b).

Northern myotis, although once considered uncommon throughout Nova Scotia, is likely ubiquitous in the forested regions of the province (Moseley, 2007; Broders et al., 2003). This species is widely distributed in the eastern United States and Canada and is commonly encountered during swarming and hibernation (Caceres & Barclay, 2000). During the day, Northern myotis show a preference for roosting in trees; however, the habitat preferences of females may vary according to their reproductive status (Garroway & Broders, 2008). Females appear to prefer shade tolerant deciduous trees over coniferous trees, whereas males roost alone in coniferous or mixed-stands in mid-decay stages (Broders & Forbes, 2004). Northern myotis are also non-migratory and are typically associated with the Little brown myotis during hibernation, being found in caves or abandoned mines also inhabited by this species (Moseley, 2007). Hibernation of the Northern myotis is thought to begin as early as September and can last until May (Caceres & Barclay, 2000). ACCDC data has no records of Northern myotis within 100 km of the Study Area (ACCDC, 2022b).

The Tri-colored bat (also known as the Eastern pipistrelle) only has approximately 10% of its range in Canada and is considered rare in Nova Scotia (COSEWIC, 2013b). Documented observations of the Tri-colored bat predominantly occur in the southwest region of the province, especially during the summer months (Broders et al., 2003). The Tri-colored bat can be found in a variety of habitats, foraging in covered riparian areas and around open bodies of water. Hibernation for this species begins in September and extends to early or mid-May in abandoned mines or caves with high humidity and above freezing temperatures (COSEWIC, 2013b). ACCDC data has no records of Tri-colored bat within 100 km of the Study Area (ACCDC, 2022b).

7.4.4.4 Field Assessment Methodology

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

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

Incidental Observations

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

- Large diameter (≥25 cm) snags and downed trees.
- Large diameter living trees or trees in early stages of decay with cavities and peeling bark (candidate species include white pine, oak, ash, aspen, and maple).
- Rock outcrops and cliffs.
- Wetlands.
- Old growth forests.
- Clusters of snags (≥25 cm diameter breast height and >10 snags per ha) for potential maternity colony habitat (as per Ontario Ministry of Natural Resources and Forestry, 2022).
- Cave and abandoned mines (for potential hibernacula/overwintering habitat).

Several ideal habitat features for bats (i.e., wetlands and old growth forests) are assessed in other biophysical sections, and therefore, are not considered further here.

Passive Bat Assessment

Passive acoustic monitoring was conducted within the Study Area across various representative habitats such as clear cuts, riparian river valleys, and forest edges (Drawing 7.23). Monitoring stations were chosen based on habitat mapping and accumulated knowledge from field studies to represent various habitats present within the Study Area along with ideal habitat for the bat species present in Nova Scotia. The passive acoustic bat monitoring program was conducted using Song Meter SM4BAT FS Ultrasonic Recorders from Wildlife Acoustics. The detectors were programed to monitor from 30 minutes (mins) before sunset to 30 mins after sunrise to correspond with nightly bat activity. Photos, GPS points, and supplementary information (i.e., habitat descriptions) of each monitor location and detector set up were recorded (see Appendix L for a photo log).

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

- MYOT Myotis (Little brown myotis and Northern myotis)
- PESU Tri-colored bat
- LACI Hoary bat
- LABO Eastern red bat
- LANO Silver-haired bat
- UNKW Unknown

Due to their similarity, calls of Nova Scotia's two resident Myotis species (Little brown myotis and Northern myotis) can be difficult to reliably distinguish from one another, so these calls are typically not identified to species (O'Farrell et al., 1999). Bat generated calls were identified as Unknown (UNKW) if the recording was within the correct frequency range for bats (20-40 kHz for low frequency bats and 40-120 kHz for high frequency bats) but was unable to be speciated based on the quality or length of the recording.

Passive acoustic bat monitoring was conducted for 173 consecutive days within the Study Area between the dates of May 31 and November 19, 2021; encompassing the spring, summer, and fall active bat seasons. Four detectors were deployed in habitats representative of the Study Area and in areas expected to provide suitable foraging habitat for bats (i.e., forest edges, waterbodies, watercourses, and wetlands).

Detector 001 was deployed along the eastern shoreline of Five Mile Lake in the western portion of the Study Area. Detector 002 was deployed along the western shoreline of Long Lake near the center of the Study Area. Detector 003 was set up near an existing meteorological tower along the edge of a regenerating softwood stand. Detector 004 was deployed along a section of Stillwater Brook containing a beaver dam (Drawing 7.23; Table 7.50).

Table 7.50: Monitoring Periods for Each Detector

Detector Location	Habitat	Monitoring Duration (2021)	Consecutive Days	# Of Recordings
Detector 001: Five Mile Lake	Riparian zone, wetland	May 31st – November 19th	173	988
Detector 002: Long Lake	Riparian zone, wetland	May 31st – November 19th	173	1110
Detector 003: Meteorological Tower	Edge of regenerating softwood stand	May 31st – November 19th	173	935
Detector 004: Stillwater Brook	Riparian zone with beaver dam	May 31st – November 19th	173	1560

7.4.4.5 Field Assessment Results

Incidental Observations

Bat habitat features such as snags, downed trees, and living trees in the early stages of decay were found across the Study Area; especially in bogs, treed swamps, and riparian areas where waterlogged sediments resulted in the decay of large diameter trees. These freshwater habitats (i.e., waterbodies, watercourses, wetlands, and riparian areas) encountered during field studies were all considered potential over-day habitat and/or potential feeding grounds for various bat species. Individual data points for each bat habitat feature (e.g., each snag) within these freshwater habitats were not recorded because they are delineated and described in Section 7.3.1 and 7.3.3 (see Drawings 7.12A-7.12Q for wetland/watercourse locations). Locations of old-growth forest are discussed in Section 7.4.1.

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

Passive Bat Assessment
In total, 4,593 files were recorded by the four Wildlife Acoustics detectors, of which 501 were determined to be bat generated ultrasound using Kaleidoscope Software. The remaining files were determined to be caused by extraneous noise from sources such as vegetation, wind, or precipitation. There were 290 Myotis species, 133 Eastern red bats, 44 Hoary bats, 15 Silver-haired bats, and 19 unknown calls identified (Table 7.51).

Table 7.51: Results of the Passive Acoustic Bat Survey (2021)

Detector	MYOT	LABO	LACI	LANO	UKWN	Calls per Detector
001 Five Mile Lake	189	118	13	5	11	**336**
002 Long Lake	42	9	18	4	5	**78**
003 Meteorological Tower	14	2	6	4	1	**27**
004 Stillwater Brook	45	4	7	2	2	**60**
Calls per Species	**290**	**133**	**44**	**15**	**19**	***Survey Total = 501***

The detectors located along waterbody/riparian zones recorded significantly higher call counts compared to the detector located along a forest edge near the meteorological tower. Freshwater habitats are important foraging grounds for bats while forest edges are typically associated with travel corridors between other habitat features. In addition, detectors positioned over/near open water likely experienced reduced background noise associated with vegetation and increased detection range, resulting in a higher number of recorded and identifiable bat calls. The detector positioned along the forest edge near the meteorological tower was also located in an area that experienced increased road traffic and possible disturbance from meteorological and/or radar monitoring equipment.

Across the entire Study Area (including all monitors), 501 bat calls were detected over a 173-day period resulting in an average of 2.90 bat calls/day. Recorded bat calls may belong to the same or a different individual bat. For example, a bat foraging near a detector may be recorded several times throughout the night and/or over multiple nights. Average bat calls per day for each detector are as follows:

- 001 Five Mile Lake 1.94 bat calls/day
- 002 Long Lake 0.45 bat calls/day
- 003 Meteorological Tower 0.15 bat calls/day
- 004 Stillwater Brook 0.35 bat calls/day

Bat calls were also assessed hourly throughout the night (Figure 7.3). Peak hourly bat activity was observed a few hours after sunset (21:00-22:00), at midnight (0:00), and a few hours before sunrise (4:00). These findings are relatively consistent with the most current and available literature on bat species and nightly activity in Nova Scotia (NSNRR, 2020).

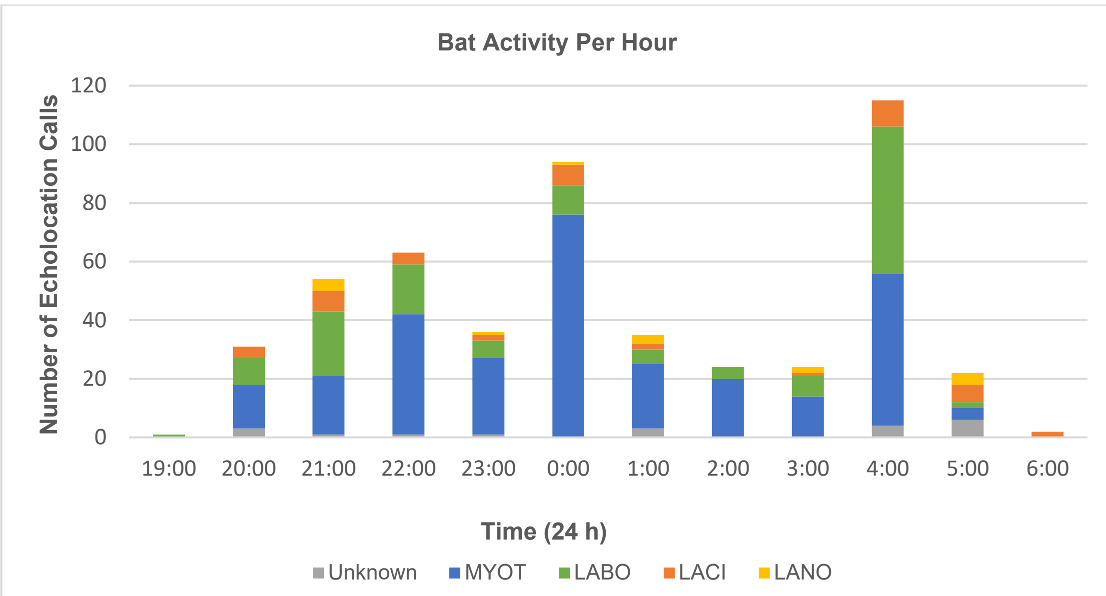

Figure 7.3: Bat Activity Recorded per Hour During the Passive Acoustic Survey (2021)

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

Bat calls were also analyzed monthly across the monitoring period. Overall, calls persisted throughout the monitoring period, but decreased significantly between September and November (Figure 7.4). This is likely a result of migratory bats beginning to migrate south for the winter and resident species congregating near hibernacula for over-wintering. During the 2021 spring and summer months (end of May to August), bat activity was generally consistent for all the recorded bat species.

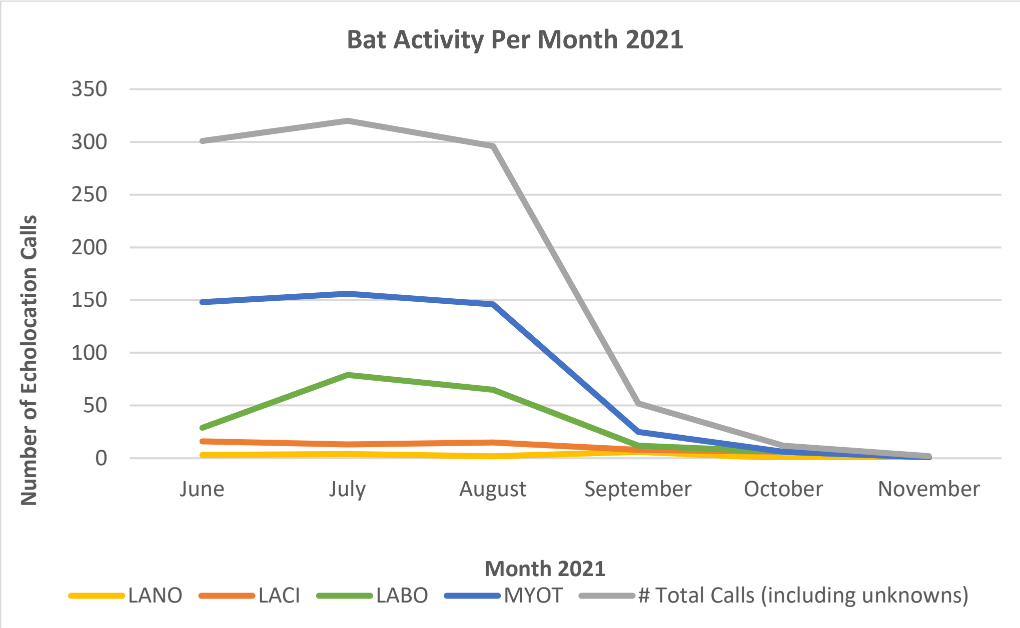

Figure 7.4: Bat Activity Per Month Observed During the Passive Acoustic Survey (2021)

7.4.4.6 Effects Assessment

Project-Bat Interactions

Project activities, primarily those involving vegetation removal and turbine operation, have the potential to impact bat and bat habitat (Table 7.52). These activities could result in habitat removal along with accidental injury/mortality. Other Project activities during construction and operation may impact bat behaviors such as increased noise and lighting.

Table 7.52: Potential Project-Bat Interactions

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

Assessment Boundaries
The LAA for bats includes the Assessment Area, while the RAA includes the Study Area (Drawing 2.2).

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

- Negligible – no loss of bat habitat or impact to bat behaviours expected.
- Low – small loss of habitat supporting bats, but loss of individuals is not expected.
- Moderate – minimal loss of individuals or impacts to bat behaviours, but these impacts will only be experienced by individuals rather than entire populations.
- High – high loss of habitat that supports bats and/or loss of individuals or impacts to bat behaviours on a population scale.

Effects
Potential impacts to bat species from the Project's construction and operation include:

- Habitat fragmentation and/or removal.
- Injury/mortality from barotrauma or collision with turbine blades.
- Sensory disturbance (i.e., lighting, noise, human activity, etc.).

Habitat Fragmentation and Removal
There is extremely limited research and knowledge on how wind farm developments impact habitat suitability and populations of bat species (Segers & Broders, 2014). Vegetation clearing required for wind turbine construction can result in the removal of ideal bat habitat (snags, wetlands, etc.) and/or disrupt corridors between important habitat features (foraging grounds, birthing areas, etc.). In addition, the construction of roads can potentially impede movement, foraging, flight activity, and habitat use (GOC, 2015). One study by Segers & Broders (2014) found that different species of bats respond differently to landscape alteration for wind farm development. Suitable habitat for the Little brown myotis increased after wind turbine installation, which is likely associated with the increase in open areas and forested edges as these areas are preferred foraging habitats for the species. Alternatively, suitable habitat for Northern myotis bats decreased, likely due to this species' preference to forage in forested areas and around canopy covered streams. Pregnant and lactating female bats have also been shown to be sensitive to habitat degradation as their foraging ranges are more constricted due to decreased energy and caring for young (Henry et al., 2002; Segers & Broders, 2014).

During field surveys, it was observed that the Assessment Area is already fragmented and disturbed from previous developments, primarily from active/previous forestry activity. Field assessments identified no areas of mature hardwood forests with the necessary density or clusters of snags (at ≥10 snags per hectare) required to support maternity colonies (OMNR, 2022). It is unlikely that the bat habitat observed during the survey supports maternity colonies; however, snags/downed trees may provide adequate day-roosting habitat for a variety of bat species. Other significant habitat features, including caves and abandoned mines, that could serve as hibernacula or over-wintering sites, were also not observed during the survey.

Impacts to bats from habitat fragmentation and removal are expected to be minimal based on the widespread existing disturbance/fragmentation in the Study Area along with the Project's maximized use of existing roadways. Although there will be a small increase in habitat fragmentation and removal associated with newly constructed roads, this only represents 12 km of the 65 km of total roads. Furthermore, areas where new road construction is proposed do not contain significant bat habitat.

Injury/Morality
Wind project related bat injuries/mortalities are increasingly becoming a concern as some researchers have highlighted that turbines could have a greater impact on bats compared to birds. Bats have a slower life cycle than birds resulting in impacts to population dynamics when mortalities occur, especially where populations are already small (Wellig et al., 2018). Bat injuries and mortalities can result either from a direct collision with a turbine blade or from barotrauma which is caused by the sudden decrease in air pressure following rotating blades (GOC, 2015). Reasons for bats colliding with blades include the inability for bats to detect or avoid rotating blades due to their high speeds, which can be up to 300 km/h at the tip of the blade (Wellig et al., 2018). In addition, research suggests that bats can be attracted to wind turbines because the tall structures dominate landscapes which may attract insects or be perceived as potential mating sites or roost trees (Wellig et al., 2018). A study done by Horn et al. (2008) found that bats actively forage within turbine locations during operation. Through the investigation, researchers observed bats approaching non-rotating and rotating blades, repeatedly investigating turbine elements, following or trapped by blade-tip vortices, and bats colliding with turbine blades (Horn et al., 2008).

Long distance migrating bats including the Eastern red bat, Hoary bat, and Silver-haired bat comprise most of the reported mortalities from wind turbines due to their higher flight elevations and long migration distances (Parisé & Walker, 2017; GOC, 2015). Alternatively, Myotis species of bats have lower fatality rates due to lower flight elevation and short migrating distances (GOC, 2015). In the Recovery Strategy for Little Brown Myotis, Northern Myotis, and Tri-colored Bat (GOC, 2015), collisions and barotrauma from wind turbines were listed as a high level of concern in areas impacted by white-nose syndrome (like Nova Scotia), with localized seasonal impacts in the spring, summer, and fall.

Bat activity and use of habitat within the Study Area was assessed through incidental observations and passive acoustic monitoring. Bat species identified during field studies include Myotis species, Hoary bats, Silver-haired bats, and Eastern red bats. Myotis resident bats were the most frequently recorded species within the Study Area representing 58% of species recorded and are at a lower risk for turbine related injuries and mortalities due to lower flight patterns. Migratory bat species, which are at a higher risk due to higher flight patterns and longer migration routes, comprised 38% of calls identified: Hoary bats (9%), Silver-haired bats (3%), and Eastern red bats (26%). Lastly, 4% of bat calls were not speciated based on the poor quality of the recordings and/or the calls were too short to definitively identify. Individual bat injury/mortality as a result of wind turbine operation is possible, as a result of Project construction (i.e., during vegetation removal) and operation within the Study Area. Impacts to bat SOCI populations at a regional scale or population level are not anticipated based on no desktop identified hibernacula within 50 km and no significant habitat identified within the Study Area during field assessments.

Strum Consulting has completed numerous post-construction bat mortality surveys for wind turbine developments and has identified minimal/negligible levels of bat mortality across the Province of Nova Scotia. These reports/results are client-confidential, but copies were submitted to and are accessible by NSECC in accordance with the EA Approvals of past wind turbine developments.

Sensory Disturbance
Sensory disturbance generated primarily by lighting and noise during both construction and operation phases of the Project may also impact bat behaviors and/or impede movement, foraging, flight activity, and habitat use. Based on the pre-existing traffic loads, forestry, and recreational activity within the Study Area, and the minimal traffic associated with the Project, effects on bat behaviors are not anticipated within the LAA. In addition, turbine lighting will be restricted to minimums required for safety and potential impacts bat behavior and movements are negligible/low.

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

Habitat Fragmentation and Removal
- Minimize overall area to be cleared by utilizing pre-existing roads and previously altered areas (i.e., clearcuts).
- Complete clearing during winter months when bats are overwintering in caves (end of September to late April), where possible.
- Maintain avoidance of important bat habitat (e.g., abandoned mines) to the greatest extent possible.
- Avoid/minimize the removal of large diameter (≥25 cm) snags and hollow trees (bat over-day roosting habitat) within the Project Area during the detail design phase, to the greatest extent possible.
- Minimize fragmentation and habitat isolation during the design phase.
- Revegetate roadsides and cleared areas to minimize lost habitat as much as possible.

Injury/Morality
The primary mitigation measure to prevent injury/mortality of bats is avoidance of important habitat (i.e., hibernacula, migration routes, and migratory stopovers) along with placement of turbines away from freshwater habitats demonstrated to bat activity, which has been incorporated into the Project's design/development.

Sensory Disturbance

- Continue to prioritize the use of existing roads to the extent possible to minimize increases in the road density.
- Restrict lighting to minimums required for safety considerations.
- Utilize noise controls (e.g., mufflers) on machinery, equipment, etc. during construction of the Project.

Monitoring
A detailed Post Construction Bat Monitoring Plan will be developed and submitted to NSECC and NSNRR for review. Monitoring activities may include:

- Passive acoustic monitoring.
- Post-construction bat mortality monitoring (up to two years).
- Adaptive management/contingency plan if post-construction monitoring identifies significant bat mortality, which would include consultation with NSNRR.

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

7.4.5 Avifauna

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

- Assess species composition, species diversity, and habitat utilization within the Study Area during all seasons.
- Use the information collected to inform and refine the Project design (i.e., avoid impacts to SOCI and their habitats).
- Use the information collected to inform mitigation and management practices.

7.4.5.2 Regulatory Context
Applicable laws and regulations relating to the protection of avian species include the following:

- *MBCA*
- NS *ESA*
- *SARA*

The *MBCA* protects all migratory birds while they are present in Canadian Jurisdiction, including on land, in the air, and on the water. The NS *ESA* and *SARA* prohibit harm to listed SAR along with their habitually occupied spaces and core/critical habitat (respectively).

7.4.5.3 Desktop Review

Desktop information was utilized to gain insight into protected avifauna habitats, species utilization of the area, and to identify SOCI (see Section 7.3.2.2 for definition of SOCI species) potentially occurring at or within the Assessment Area using the following sources:

- Terrestrial Habitat Mapping (Section 7.4.1)
- Important Bird Areas (IBAs) (Bird Studies Canada & Nature Canada, 2022)
- Maritimes Breeding Bird Atlas (MBBA) (Bird Studies Canada, 2016)
- Nova Scotia Significant Species and Habitats Database (NSNRR, 2018)
- ACCDC Data Report (ACCDC, 2022b)

The Study Area features predominantly softwood dominated stands, with some hardwood and mixed wood stands present, especially near water bodies. Much of the forested area is managed for silviculture and has been subject to clear-cutting or thinning activities within the past decade. The diversity of habitat types, in particular the prevalence of edge/transitional habitat, provides for the foraging, breeding, and roosting requirements of a variety of resident and migratory bird species.

The closest IBA in Nova Scotia is NS009: Pomquet Beach Region, approximately 26 km northwest of the Project (Drawing 7.24) (IBA Canada, 2016). At low tide, sand flats and salt marshes are exposed, and this ecosystem supports breeding Piping Plovers, a nationally endangered and globally vulnerable species (IBA Canada, 2016). This IBA is far enough from the Project Area that there are no interactions with the Project expected.

The majority of the Assessment Area is contained within the map square 20PR14 of the MBBA, and to a lesser extent, 20PR13, 20PR15, and 20PR24 (MBBA 2012). In the most recent edition of the MBBA (2006-2010), 89 species were identified as being possible, probable, or confirmed breeders for square 20PR14. The following SOCI are considered possible, probable, or confirmed breeders within these map squares:

- American Kestrel (*Falco sparverius*) – “S3B” (ACCDC)
- American Robin (*Turdus migratorius*) – “S5B, S3N” (ACCDC)
- Barn Swallow (*Hirundo rustica*) – “Threatened” (*SARA*), “Special Concern” (COSEWIC), “Endangered” (NS *ESA*), “S3B” (ACCDC)
- Boreal Chickadee (*Poecile hudsonicus*) – “SU” (ACCDC)
- Canada Warbler (*Cardellina canadensis*) – “Threatened” (*SARA*), “Special Concern” (COSEWIC), “Endangered” (NS *ESA*), “S3B” (ACCDC)
- Common Nighthawk (*Chordeiles minor*) – “Threatened” (*SARA*), “Special Concern” (COSEWIC), “Threatened (NS *ESA*), “S3B” (ACCDC)
- Downy Woodpecker (*Picoides pubescens*) – “SU” (ACCDC)
- Fox Sparrow (*Passerella iliaca*) – “S3S4B” (ACCDC)
- Gray Jay (*Perisoreus canadensis*) – “S3” (ACCDC)
- Hairy Woodpecker (*Picoides villosus*) – “SU” (ACCDC)
- Mourning Warbler (*Oporornis philadelphia*) – “SU” (ACCDC)

- Nashville Warbler (*Vermivora ruficapilla*) – “SU” (ACCDC)
- Northern Parula (*Parula americana*) – “SU” (ACCDC)
- Northern Waterthrush (*Seiurus noveboracensis*) – “S2S3” (ACCDC)
- Olive-sided Flycatcher (*Contopus cooperi*) – “Threatened” (*SARA*), “Special Concern” (COSEWIC), “Threatened” (NS *ESA*), “S3B” (ACCDC)
- Pine Grosbeak (*Pinicola enucleator*) – “S3B” (ACCDC)
- Rose-breasted Grosbeak (*Pheucticus ludovicianus*) – “S3B” (ACCDC)
- Rusty Blackbird (*Euphagus carolinus*) – “S2B” (ACCDC)
- Winter Wren (*Troglodytes troglodytes*) – “SU” (ACCDC)

The NSNRR Significant Species and Habitats database (2018) contains 3501 unique records pertaining to birds and/or bird habitat within a 100 km radius of the Project. The most abundant records within each classification are listed below:

- 1907 records classified in the database as “Other Habitat”, most of which relate to Bald Eagle (*Haliaeetus leucocephalus*) (1740).
- 533 records classified as “Species of Concern” which relate to Northern Goshawk (*Accipiter gentilis*) (36), Common Loon (*Gavia immer*) (57), Common Tern (Sterna hirundo) (39), and unclassified Tern (227).
- 344 records classified as “Migratory Bird” which relate to unclassified Cormorant (26), Double-crested Cormorant (*Phalacrocorax auritus*) (51), unclassified waterfowl (15), Great Blue Heron (*Ardea herodias*) (33), and unclassified Tern (five).
- 715 records classified as “Species at Risk” which relate to Canada Warbler (*Wilsonia canadensis*) (52), Piping Plover (*Charadrius melodus*) (49), Common Loon (*Gavia immer*) (27), Rusty Blackbird (*Euphagus carolinus*) (10), Olive-sided Flycatcher (*Contopus cooperi*) (17).
- Two records classified as “Deer Wintering” which also relate to Bald Eagle.

A total of 247 records that relate to avifauna habitat are within 10 km of the Project, including:

- Four records classified in the database as “Other Habitat”, all of which relate to Bald Eagle (*Haliaeetus leucocephalus*).
- 34 records classified as “Species of Concern” which relate to Ruby-crowned Kinglet (*Regulus calendula*) (four), Bald Eagle (*Haliaeetus leucocephalus*) (one), Common Loon (*Gavia immer*) (one), Willet (*Tringa semipalmata*) (two), Yellow-bellied Flycatcher (*Empidonax flaviventris*) (two), Common Tern (Sterna hirundo) (five), Greater Yellowlegs (*Tringa melanoleuca*) (two), Swainson’s Thrush (*Catharus ustulatus*) (two), Tennessee Warbler (*Oreothlypis peregrina*) (one), Boreal Owl (*Aegolius funereus*) (one), Gray Catbird (*Dumetella carolinensis*) (one), Tree Swallow (*Tachycineta bicolor*) (one), and unclassified Tern (11).
- 22 records classified as “Migratory Bird” which relate to unclassified migratory birds (two), unclassified Cormorant (two), Double-crested Cormorant (*Phalacrocorax auritus*) (two), unclassified Tern (two), Great Blue Heron (*Ardea herodias*) (two), Canada Goose (Branta canadensis) (one), and Willet (*Tringa semipalmata*) (11).

- 187 records classified as "Species at Risk" which relate to Canada Warbler (*Wilsonia canadensis*) (23), Ruby-crowned Kinglet (*Regulus calendula*) (36), Common Nighthawk (*Chordeiles minor*) (four), Common Loon (*Gavia immer*) (22), Yellow-bellied Flycatcher (*Empidonax flaviventris*) (19), Swainson's Thrush (*Catharus ustulatus*) (15), Gray Jay (*Perisoreus canadensis*) (14), Olive-sided Flycatcher (*Contopus cooperi*) (12), Tree Swallow (*Tachycineta bicolor*) (eight), Eastern Wood-Pewee (*Contopus virens*) (three), Golden-crowned Kinglet (*Regulus satrapa*) (five), Boreal Chickadee (Poecile hudsonicus) (five), Wilson's Snipe (*Gallinago delicata*) (five), Rusty Blackbird (*Euphagus carolinus*) (four), American Kestrel (*Falco sparverius*) (two), Blackpoll Warbler (*Setophaga striata*) (one), Killdeer (*Charadrius vociferus*) (one), Northern Goshawk (*Accipiter gentilis*) (three), Osprey (*Pandion haliaetus*) (one), Wood Duck (*Aix sponsa*) (one), Pine Siskin (*Carduelis pinus*) (one), Black-backed Woodpecker (Picoides arcticus) (one), and Bald Eagle (*Haliaeetus leucocephalus*) (one).

The ACCDC Data Report (2022b) contains records of 106 bird species within a 100 km radius of the Study Area. Table 7.53 lists these species as well as their respective provincial and national conservation status ranks.

Table 7.53: ACCDC Recorded Avian Species within 100 km of the Study Area

Common Name	Scientific Name	COSEWIC[1]	*SARA*[2]	NS *ESA*[3]	NS S-Rank[4]
American Bittern	*Botaurus lentiginosus*	---	---	---	S3S4B, S4S5M
American Coot	*Fulica americana*	Not At Risk	---	---	S1B
American Golden-Plover	*Pluvialis dominica*	---	---	---	S2S3M
American Kestrel	*Falco sparverius*	---	---	---	S3B, S4S5M
American Three-toed Woodpecker	*Picoides dorsalis*	---	---	---	S1?
Arctic Tern	*Sterna paradisaea*	---	---	---	S3B
Atlantic Puffin	*Fratercula arctica*	---	---	---	S2B
Baltimore Oriole	*Icterus galbula*	---	---	---	S2S3B, SUM
Bank Swallow	*Riparia riparia*	Threatened	Threatened	Endangered	S2B
Barn Swallow	*Hirundo rustica*	Special Concern	Threatened	Endangered	S3B
Barrow's Goldeneye	*Bucephala islandica*	Special Concern	Special Concern	---	S1N, SUM
Bay-breasted Warbler	*Setophaga castanea*	---	---	---	S3S4B, S4S5M
Bicknell's Thrush	*Catharus bicknelli*	Threatened	Threatened	Endangered	S1B
Black Tern	*Chlidonias niger*	Not At Risk	---	---	S1B
Black-backed Woodpecker	*Picoides arcticus*	---	---	---	S3S4
Black-bellied Plover	*Pluvialis squatarola*	---	---	---	S3M
Black-billed Cuckoo	*Coccyzus erythropthalmus*	---	---	---	S3B

Common Name	Scientific Name	COSEWIC[1]	*SARA*[2]	NS *ESA*[3]	NS S-Rank[4]
Black-crowned Night-heron	*Nycticorax nycticorax*	---	---	---	S1B
Black-headed Gull	*Chroicocephalus ridibundus*	---	---	---	S3N
Black-legged Kittiwake	*Rissa tridactyla*	---	---	---	S2S3B
Blackpoll Warbler	*Setophaga striata*	---	---	---	S3B, S5M
Blue-winged Teal	*Spatula discors*	---	---	---	S3B
Bobolink	*Dolichonyx oryzivorus*	Special Concern	Threatened	Vulnerable	S3B
Boreal Chickadee	*Poecile hudsonicus*	---	---	---	S3
Boreal Owl	*Aegolius funereus*	Not At Risk	---	---	S2?B, SUM
Brant	*Branta bernicla*	---	---	---	S3M
Brown Thrasher	*Toxostoma rufum*	---	---	---	S1B
Brown-headed Cowbird	*Molothrus ater*	---	---	---	S2B
Canada Jay	*Perisoreus canadensis*	---	---	---	S3
Canada Warbler	*Cardellina canadensis*	Special Concern	Threatened	Endangered	S3B
Cape May Warbler	*Setophaga tigrina*	---	---	---	S3B, SUM
Chimney Swift	*Chaetura pelagica*	Threatened	Threatened	Endangered	S2S3B, S1M
Cliff Swallow	*Petrochelidon pyrrhonota*	---	---	---	S2S3B
Common Eider	*Somateria mollissima*	---	---	---	S3B, S3M, S3N
Common Goldeneye	*Bucephala clangula*	---	---	---	S2S3B, S5N, S5M
Common Murre	*Uria aalge*	---	---	---	S1?B
Common Nighthawk	*Chordeiles minor*	Special Concern	Threatened	Threatened	S3B
Common Tern	*Sterna hirundo*	Not At Risk	---	---	S3B
Eastern Bluebird	*Sialia sialis*	Not At Risk	---	---	S3B
Eastern Kingbird	*Tyrannus tyrannus*	---	---	---	S3B
Eastern Meadowlark	*Sturnella magna*	Threatened	Threatened		SHB
Eastern Whip-Poor-Will	*Antrostomus vociferus*	Threatened	Threatened	Threatened	S1?B
Eastern Wood-Pewee	*Contopus virens*	Special Concern	Special Concern	Vulnerable	S3S4B
Evening Grosbeak	*Coccothraustes vespertinus*	Special Concern	Special Concern	Vulnerable	S3B, S3N, S3M
Fox Sparrow	*Passerella iliaca*	---	---	---	S3S4B, S5M
Gadwall	*Mareca strepera*	---	---	---	S2B, SUM
Great Cormorant	*Phalacrocorax carbo*	---	---	---	S2S3B, S2S3N
Great Crested Flycatcher	*Myiarchus crinitus*	---	---	---	S1B

Common Name	Scientific Name	COSEWIC[1]	*SARA*[2]	NS *ESA*[3]	NS S-Rank[4]
Greater Yellowlegs	*Tringa melanoleuca*	---	---	---	S3B, S4M
Harlequin Duck - Eastern population	*Histrionicus histrionicus pop. 1*	Special Concern	Special Concern	Endangered	S2S3N, SUM
Horned Grebe	*Podiceps auritus*	Special Concern	Special Concern	---	S3N, SUM
Hudsonian Godwit	*Limosa haemastica*	Threatened	---	---	S2S3M
Indigo Bunting	*Passerina cyanea*	---	---	---	S1?B, SUM
Ipswich Sparrow	*Passerculus sandwichensis princeps*	Special Concern	Special Concern	---	S1B
Killdeer	*Charadrius vociferus*	---	---	---	S3B
Lapland Longspur	*Calcarius lapponicus*	---	---	---	S3?N, SUM
Laughing Gull	*Leucophaeus atricilla*	---	---	---	SHB
Leach's Storm-Petrel	*Hydrobates leucorhous*	Threatened	---	---	S3B
Least Sandpiper	*Calidris minutilla*	---	---	---	S1B, S4M
Lesser Yellowlegs	*Tringa flavipes*	Threatened	---	---	S3M
Long-eared Owl	*Asio otus*		---	---	S2S3
Nelson's Sparrow	*Ammospiza nelsoni*	Not At Risk	---	---	S3S4B
Northern Gannet	*Morus bassanus*	---	---	---	SHB
Northern Goshawk	*Accipiter gentilis*	Not At Risk	---	---	S3S4
Northern Mockingbird	*Mimus polyglottos*	---	---	---	S1B
Northern Pintail	*Anas acuta*	---	---	---	S1B, SUM
Northern Shoveler	*Spatula clypeata*	---	---	---	S2B, SUM
Northern Shrike	*Lanius borealis*	---	---	---	S3S4N
Olive-sided Flycatcher	*Contopus cooperi*	Special Concern	Threatened	Threatened	S3B
Pectoral Sandpiper	*Calidris melanotos*	---	---	---	S3M
Peregrine Falcon - anatum/tundrius	*Falco peregrinus pop. 1*	Not At Risk	Special Concern	Vulnerable	S1B, SUM
Philadelphia Vireo	*Vireo philadelphicus*	---	---	---	S2?B, SUM
Pine Grosbeak	*Pinicola enucleator*	---	---	---	S3B, S5N, S5M
Pine Siskin	*Spinus pinus*	---	---	---	S3
Pine Warbler	*Setophaga pinus*	---	---	---	S2S3B, S4S5M
Piping Plover melodus subspecies	*Charadrius melodus melodus*	Endangered	Endangered	Endangered	S1B
Purple Martin	*Progne subis*	---	---	---	SHB
Purple Sandpiper	*Calidris maritima*	---	---	---	S3S4N
Razorbill	*Alca torda*	---	---	---	S2B
Red Crossbill	*Loxia curvirostra*	---	---	---	S3S4

Common Name	Scientific Name	COSEWIC[1]	*SARA*[2]	NS *ESA*[3]	NS S-Rank[4]
Red-breasted Merganser	*Mergus serrator*	---	---	---	S3S4B ,S5M, S5N
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	---	---	---	S3B
Roseate Tern	*Sterna dougallii*	Endangered	Endangered	Endangered	S1B
Rough-legged Hawk	*Buteo lagopus*	Not At Risk	---	---	S3N
Ruddy Duck	*Oxyura jamaicensis*	---	---	---	S1B
Ruddy Turnstone	*Arenaria interpres*	---	---	---	S3M
Rusty Blackbird	*Euphagus carolinus*	Special Concern	Special Concern	Endangered	S2B
Sanderling	*Calidris alba*	---	---	---	S2N, S3M
Scarlet Tanager	*Piranga olivacea*	---	---	---	S2B, SUM
Semipalmated Plover	*Charadrius semipalmatus*	---	---	---	S1B, S4M
Semipalmated Sandpiper	*Calidris pusilla*	---	---	---	S3M
Short-billed Dowitcher	*Limnodromus griseus*	---	---	---	S3M
Short-eared Owl	*Asio flammeus*	Threatened	Special Concern	---	S1B
Spotted Sandpiper	*Actitis macularius*	---	---	---	S3S4B, S5M
Tennessee Warbler	*Leiothlypis peregrina*	---	---	---	S3S4B, S5M
Turkey Vulture	*Cathartes aura*	---	---	---	S2S3B, S4S5M
Vesper Sparrow	*Pooecetes gramineus*	---	---	---	S1S2B, SUM
Virginia Rail	*Rallus limicola*	---	---	---	S2S3B
Warbling Vireo	*Vireo gilvus*	---	---	---	S1B, SUM
Whimbrel	*Numenius phaeopus hudsonicus*	---	---	---	S2S3M
Willet	*Tringa semipalmata*	---	---	---	S3B
Willow Flycatcher	*Empidonax traillii*	---	---	---	S2B
Wilson's Snipe	*Gallinago delicata*	---	---	---	S3B, S5M
Wilson's Warbler	*Cardellina pusilla*	---	---	---	S3B, S5M
Wood Thrush	*Hylocichla mustelina*	Threatened	Threatened	---	SUB

Source: ACCDC (2022b): [1]Government of Canada 2022; [2]Government of Canada 2022; [3]NS *ESA* 2022; [4]ACCDC 2022a
Note: The ACCDC Conservation Ranks (S-Ranks) were updated in March of 2022.

Of the 106 recorded species within 100 km, nine SAR with provincial or national designations under their respective legislation were recorded within the Study Area during field surveys:

- Barn Swallow (*Hirundo rustica*)
- Bay-breasted Warbler (*Setophaga castanea*)
- Canada Warbler (*Cardellina canadensis*)

- Chimney Swift (*Chaetura pelagica*)
- Common Nighthawk (*Chordeiles minor*)
- Evening Grosbeak (*Coccothraustes vespertinus*)
- Olive-sided Flycatcher (*Contopus cooperi*)
- Peregrine Falcon (natum-tundrius) (*Falco peregrinus pop. 1*)
- Rusty Blackbird (*Euphagus carolinus*)

7.4.5.4 Field Survey Methodology

Several survey methods were employed to assess the avian species using the Study Area throughout the year.

Point Counts

Point count surveys were used as the primary means of identifying all species that are present in the Study Area through all seasons. Surveys were completed in 10-minute intervals at specific predetermined locations to inventory species within view or that are audible from the given survey location. The estimated distance to target, direction, and number of species is recorded, while the observer remains still and silent for the duration of the survey interval. Surveys were conducted from 30 mins before, through four hours after dawn in any given season to observe the most active time of day for passerine species. Survey opportunities were maximized for clear weather and minimal wind within the appropriate timeframe.

Diurnal/Hawk Watches

Watch surveys were conducted to inventory the movement of species throughout the Study Area during the day, as well as how different species or flocks behave around specific habitat features throughout the Study Area or nearby, such as the Strait of Canso. These surveys were conducted during the day for a period of 120 mins. Each target observed was identified as specifically as possible, including bearing from the observer, distance to the target, the direction that the target was moving, its passing height, and any other behaviour notes.

Area/Species Searches

Area searches were conducted to establish the presence or absence of species throughout specific habitats. These surveys can be conducted for specific durations, or in search of specific species. When searching for a target species, playback was used to encourage singing and to establish breeding evidence. Area searches were employed to better establish breeding evidence for SAR observed during the breeding season.

Each of the above survey methodologies was employed at different times of year to inventory avian species throughout the Study Area. Seasonal survey programs are detailed below.

Breeding Bird Surveys (2021)

Breeding bird surveys (BBS) were conducted to inventory avian species that were using the Study Area during the breeding season. In Nova Scotia, the core breeding season for migratory species runs from mid-June to late July. BBS were conducted using point counts throughout the

Study Area. The point counts were completed twice throughout the breeding survey, and any evidence of breeding as outlined by the MBBA was recorded. Area searches were employed to establish breeding evidence for SAR observed during point counts.

Fall Migration Season Bird Surveys (2021)

Fall migration surveys were conducted in tandem with spring migration surveys to determine the migratory species that are moving through the Study Area. In Nova Scotia, the fall migration period runs from late August through late October for most species. These surveys included point counts and diurnal hawk watches. Diurnal watches were targeted both within the Study Area and along the Strait of Canso to establish movement of migratory flocks in the region.

Winter Bird Surveys (2021-2022)

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

Spring Migration Season Bird Surveys (2021)

Spring migration surveys were conducted to inventory all species migrating through or over the Study Area. The spring migratory period included point count surveys and diurnal hawk watches. Diurnal watches were targeted both within the Study Area and along the Strait of Canso to establish movement of migratory flocks in the region.

7.4.5.5 Habitat Modelling Methodology

Habitat modelling was conducted for SOCI observed during the 2021 BBSs and with ranks of “Endangered”, "Threatened”, “Special Concern” or “Vulnerable” under *SARA*, COSEWIC, and/or NS *ESA*. Modelling was conducted to establish the likely or possible habitat throughout the Study Area used by those species. Specific habitat preferences were established for each species, and relevant GIS data was used to model these attributes to identify areas in the Study Area that meet the criterion for breeding and nesting habitat for these sensitive species.

Canada Warbler (Wilsonia canadensis)

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

Common Nighthawk (Chordeiles minor)

Forestry inventory data was filtered to identify land cover areas with bare ground, including clear cuts, ditched areas, push up features (confirmed by DEM), roadsides, laydown areas, and other corridors where vegetation has been removed or is kept cut. Nesting habitats throughout these existing modelled habitats were identified. Land cover was queried based on blueberries or barren, harvests, and utility corridors. Transportation data from the Province of Nova Scotia was queried based on FEAT_DESC of TRACK, TRACK - Indefinite/Approximate, TRAIL, Unpaved, UNPAVED. This layer was then buffered 10 m to account for the areas defined above.

Evening Grosbeak (Coccothraustes vespertinus)
Using the forest inventory, the data was filtered based on the classified softwood forests and harvests in the land cover dataset. This accounted for mature coniferous and second growth coniferous forests, mixed wood forests. In addition, the Evening Grosbeak has been observed in forests with aspen stands. Therefore, the forest inventory was used where the leading species (SP1) matched the attribute of TA (large tooth aspen and trembling aspen).

Olive-sided Flycatcher (Contopus cooperi)
Using the forest inventory, the data was filtered based on the preferred coniferous forest assemblage like that of the coniferous forests seen in southwest Nova Scotia. Forest data was queried to include the leading species (SP1) attribute of BS (black spruce), RS (red spruce), WS (white spruce), SP (scots pine), RP (red pine), JP (jack pine), EH (eastern hemlock) if present. To account for all softwood forests the land cover dataset was filtered based on the softwood classification (may result in an overestimation of habitat).

7.4.5.6 Remote Sensing

Avian Radar Assessment
Avian radar assessments were undertaken during two monitoring campaigns timed to coincide with the spring (April 15 to June 15, 2022) and fall (August 15 to October 15, 2022) migratory bird seasons. Avian radar systems (ARS) were deployed from April 12 to June 10, 2022 for the spring 2022 monitoring campaign, and from July 27 to October 31, 2022 for the fall monitoring campaign. The ARS can be configured with different radar orientations. During the spring 2022 monitoring campaign, the ARS consisted of one Simrad Halo 6 pulse compression marine surveillance radar oriented at 0° to scan horizontally. During the fall 2022 monitoring campaign, one Simrad Halo 20+ pulse compression marine surveillance radar was used and was angled diagonally at 45° above the horizon.

The horizontal mode radar scans a 360° area around the system. While the diagonal mode also scans in a 360° circle, the 180° of the radar’s sweep behind the radar is blanked.

An off grid 12V system was designed for optimal active monitoring and specificity in deployment. It was designed to charge and store energy using solar panels and a battery bank, while also powering the radar and associated equipment for data collection and remote communications. The system in its entirety was designed to be mobile, so the movement of the radar throughout the Study Area was possible, if desired.

A central location within the Study Area was chosen, which also provided a good line of site (relatively few trees in the immediate area) into the airspace above the Study Area, a southern exposure for solar charging, sufficient cellular and satellite coverage for remote communications, and accessibility for spot checks. The horizontal radar was mounted off the ground (approximately 5 m) to eliminate ground noise interference and lessen the impacts of local microtopography on data collection and clarity. The diagonal radar was mounted closer to the ground but was angled to view the airspace above-ground with no direct obstructions.

Avian radar assessment results were processed using the radR platform (R-Forge, 2023) – an open-source platform designed for the processing of radar data for biological applications – and outputs were analyzed using Microsoft Excel. Standard settings for the identification of biological targets (BT), such as birds, and bats were used. Targets reflected by the radar generate blips in the image of the radar scan. radR helps filter sequential images of radar scans to identify blips that occur in the same area over at-least four out of five scans. Should these constraints be met, a target is generated. BTs are most likely generated by birds, but could also be bats and insects, or even drones and planes. Another important factor in the detection of targets is the interference associated with weather systems and precipitation. Fog, rain, low cloud cover, and snow are detectable by the radar (similarly to weather radar), which lowers the effectiveness of the system, and may cause false positive- BT identifications. As such, any data collected when the nearest weather station (in this case, ECCC's Port Hawkesbury Weather Station) indicates a minimum hourly rainfall of 0.5 mm are excluded from this analysis.

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

Avian Acoustic Assessment
Wildlife Acoustics SM4 Acoustic monitors were deployed within the Study Area in tandem with the radar system during the late fall of 2021 (October 25 to November 19, 2021) and spring of 2022 (April 14 to June 29, 2022). These monitors were programmed to record during the night during the monitoring periods with the intention of recording the acoustic activity of migratory songbirds for analysis.

The acoustic data was initially processed using Wildlife Acoustics' Kaleidoscope's cluster analysis capabilities. The dataset was restricted to only assess data between 8 pm and 5 am with the goal of finding night flight calls (NFCs). The cluster analysis was done using bait files in conjunction with the raw acoustic data. The bait files included sample audio from 91 SOCI bird species (Table 7.54) for Kaleidoscope to create clusters around avian acoustics.

Table 7.54: Species Used as Bait Files for NFC Recognition Using Kaleidoscope

Common Name	Scientific Name
American Coot	*Fulica americana*
American Kestrel	*Falco sparverius*
American Robin	*Turdus migratorius*
American Three-toed Woodpecker	*Picoides dorsalis*
Arctic Tern	*Sterna paradisaea*
Atlantic Puffin	*Fratercula arctica*
Bank Swallow	*Riparia riparia*
Barn Swallow	*Hirundo rustica*
Bay-breasted Warbler	*Setophaga castanea*
Bicknell’s Thrush	*Catharus bicknelli*
Black-backed Woodpecker	*Picoides arcticus*
Black-billed Cuckoo	*Coccyzus erythropthalmus*
Black-crowned Night-heron	*Nycticorax nycticorax*
Black-headed Gull	*Chroicocephalus ridibundus*
Blacklegged Kittiwake	*Rissa tridactyla*
Blackpoll Warbler	*Setophaga striata*
Black Tern	*Chlidonias niger*
Blue-winged Teal	*Spatula discors*
Bobolink	*Dolichonyx oryzivorus*
Boreal Chickadee	*Poecile hudsonicus*
Boreal Owl	*Aegolius funereus*
Brown-headed Cowbird	*Molothrus ater*
Brown Thrasher	*Toxostoma rufum*
Canada Jay	*Perisoreus canadensis*
Canada Warbler	*Wilsonia canadensis*
Cape May Warbler	*Setophaga tigrina*
Chimney Swift	*Chaetura pelagica*
Cliff Swallow	*Petrochelidon pyrrhonota*
Common Eider	*Somateria mollissima*
Common Gallinule	*Gallinula galeata*
Common Goldeneye	*Bucephala clangula*
Common Murre	*Uria aalge*
Common Nighthawk	*Chordeiles minor*
Common Tern	*Sterna hirundo*
Cooper's Hawk	*Accipiter cooperii*
Eastern Bluebird	*Sialia sialis*
Eastern Kingbird	*Tyrannus tyrannus*
Eastern Whip-Poor-Will	*Antrostomus vociferus*
Eastern Wood-Pewee	*Contopus virens*
Evening Grosbeak	*Coccothraustes vespertinus*

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

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

The signal parameters used for this analysis included:

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

The cluster analysis parameters for this analysis included:

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

Once the clusters were generated by Kaleidoscope, the output was vetted for the presence of avian acoustics. Every cluster was manually scanned to a minimum of 5% of its contents to determine whether it contained avian calls or singing, or noise including any non-avian sounds. If the cluster was found to be 90% noise, the entire cluster was considered noise. If the cluster scan achieved less than 90% noise, the entire cluster was investigated for avian acoustics. Some clusters were investigated more thoroughly for avian acoustics than the 5% minimum threshold. Any avian acoustics recorded during these scans were included in the analysis regardless of whether the cluster itself was considered noise.

7.4.5.7 Field Survey Results

2021 Breeding Bird Surveys

Two BBS were conducted within the Study Area in 2021 (June 5, 6, 7; June 29, 30; and July 1). In total, 101 10-minute point counts were conducted covering a wide range of habitat types and a wide spatial distribution (Drawing 7.25). A total of 1,681 individual birds, representing 64 species, were observed during these point counts (Table 7.55; Appendices M1/2). The most abundant and frequently observed species were the Black-throated Green Warbler (*Dendroica virens*), Magnolia Warbler (*Dendroica magnolia*), Ovenbird (*Seiurus aurocapilla*), and White-throated Sparrow (*Zonotrichia albicollis*). Migrant passerines accounted for 78.1% of the species and 94.6% of the individual birds observed.

Table 7.55: Total Observations by Bird Group – 2021 Breeding Bird Point Count Surveys

Bird Group	Group #	# Individuals	# Species
Waterfowl	1	9*	3
Shorebirds	2	7	3
Other Waterbirds	3	6	1
Diurnal Raptors	4	2	1
Nocturnal Raptors	5	0	0
Passerines	6	1590	50
Other Landbirds	7	67	7
Total		**1681**	**64**

*Two unidentified duck specimens were observed

SOCI observed during the 2021 BBS include American Robin (*Turdus migratorius*), Boreal Chickadee (*Poecile hudsonica*), Canada Warbler (*Wilsonia canadensis*), Common Nighthawk (*Chordeiles minor*), Double-crested Cormorant (*Phalacrocorax auritus*), Evening Grosbeak (*Coccothraustes vespertinus*), Gray Jay (*Perisoreus canadensis*), Hairy Woodpecker (*Picoides villosus*), Mourning Warbler (*Oporornis philadelphia*), Nashville Warbler (*Vermivora ruficapilla*), Northern Parula (*Parula americana*), Olive-sided Flycatcher (*Contopus cooperi*), Pine Grosbeak (*Pinicola enucleator*), Red Crossbill (*Loxia curvirostra*), Spruce Grouse (*Falcipennis canadensis*) and Winter Wren (*Euphagus carolinus*).

Complementary to the 2021 BBS point counts, area/species searches were conducted for Canada Warblers (*Wilsonia canadensis)* and Rusty Blackbirds (*Euphagus carolinus*), which were observed during the first round of BBS, and/or during spring migration bird surveys. Probable or confirmed breeding evidence was established for Canada Warbler, while no observations of breeding evidence for Rusty Blackbirds were made during these targeted surveys.

2021 Fall Migration Surveys
Fall migration surveys were conducted on September 2, 4, 6, and 26 and October 1, 2, 16, 21, and 29, 2021. The surveys included 89 10-minute point counts and 14 120-minute hawk watches.

A total of 58 species, comprising 1,029 individual birds, were observed during the fall migration point count surveys (Table 7.56; Appendices M3/4). American Robin (*Turdus migratorius*), Dark-eyed Junco (*Junco hyemalis*), Golden-crowned Kinglet (*Regulus satrapa*), and Purple Finch (*Carpodacus purpureus*) were the most abundant and frequently observed species.

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

Bird Group	Group #	# Individuals	# Species
Waterfowl	1	14	2
Shorebirds	2	4	4
Other Waterbirds	3	7	2
Diurnal Raptors	4	14	4
Nocturnal Raptors	5	0	0
Passerines	6	*950	41
Other Landbirds	7	41	6
Total		**10230**	**59**

*39 unidentified passerine specimens were observed

SOCI observed during the fall migratory point count surveys include American Robin (*Turdus migratorius*), Boreal Chickadee (*Poecile hudsonica*), Chimney Swift (*Chaetura pelagica*), Double-crested Cormorant (*Phalacrocorax auritus*), Downy Woodpecker (*Picoides Pubescens*), Fox Sparrow (*Passerella iliaca*), Gray Jay (*Perisoreus canadensis*), Greater Yellowlegs (Tringa melanoleuca), Hairy Woodpecker (*Picoides villosus*), Northern Parula (*Parula americana*), Solitary Sandpiper (*Tringa solitaria*), Spruce Grouse (*Falcipennis canadensis*), Winter Wren (*Troglodytes troglodytes*), and Whimbrel (*Numenius phaeopus*).

A total of 42 species, comprising 2847 individual birds, were observed during fall migration diurnal watch surveys (Table 7.57; Appendices M5/6) conducted on September 6, and October 1, 2, 16, and 29, 2021. These surveys were conducted at several different locations both within the Study Area, and along the Strait of Canso (Drawing 7.25). Herring Gull (*Larus argentatus*), Common Eider (*Somateria mollissima*), and Northern Gannet (*Morus bassanus*) were the most abundantly observed species. Several large migratory flocks were observed along the Strait of Canso during diurnal watch surveys, all of which were shorebirds. Several flocks were observed feeding/fishing, while others were seen passing through the area, especially near the Canso Causeway.

Table 7.57: Total Observations by Bird Group – 2021 Fall Migration Diurnal Watch Surveys

Bird Group	Group #	# Individuals	# Species
Waterfowl	1	481	7
Shorebirds	2	1455**	9
Other Waterbirds	3	680	4
Diurnal Raptors	4	101***	10
Nocturnal Raptors	5	0	0
Passerines	6	147*	16
Other Landbirds	7	12	3
Total		**2876**	**47**

*19 unidentified passerine specimens were observed
**126 unidentified gull and large waterbird specimens were observed
***5 unidentified raptor specimens of various sizes were observed

SOCI observed during 2021 fall migration diurnal watch surveys included American Kestrel (*Falco sparverius*), American Robin (*Turdus migratorius*), Black-legged Kittiwake (*Rissa tridactyla*), Black Scoter (*Melanitta nigra*), Canada Goose (*Branta canadensis*), Common Eider (*Somateria mollissima*), Double-crested cormorant (*Phalacrocorax auritus*), Gray Jay (*Perisoreus canadensis*), Hairy Woodpecker (*Picoides villosus*), Northern Harrier (*circus cyaneus*), Northern Parula (*Parula americana*), Peregrine Falcon (*Falco peregrinus*), Ring-billed Gull (*Larus delawarensis*), Red Crossbill (*Loxia curvirostra*), Semipalmated Plover (*Charadrius semipalmatus*), and Turkey Vulture (*Cathartes aura*).

Throughout the 2021 fall migration point count surveys, no large flocks of migratory species were observed, while diurnal watch counts observed many, though only near the Strait of Canso, not within the Study Area.

Despite most species observed during point counts being migratory, most were passerine species, not migratory shorebirds or waterfowl flying at high altitudes or in larger flocks. Waterfowl observed during point count surveys were only observed in pairs or smaller groups, indicating a resident population.

2021-2022 Winter Surveys
Winter surveys were conducted on December 17 and 28, 2021, and on January 21, February 16, and March 1, 2022. The surveys included 90 10-minute point counts across 30 locations. A total of 27 species, comprising 725 individual birds, were observed (Table 7.58; Appendices M7/8). White-winged Crossbill (*Loxia leucoptera*), and Common Redpoll (*Acantis flammea*) were the most abundant and commonly observed species.

Table 7.58: Total Observations by Bird Group – 2021-2022 Winter Bird Surveys

Bird Group	Group #	# Individuals	# Species
Waterfowl	1	1	1
Shorebirds	2	6	1
Other Waterbirds	3	0	0
Diurnal Raptors	4	4	2
Nocturnal Raptors	5	0	0
Passerines	6	688	19
Other Landbirds	7	26*	4
Total		**725**	**27**

*Three unidentified woodpeckers were observed

SOCI observed during the 2021 to 2022 winter surveys included American Robin (*Turdus migratorius*), Boreal Chickadee (*Poecile hudsonica*), Canada Goose (*Branta canadensis*), Downy Woodpecker (*Picoides pubescens*), Evening Grosbeak (*Coccothraustes vespertinus*), Gray Jay (*Perisoreus canadensis*), Hairy Woodpecker (*Picoides villosus*), Pine Grosbeak (*Pinicola enucleator*), and Red Crossbill (*Loxia curvirostra*).

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

2021 Spring Migration Surveys
Spring migration surveys were completed within the Study Area on April 23, 24 and 25 and on May 13, 14, 28, and 29, 2021. The surveys included 90 10-minute point counts, and four 120-minute diurnal watches.

A total of 1,145 individual birds, representing 42 species, were observed during spring migration point count surveys (Table 7.59; Appendices M9/10). American Robin (*Turdus migratorius*), Ruby-crowned Kinglet (*Regulus calendula*), and White-throated Sparrow (*Zonotrichia albicollis*) were the most abundant and frequently observed species during spring migration surveys. Migrant passerines accounted for 77.6% of the species and 84.4% of the individual birds observed.

Table 7.59: Total Observations by Bird Group – 2021 Spring Migration Point Count Surveys

Bird Group	Group #	# Individuals	# Species
Waterfowl	1	8	3
Shorebirds	2	14	4
Other Waterbirds	3	5	2
Diurnal Raptors	4	10	2
Nocturnal Raptors	5	0	0
Passerines	6	1150*	50
Other Landbirds	7	176**	6
Total		**1363**	**67**

*Seven unidentified passerines were observed
**21 unidentified woodpecker specimens were observed

SOCI observed during the spring migration point count surveys included American Kestrel (*Falco* sparverius), American Robin (*Turdus migratorius*), Barn Swallow (*Hirundo rustica*), Boreal Chickadee (*Poecile hudsonica*), Canada Goose (*Branta canadensis*), Canada Warbler (*Wilsonia canadensis*), Evening Grosbeak (*Coccothraustes vespertinus*), Fox Sparrow (*Passerella iliaca*), Gray Jay (*Perisoreus canadensis*), Hairy Woodpecker (*Picoides villosus*), Mourning Warbler (*Oporornis 180hiladelphia*), Nashville Warbler (*Vermivora ruficapilla*), Northern Parula (*Parula americana*), Northern Waterthrush (*Seiurus noveboracensis*), Pine Grosbeak (*Pinicola enucleator*), Red Crossbill (*Loxia curvirostra*), Rusty Blackbird (*Euphagus carolinus*), Spruce Grouse (*Falcipennis canadensis*), Winter wren (*Troglodytes troglodytes*), and Wilson's Snipe (*Gallinago delicata*).

A total of 19 species comprising 148 individual birds were recorded in the Study Area during spring migration diurnal watch surveys (Table 7.60; Appendices M11/12). American Robin (*Turdus migratorius*), Bald Eagle (*Haliaeetus leucocephalus*) and Double-crested Cormorant (*Phalacrocorax auritus*) were the most frequently and abundantly observed species. Several soaring birds were observed, including at least eight diurnal raptor species, though no large flocks of migrating waterfowl were observed within the Study Area. Shorebirds observed were along the strait of Canso.

Table 7.60: Total Observations by Bird Group – 2021 Spring Migration Diurnal Watch Surveys

Bird Group	Group #	# Individuals	# Species
Waterfowl	1	5	2
Shorebirds	2	60	7
Other Waterbirds	3	3	1
Diurnal Raptors	4	28*	7
Nocturnal Raptors	5	0	0
Passerines	6	62**	5
Other Landbirds	7	10	1
Total		**168**	**23**

*Three unidentified raptor specimens were observed
**Three unidentified passerine specimens were observed

SOCI observed during spring migration diurnal watch surveys included American Kestrel (*Falco sparverius*), American Robin (*Turdus migratorius*), Canada Goose (*Branta canadensis*), Double-crested cormorant (*Phalacrocorax auritus*), Northern Harrier (*Circus cyaneus*), Peregrine Falcon (*Flaco peregrinus*), Ring-billed Gull (*Larus delawarensis*), and Surf Scoter (*Melanitta perspicillata*).

Throughout 2021 spring migration bird surveys, no large flocks of migratory waterfowl or shorebirds were observed within the Study Area. Each of the diurnal watch locations was chosen to establish whether significant movement of flocks was happening across key habitat features near the Study Area, primarily the Strait of Canso. With the largest percentage of individual birds being passerines, sub-canopy and low altitude flights are expected to comprise most of the bird movements, as they were the majority of observations over the course of field surveys. While there was significant movement of shorebirds near the watch locations around the Strait of Canso, very few of those birds were travelling on trajectories or at altitudes that would bring them within the Study Area, or near turbine rotor heights therein.

Throughout all field surveys, the occurrence of any species listed under *SARA*, COSEWIC, and/or the NS *ESA* was recorded (Appendix M13; Drawings 7.26 A-D, and 7.27).

7.4.5.8 Habitat Modelling Results

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

- Canada Warbler *(Wilsonia canadensis)*
- Common Nighthawk *(Chordeiles minor)*

- Evening Grosbeak *(Coccothraustes vespertinus)*
- Olive-sided Flycatcher *(Contopus cooperi)*

The results of the modelling are shown in Drawings 7.28 – 7.31.

7.4.5.9 Remote Sensing Results

Avian Radar Assessment
Through both the spring (April 12 to June 10, 2022) and fall (July 27 to October 31, 2022) migration periods, the ARS was deployed to monitor for BTs within the airspace above and near the Study Area. The spring 2022 radar deployment was at the meteorological tower in the northeastern portion of the Study Area. The fall 2022 radar deployment was at the southern end of Goose Harbour Lake along the road on the dam (Drawing 7.32).

Figure 7.5 (Appendix M14) shows that the horizontal radar mode identified 43,636 BTs during the spring 2022 monitoring campaign. Most of these BTs (nBTs = 42,682) were detected on May 5, which was possibly an avian migration event. The next largest migration event (nBTs = 590) occurred on April 13. No BTs were detected after May 5.

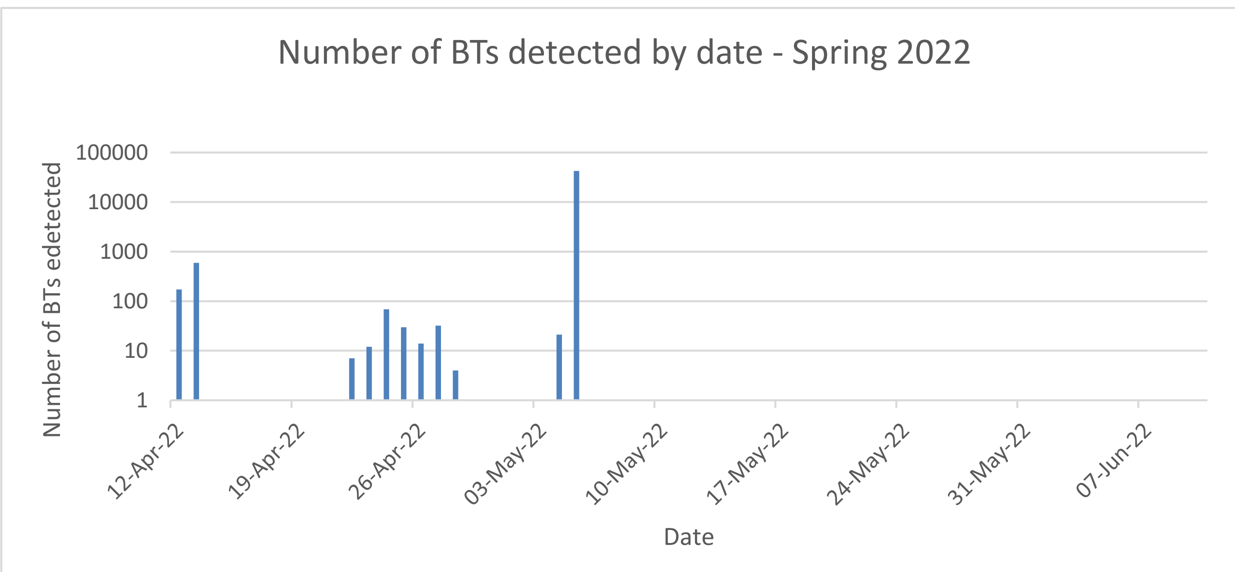

Figure 7.5: BT Detection Results for the Spring 2022 Monitoring Campaign

Figure 7.6 (Appendix M15) shows that the diagonal radar mode identified 150,479 BTs during the fall 2022 monitoring campaign (July 27 to October 31, 2022). Unlike the spring, there was a relatively consistent number of observed BTs, with a peak observed on September 8 and 9 (nBTs = 12,696,12,487 respectively). No observations were made after October 7, 2022. While BT observations peaked in early-to-mid September, migratory bird movement appears to have persisted into at least early October.

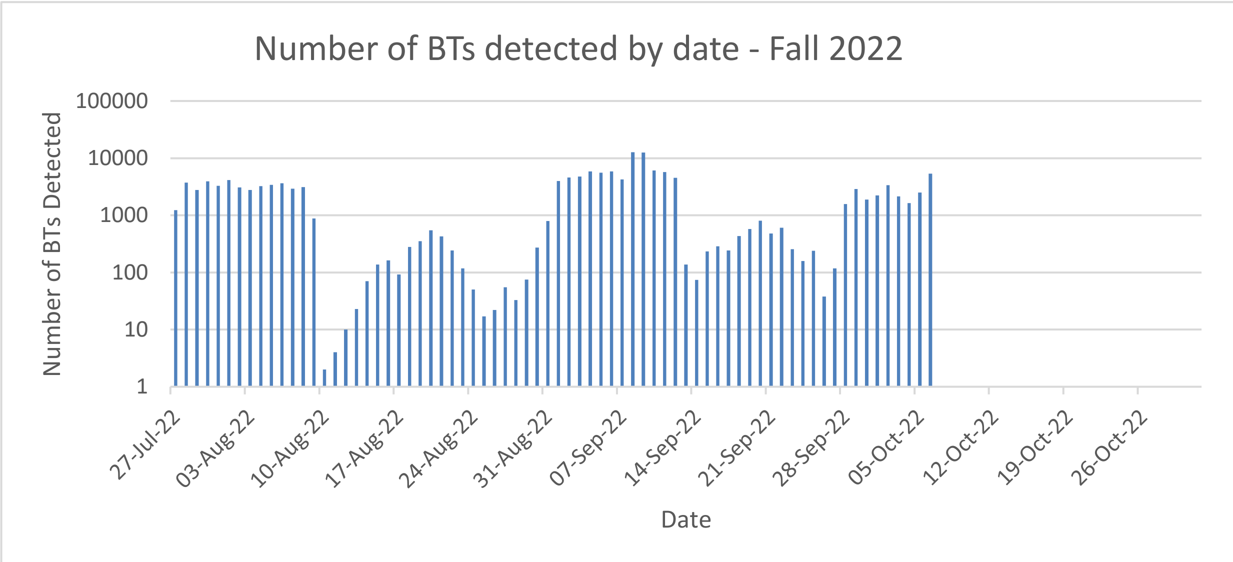

Figure 7.6: BT Detection Results for the Fall 2022 Monitoring Campaign

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

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

Weather data was collected from the nearby Port Hawkesbury Weather station (ECCC, 2022a; Appendices M16/17). While peak BT detection in spring 2022 occurred on May 5, 2022, the weather for that day indicated some rain and other precipitation (fog, mist, etc.), with wind coming primarily from the north and northwest, suggesting some of those BTs could be weather related noise. Though with migratory movements being stochastic, it is possible that bird movements occurred during poor weather. In fall 2022, peak BT detection (September 8 and 9) occurred during a period of clear skies, with no precipitation and a slight northeasterly breeze. In addition, comparatively high BT detection was recorded in the days before and following peak detection, suggesting migratory movements were occurring. Both results are consistent with the findings of other studies that examined the effects of weather and atmospheric conditions on bird migration (Richardson, 1990; Liechti & Bruderer, 1998).

Determining Migratory Bird Density

In addition to the number of migratory birds, it is also important to assess the height at which migratory birds travel. Birds are known to migrate at heights over 3,000 m, but most may fly much lower, with smaller bodied species generally traveling at lower heights (Farnsworth, 2013). The height at which targets were observed by the diagonal radar mode deployed in fall 2022 can be calculated trigonometrically. However, the horizontal radar is unable to report target height.

The diagonal radar mode provided high resolution on the height at which BTs were detected during the fall 2022 monitoring campaign. Data showed that BTs were usually detected across multiple height bins on days when avian migration activity was detected (Appendix M15), which may indicate diversity in the body size composition (and thus species composition) of the migratory birds passing through the area.

The height bins of 250-500 m and 500-1000 m had the largest numbers of BTs detected for the fall 2022 dataset (Appendix M15). While this would seemingly indicate that proportionately, more birds travel at these heights during migration, it is important to correct for the geometry of the ARS radar's beam angle. The Halo 20+ radar (used for the diagonal radar mode, fall 2022) emits a beam that is angled 12.5° upward and downward from the radar's antenna plane. As the radar beam extends outwards, the volume of airspace that the radar scans increases with range.

As the volume of airspace scanned by the radar increases (with range), the number of BTs that it can detect also increases. Therefore, the number of BTs detected by the ARS generally increases with range, until such a point that the radar becomes limited by range and the number of BTs detected drops (Figure 7.7).

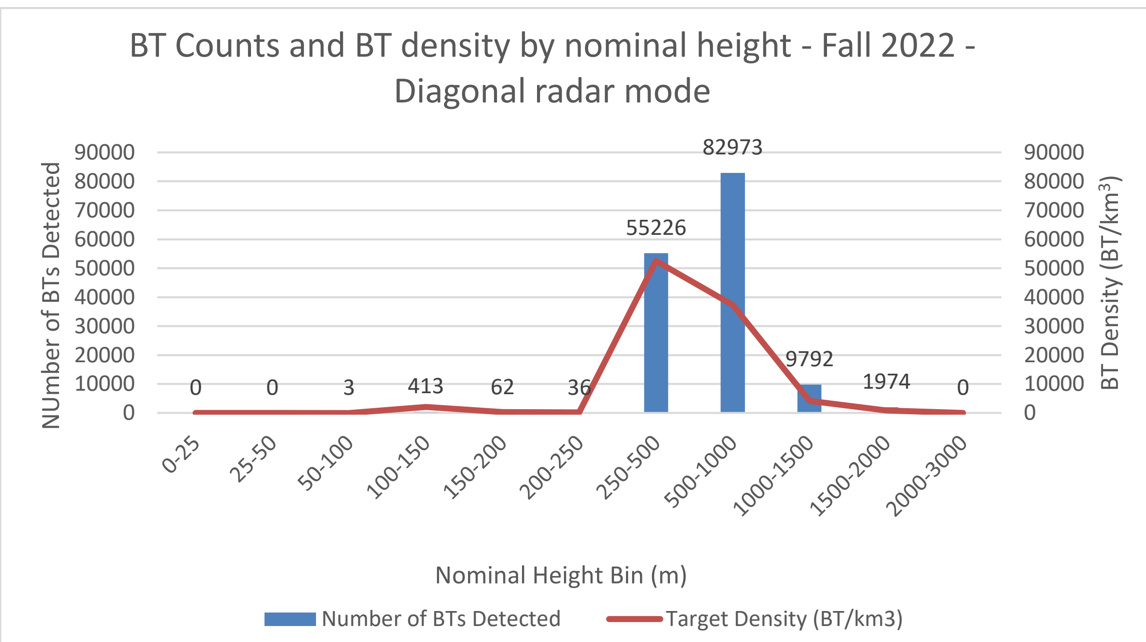

Figure 7.7: Number of BTs Detected and BT Density Compared Across Nominal Height Bins

The spring 2022 season (horizontal radar) reported most BTs in the 1750-2000 m, 2000-2500 m, and 2500-3000 m bins, with very few observed BTs under 1000 m or over 3000 m (Appendix M14).

The horizontal radar beam (spring 2022) follows the same properties as the diagonal radar beam; however, with the radar being positioned parallel to the ground, the volume increases at half the rate at which that of the diagonal radar increases. Therefore, half the beam width is below the horizon, which in a relatively flat topographical area does not aid in the observation of more BTs. Given the inconsistency in spring 2022 BT detection, only fall 2022 data was analyzed for BT density.

To correct for the distortions in BT detection counts at different ranges (both distance and height), it is necessary to correct for the airspace volume scanned by the radar at each range bin (or height bin in the case of the horizontal radar mode). Based on the geometry of the radar's beam angle (described above), the volume of airspace scanned in each of the range and height bins for the diagonal radar mode was determined using CAD software. These volumes are shown for each height bin in Table 7.61, along with the number of BTs detected in each bin during the fall 2022 migration season (this analysis was not conducted for the spring 2022 dataset as the number of targets detected was too low and concentrated to specific ranges). This information was used to determine the density of targets detected across the whole monitoring period (i.e., migration season) per cubic kilometer (km^3) (Farnsworth, 2013).

Table 7.61: BT Density and Related Parameters Observed During Fall 2022 Migration Season

Nominal Target Height Bin (m)	Airspace Scanned (km^3)	Number of Targets Detected	Target Density (BT/km^3)
0-25	0.1015	0	0
25-50	0.1016	0	0
50-100	0.2036	3	14.73
100-150	0.2043	413	2021.54
150-200	0.2052	62	302.14
200-250	0.2063	36	174.50
250-500	1.052	55226	52496.20
500-1000	2.226	82973	37274.48
1000-1500	2.337	9792	4189.99
1500-2000	2.426	1974	813.69
2000-3000	3.774	0	0
Total	12.8375	150479	11721.83

Table 7.61 shows that beyond peak target density, BTs decreased until the point where BTs were too distant to generate a strong enough radar reflection to be detected, and detection dropped. The target density indicates that density is low near the ground, and most migratory bird activity occurred in the 250-500 m and 500-1000 m height bins, which is in agreement with other migratory studies and the expected height of many migrants (Richardson, 1990).

Avian Interaction Model

The level of interaction between migratory birds and the Project turbines can be estimated using data collected from the radar monitoring in fall 2022 (data from spring 2022 was inconsistent). Interactions may include sensory disturbance to birds passing near the turbines, a requirement for birds to maneuver around the turbines (thus forcing migratory birds to expend energy), bird collisions with the turbine components, or blade strikes (for operating turbines).

The Migratory Bird Interaction Index (MBII) (M) is an estimate of the level of risk that aerial infrastructure for a Project poses to migratory birds. This index is calculated using the following expression:

Equation 1:

$$M = D \div I$$

Where D is the migratory bird density, and I is the volume of airspace that the infrastructure being assessed would occupy. The Migratory Bird Density Index (MBDI) or the target density derived from the Project's dataset can be used to represent the migratory bird density (D).

To represent the volume of airspace occupied by the infrastructure (I), the volume of airspace where avifauna would interact with the turbines was estimated using CAD software that is based on morphology of the turbine model. An over-estimate of the volume of the turbine's physical components was used to represent the larger volume of airspace where the turbines would influence avifauna. Table 7.62 shows the turbine dimensions for this Project and the parameters used to calculate the interaction airspace volume for the turbine model.

Table 7.62: Turbine – Avifauna Interaction Volume Calculation Information

Turbine Model Information		
Component	**Description**	
Number of Turbines	29	
Hub Height	120 m	
Total Height	195 m	
Rotor Diameter	150 m	
Blade Length	75 m	
Rotor Sweep Area	17,671 m^2	
Turbine – Migratory Bird Interaction Volume Calculations		
Interaction Airspace Model Component	**Dimensions**	**Airspace Interaction Volume**
Tower	15 m diameter cylinder, 120 m tall	21,205 m^3
Nacelle	7.5 m x 7.5 m x 24 m cuboid	1,483 m^3
Rotor (Operational)	150 m diameter cylinder, 7.5 m thick	133,000 m^3
Total airspace volume (operational)		**155,688 m^3**

Using the findings from the target density calculations (calculated from values in Appendix M15) and the calculated airspace volume (Table 7.62), the MBII was determined (Figure 7.8).

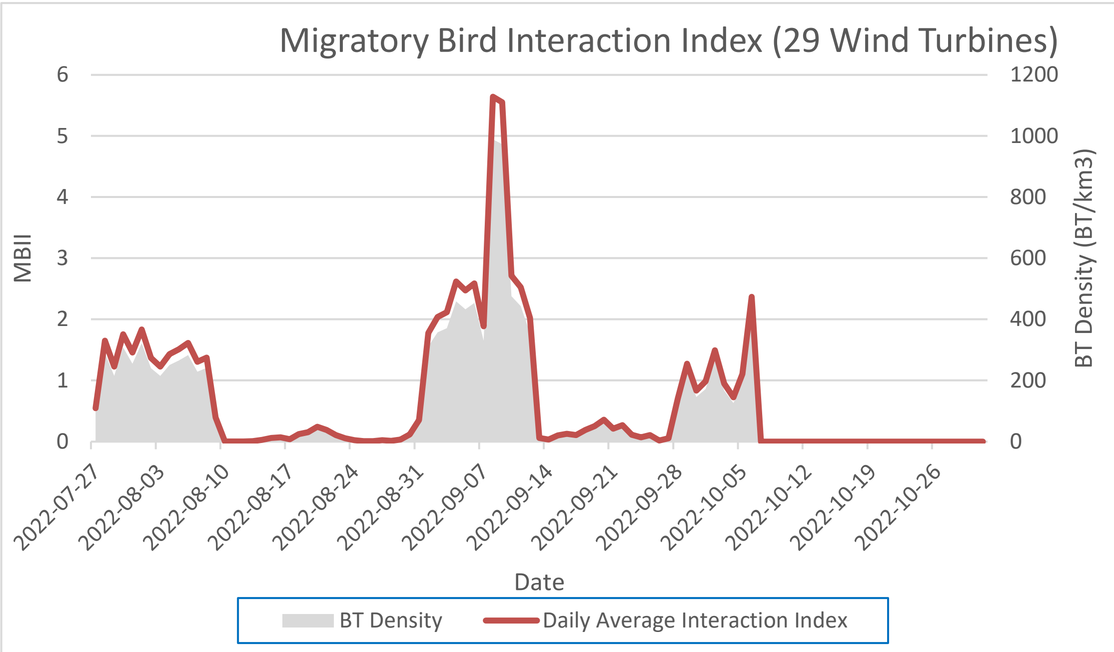

Figure 7.8: Migratory Bird Interaction Index Calculated Daily for Fall 2022 Migratory Period

Figure 7.8 shows a range of MBII values (0 to 5.64) that correlate strongly with the density of birds. Peak MBII values of 5.64 and 5.55 occur on September 8 and 9, which corresponds to the days with the highest number of BTs observed.

The MBII is derived from a conservative estimate of each of the 29 turbines being operational at any given time. It also assumes density is consistent across all height distributions which, as demonstrated above in Table 7.61 is not the case. In fact, most BTs observed were between 250 m and 1000 m nominal height, meaning they are unlikely to interact with turbines.

The density of migrating birds will vary spatially and temporally within the Project Area in any given year. The MBII values in Figure 7.8 cannot be used as a predictor of mortality rates without further study to relate MBII values to bird mortality rates, as not every interaction would result in mortality. Strum has conducted several mortality monitoring studies at various wind farm sites across Nova Scotia, with low mortality rates observed.

Daytime field surveys carried out in the fall 2021 season, though not conducted simultaneously with radar monitoring, were generally consistent with the radar findings that large, regular migratory movements are not occurring within the Study Area. As described below, acoustic monitoring was not able to complement radar studies in a meaningful way, as much of the potential observation of NFCs were masked by other ground-related noise.

Avian Acoustic Assessment

The results of the spring analysis demonstrate the abundance of bird activity within the Study Area. As spring migration for many avian species begins in mid-April and continues until mid-June, a greater number of avian species would be expected to be observed towards the end of the spring migration period, as shown in Figure 7.9. Data clarity in the early spring is poor, and this is likely a result of several factors, including noise from Spring peepers (*Pseudacris crucifer*), a species of frog that creates a loud noise that interferes with avian acoustic monitoring from late Match until mid-June when their breeding period is over. In addition, the majority of avian acoustics identified were calls or songs, rather than NFCs, which may explain the large number of calls identified at the end of June when the spring migration is ending and breeding activity is increasing. The spike in bird calls at the start of June is also attributable to a time period that was over-analyzed due to the reduction of Spring peeper activity.

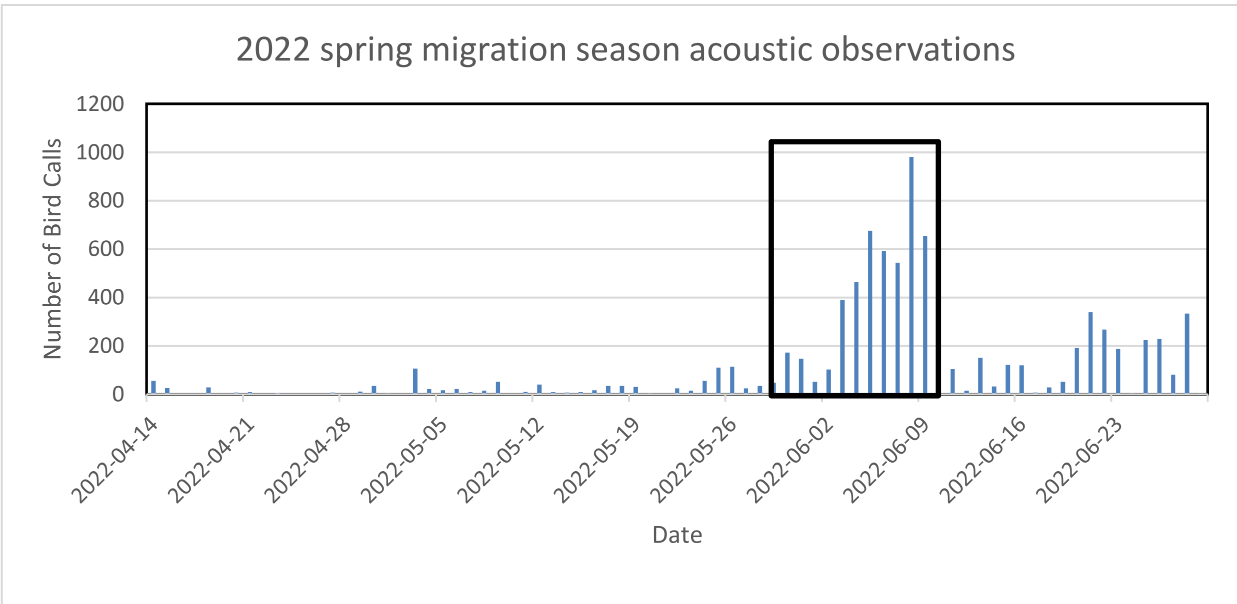

Figure 7.9: Avian Activity by Date During the 2022 Spring Migration Season, Compiling NFCs, Calls, and Songs [the area boxed (May 30th – June 10th) shows an anomaly in activity, as a result of an increase in manual scanning efforts]

This passive data collection method allows for the detection of avian species that are not likely to be found during daytime field surveys. For example, the Great Horned Owl (*Bubo virginianus*) was a species identified through acoustic monitoring (Figure 7.10); however, it was not found through other bird surveys and is not included in the ACCDC Data Report (2022b) (Table 7.53).

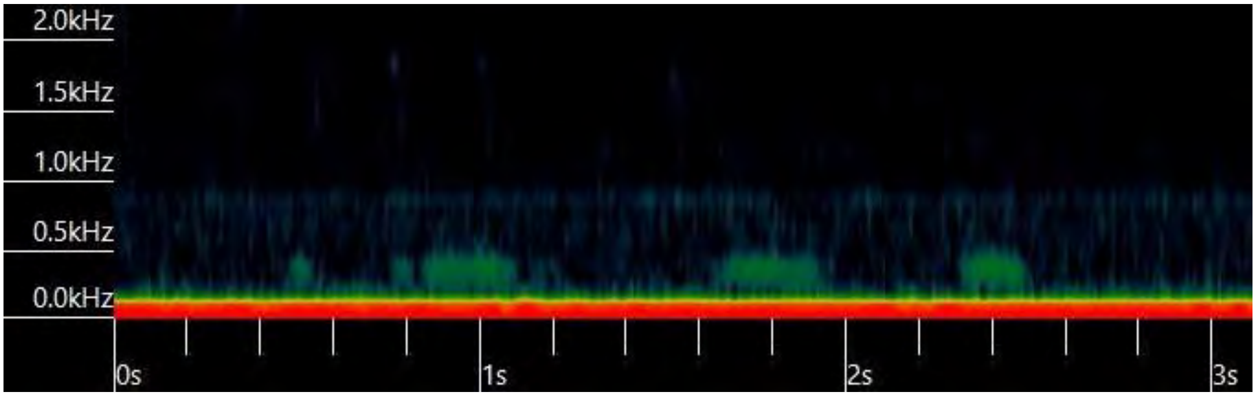

Figure 7.10: Spectrogram Showing a Great Horned Owl Call, Identified Using Kaleidoscope (2022)

This analysis does not meaningfully aid the radar assessment in quantifying the movement and composition of migratory avian species throughout the Study Area, especially given the detection range of the acoustic monitor compared to that of the radar system.in addition, the presence of Spring Peepers during the spring migration season made the results difficult to parse given that these amphibians are loud and occupy a similar frequency to many avian NFCs.

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

7.4.5.10 Effects Assessment

Project-Avifauna Interactions
Project activities, primarily those that involve earth moving or vegetation removal, or interactions with avifauna in the airspace have the potential to impact avifauna (Table 7.63). These activities could result in habitat removal, reductions in food availability, and direct bird-turbine interactions which often involve strikes. Other Project related activities, including during construction and operation, may impact avifauna behaviors, such as increased traffic and noise.

Table 7.63: Potential Project-Avifauna Interactions

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

Assessment Boundaries
For the purposes of this assessment, the LAA for avifauna includes the Assessment Area, as well as the airspace that is directly surrounding the turbines, as described above in the MBII. The RAA for avifauna includes surrounding regions that may fall within the habitat range of each species, bounded by pre-existing infrastructure and roads, as well as the Strait of Canso, as it is a known migratory corridor for many seabirds. (Drawing 7.22).

Assessment Criteria
Assessment criteria provided below apply for avifauna. The VC-specific definition for magnitude is as follows:

- Negligible – no loss of important avifauna habitat (e.g., breeding bird habitat) and no impacts to migratory avifauna are expected.
- Low – small loss of important habitat supporting avifauna and/or impacts to migratory avifauna are expected to be low.
- Moderate – moderate loss of important avifauna habitat and/or moderate impacts to migratory avifauna.
- High – high loss of important avifauna habitat and/or high impact to migratory that would be sufficient to impact species on a population scale.

Effects

Canada Warbler and SAR
One of the primary threats to the Canada Warbler, who prefer tree and shrub swamps with a dense and complex understory, is habitat loss. Across Canada, forest harvesting, and silviculture are leading causes of habitat loss, with mining and energy exploration also contributing to habitat loss, as well as the disruption of individuals and their migratory and breeding behaviors (ECCC, 2016a).

Canada Warblers were observed during spring migration and breeding bird surveys, with evidence of breeding activity noted within the Study Area and confirmed near several wetlands (Appendix M13, Drawings 7.26 A-D). Impacts to wetlands with confirmed breeding evidence of Canada Warblers has been avoided through Project design. Wetlands and Canada Warbler-specific interactions are addressed in Section 7.3.3.

Habitat modelling conducted for Canada Warbler (Drawing 7.28) indicates an abundance of adequate breeding habitat within the Study Area.

The Olive-sided Flycatcher, Evening Grosbeak, and Common Nighthawk have all been assessed federally under *SARA*, to establish conservation measures and to inventory critical points of action to minimize species decline and stabilize populations for future recovery. Deforestation, reduced availability of prey, land conversion, infrastructure development, and climate change contribute to disruption (ECCC, 2016b, ECCC, 2022d, ECCC, 2016c).

Common Nighthawks were observed during surveys, primarily foraging for food over water in a group of three, with the only other specimen observed in the northeast portion of the Study Area. Neither of these observations were consistent with typical breeding behaviours, though it remains possible they are breeding within the Study Area. Modelled habitat suggests there is adequate breeding habitat available, including along roads throughout the Study Area.

Olive-sided Flycatchers occupy wetland habitats, similar to Canada Warblers. While there were numerous observations of Olive-sided Flycatchers within the Assessment Area, no confirmed breeding evidence was observed.

Evening Grosbeaks occupy breeding habitat in mature and old growth softwood stands. The only specimen observed during the 2021 BBS was calling and did not display any breeding behaviours. Preferred breeding habitats for Evening Grosbeaks (i.e., mature/old growth forests) have been avoided through the Project design (Section 7.4.1).

Habitat modelling (Drawings 7.29, 7.30, 7.31) suggests that there is abundant habitat availability for each of those species within the Study Area.

General Effects to Avifauna

Road Traffic

Many species of avifauna are known to use the roadways within the Study Area, as evidenced by field survey results (Appendix M). An increase in road traffic will increase chances of mortality to those avifauna using the roadways, especially Roughed Grouse and similar species, as they are known to use roadways for travel and nesting. Most roads within the Study Area are currently used for recreation by off-highway vehicle users and forestry activities. Outside of the construction phase, the Project will only require technicians to access the site to perform regular maintenance/equipment checks. Considering the pre-existing traffic load and the minimal traffic to be associated with the Project, road traffic is expected to have a negligible to low effect on avifauna in the LAA.

Habitat Loss and Fragmentation
Other non-priority species were observed within the Study Area and make use of various habitat types across this area. The footprint of the Project, particularly the area that will impact intact habitat, is relatively small compared to other developments in the natural resource sector. Only 12 km of new road will be constructed within the Study Area, and upgrades to pre-existing roads will be removing small areas of habitat in an area that has already been disturbed. Habitat alteration may result in the removal of refugia which may increase predation risks and disrupt the ecological balance within a localized community. Direct habitat loss and fragmentation within the LAA will therefore be small and has been minimized by Project design to reduce the effects of habitat loss.

Bird Strikes
Bird strikes are a primary concern when considering the interactions of avifauna with the Project, as turbine blades spin at high speeds through the airspace frequented by a variety of species at all different altitudes within the rotor swept area (45 to 195 m). Direct impacts to individual species are difficult to quantify, as the passage of any given species at any given moment in time is unpredictable; however, the likelihood of impacts to avifauna can be better understood with further monitoring of radar-detectable activity, in conjunction with mortality surveys. Mortality monitoring has been carried out by Strum at numerous other facilities in Nova Scotia, with low mortality rates observed.

The avian radar assessment identified potential migratory bird activity throughout the early fall migration season (up to October 7). Clear weather nights provided the highest number of BTs throughout the whole season, as was found in other migratory bird studies (Liechti & Bruderer, 1998).

The 2021 spring migration diurnal count surveys observed several large-bodied birds in the vicinity of the Strait of Canso, both over land and over water. Sea birds were not observed in large numbers within the Study Area, but many of the larger raptor species observed near the Strait of Canso were also observed within the Study Area, including Bald Eagles. During 2021 fall migration diurnal count surveys, numerous shorebirds and waterfowl were observed near the Strait of Canso. It was noted that these birds did not travel over the Project Area, rather the movement of shorebirds and waterfowl appears to be confined to the Strait of Canso itself. As such, most interactions between the turbines and avifauna are expected to be with migratory birds passing through the rotor sweep area of the turbines, not with seabirds and waterfowl moving through the Strait of Canso.

In both the spring and fall 2022 monitoring campaigns, the daily total of BTs detected was highly variable, indicating that migratory bird activity is somewhat stochastic during both the spring and fall migration seasons. This is consistent with the findings of a large-scale avian radar study conducted in the continental United States, which determined that most migratory bird movements occur on just 10% of a migration season's nights (Horton et al., 2021). The MBII (Figure 7.8) shows how interactions with the turbine infrastructure would vary over time, along with variations in migratory bird density. Bird strikes and avian mortalities are likely to be proportional to the MBII. The model indicates that interactions would be highest during migration events, which can occur stochastically throughout the spring and fall migration seasons.

The results of the fall 2022 radar monitoring program indicates that migratory bird activity was highest in the 250-500 m and 500 m-1000 m height bins, which suggests that most of the migratory bird activity would occur above the height of the wind turbines. Based on these findings, the number of bird strikes and level of avian mortalities from the Project is expected to be low, which is consistent with other studies that examined interactions between wind turbines and avifauna (Zimmerling et al., 2013)

Mitigation Measures
Adaptive management of potential effects will be addressed through the development and implementation of an EPP which will include mitigation and monitoring for avian species. The primary mitigation for avifauna is avoidance in the siting of infrastructure, including:

- Avoidance of topographic funnels, such as within valleys, for turbine placement to reduce the likelihood of interactions with concentrated bird movements.
- Avoidance of important bird habitats, such as wetlands, waterbodies, old growth forest, etc. to reduce the impact of habitat changes. This includes siting Project infrastructure within areas with existing disturbances, such as existing roads and cutover areas of forest.

Mitigations to be employed during the construction phase to reduce effects on avifauna include:

- Adhere to ECCC guidelines on clearing windows for nesting migratory birds. Vegetation clearing activities will be conducted outside of the nesting period that is generally from April 1 to September 30 each year. Timing of clearing activities are generally dependent on seasonal conditions.
- Establish speed limits within the Project Area for construction vehicles to mitigate the effect of vehicle-avifauna collisions.
- Incorporate a lighting plan for construction-related activities into the EPP.
- Maintain good housekeeping practices during construction to avoid indirectly feeding birds, and potentially attracting nuisance wildlife.
- Develop a spill response plan, and an emergency response plan within the EPP to mitigate the impacts of spills, hazardous substances, and other emergencies.
- Develop a fire response plan in accordance with provincial standards.
- Revegetate disturbed areas, as appropriate.
- Install avian deflectors on powerlines, including any powerline spans, or areas of line that will be identified in the EPP as requiring mitigation based on monitoring results.

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

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

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

- Develop a site reclamation plan in accordance with engineering standards and in consultation with NSECC and NSNRR.

Monitoring
A site-specific post-construction Wildlife Management Plan will be developed in consultation with NSECC, NSNRR, and all other relevant parties. The management plan will inform monitoring activities that will take place to ensure continued protection of known SOCI in the LAA and RAA. Some preliminary monitoring activities related to avifauna may include:

- Conduct post-construction monitoring for Canada Warblers throughout the Study area.
- Conduct post-construction avian mortality monitoring to assess mortality levels caused by turbine operations.
- Conduct post-construction avian radar monitoring in tandem with avian mortality monitoring to determine the relationship between avian mortalities and migratory bird density.
- Monitor changes to habitat within the Study Area and greater RAA that may occur as an indirect result of the Project.
- Conduct BBS post-construction to establish potential impacts to the breeding bird community, while also addressing changes in population dynamics, with special attention paid to SAR.

Conclusion
While effects to avifauna species differ, the effects considered to be of greatest concern include habitat loss, migratory disruption, and bird strikes. Based on this assessment and through the implementation of proposed mitigation and monitoring activities, effects to avifauna are expected to be of low magnitude, within the LAA, medium duration, intermittent, reversible, and not significant.

8.0 SOCIO-ECONOMIC ENVIRONMENT

8.1 Economy

8.1.1 Existing Environment

The Project is located in Guysborough County, near the communities of Monastery (13.5 km), Mulgrave (10.2 km), Lincolnville (6.6 km), Mattie Settlement (8.9 km), Upper Big Tracadie (9.4 km) and Boylston (11.1 km). The county is divided into three census subdivisions governed as the MDOG, the Municipality of the District of Saint Mary's (MDSM), and the Town of Mulgrave. The Project is situated entirely within the Guysborough Municipal District, which is the focus of the following analysis.

Population statistics for the 2016 and 2021 Census Subdivisions for the MDOG, MDSM, and Mulgrave are summarized in Table 8.1.

Table 8.1: Population Characteristics for Guysborough County

Population Statistics	Guysborough Municipal District	St. Mary's Municipal District	Town of Mulgrave
Population in 2021	4585	2161	627
Population in 2016	4670	2233	722
Population change from 2016-2021 (%)	-1.8	-3.2	-13.2
Total private dwellings in 2021	3043	1538	316
Land area (km^2)	2115.25	1904.8	17.83
Population density (per km^2)	2.2	1.1	35.2

Source: Statistics Canada 2022

The age distribution in the Guysborough Municipal District reveals a median age of 58.4 years, which is significantly higher than the provincial median age (45.6) and the Halifax Regional Municipality (HRM) (40.4) (Statistics Canada, 2022). An overview of age distribution for 2021 is outlined in Table 8.2.

Table 8.2: Age Distribution in the Guysborough Municipal District and Nova Scotia

Age Statistics	Guysborough Municipal District	Nova Scotia
0 - 14 years	515 (11.2%)	136710 (14.1%)
15 - 64 years	2455 (53.5%)	617345 (63.7%)
65+ years	1615 (35.2%)	215325 (22.2%)
Total Population	**4585 (100%)**	**969380 (100%)**

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

Average housing costs and average individual incomes for the Guysborough Municipal District compared to the provincial and federal averages are shown in Table 8.3.

Table 8.3: Housing Costs and Average Individual Income

Jurisdictions	Average Dwelling Value in 2020	Average Total Income in 2020
Guysborough Municipal District	$164,400	$38,240
Province of Nova Scotia	$295,600	$47,480
Canada	$618,500	$54,450

Source: Statistics Canada 2022

The Tracadie and District Fire Department is located approximately 13 km northwest of the Study Area on Highway 4. Milford Haven Fire and Emergency Services is also located nearby, approximately 12 km southwest of the Study Area, on Highway 16 between Boylston and Milford Haven. The Mulgrave Fire Hall is located 9.5 km northeast on Murray Street.

Health and emergency services exist in the area and are accessible to Project workers if the need should arise at the Guysborough Memorial Hospital on Marine Drive in Guysborough, approximately 16 km south of the Study Area. Limited health services are also available at the Paqtnkek Health Centre 20 km west of the Study Area.

Statistics for the Guysborough Municipal District indicate that the unemployment rate in 2021 was 18.1% and 19.4% for St. Mary's Municipal District, both being above the provincial rate of 12.7% (Statistics Canada, 2012). The Guysborough Municipal District employment rate was 38.0% and 40.3% for St. Mary's Municipal District employment rate, which are both lower than the provincial rate of 51.9% (Statistics Canada, 2022).

A breakdown of the labour force within both Municipal Districts is provided in Table 8.4. The highest proportions of workers in the Guysborough Municipal District fall into the "Agriculture, Forestry, Fishing and Hunting" category (21.6%) and in the St. Mary's Municipal District the highest percentage are in the same category (19.9%). Other significant industries include educational services, construction, and health care and social services (Statistics Canada, 2022).

Table 8.4: Top Industries for the Employed Labour Force, Colchester Subdivision A and Cumberland Subdivision D

Industry	Guysborough Municipal District (%)	St. Mary's Municipal District (%)
Total employed labour force 15 years +	1875	930
Construction	145 (7.7%)	85 (9.1%)
Retail trade	150 (8.0%)	75 (8.1%)
Health Care and Social Assistance	235 (12.5%)	125 (13.4%)
Manufacturing	165 (8.8%)	25 (2.7%)
Educational Services	145 (7.7%)	95 (10.2%)
Agriculture, Forestry, Fishing and Hunting	405 (21.6%)	185 (19.9%)

Source: Statistics Canada 2022

The Town of Mulgrave is located approximately 10 km northeast of the Project and offers a range of business services. A review of some of the businesses located near the Project is provided in Table 8.5.

Table 8.5: Local Businesses and Proximity to Study Area

Business	Distance and Direction to Project*
Guysborough Landfill	7.2 km southwest, on Highway 16
County Line Electric	7.0 km northwest, on Mattie Rd.
Porcupine Mountain Quarry	10.0 km northeast, on Highway 344
Strait of Canso Superport	9.9 km northeast, on Highway 344
Mulgrave Sewage Plant	9.9 km northeast, on Highway 344
Eastern Counties Regional Library - Mulgrave	9.6 km northeast, on Murray St.

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

Aside from the immediate area and associated businesses, the communities of Monastery, Mulgrave, Boylston, and others are all highly dependent on the greater municipal centers of Antigonish and Port Hawkesbury for many of their regular shops and services, including indoor recreation, big-box stores, and significant health care facilities including emergency services and inpatient care. Another key factor in the workforce is that many residents of the communities surrounding the Project commute daily to either Antigonish or Port Hawkesbury.

The vast majority (99%+) of residents in MODG speak English. All communications throughout Project, as well as public consultation and engagement have been undertaken in English.

8.1.2 Effects Assessment

Project-Economy Interactions
Project activities have the potential to interact with the economy during all phases of the Project (Table 8.6).

Table 8.6: Potential Project-Economy Interactions

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

Assessment Boundaries
The LAA for economy is MODG. The RAA for includes the entire province.

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

- Positive – Project is expected to have a positive effect on the economy.
- Negative – Project is expected to have a negative effect on the economy.

Effects
It is estimated that the Project will result in approximately $300 million in investments into the Province of Nova Scotia. The Proponent is committed to sharing economic opportunities with the local community throughout the development and lifespan of the Project via the use of local skills

and labour where possible, municipal tax revenue, and on-going energy literacy/education. The Project Team is also expanding the mandate of the existing FAC to include the Project. This will help to identify Project-related opportunities and benefits for the local community.

The Proponent understands the importance of supporting local rural communities. The Project Team is committed to using as many local skills as possible. Potential work includes environmental studies, geotechnical investigation, engineering, land and snow clearing, surveying, worksite security, road construction and on-going maintenance through construction and post construction, turbine component transportation, turbine foundation construction, turbine installation, collector system construction, and substation construction. Specifically, elements of job creation throughout the lifespan of the Project may include:

- Project Development - During the development phase of the Project, Nova Scotian professionals will deliver services in a variety of areas, including: civil and electrical engineering, legal, land, environmental, and biological surveys, archaeological, land and community relations, and many others. Dozens of professionals within Nova Scotia will render their services as part of the development of the Project.
- Construction - Though the construction phase of the Project is relatively short, it will require significant manpower for realization. Much of the construction employment will come through contracting and subcontracting of Nova Scotia construction firms. This will likely include significant elements of civil and electrical construction. It is estimated that the Project will require approximately 150 temporary full-time jobs of varying duration throughout the development and construction periods.
- Operations and Maintenance - Operational wind projects require long-term operations and maintenance technicians to be located either on-site or within short driving distance of the Project. Up to five permanent jobs are expected in the operations phase. The jobs associated with operations and maintenance are long-term, steady, stable, and well-paying.
- In addition to operations and maintenance of the wind turbines, there will be a variety of wind farm activities that will require on-going resources such as road network maintenance such as snow removal and road surface maintenance, administrative support, inventory/materials management, scheduling and coordination of maintenance inspections around the balance of plant (i.e., power collection system, electrical substation inspections, etc.).

In addition to the direct investments that the Project would bring to Nova Scotia’s economy, a suite of auxiliary economic benefits can also be expected. Workers that are directly involved with the development would contribute to local economies by redistributing wealth to a variety of goods and services such as hotels, restaurants, and grocery stores (USDE, 2008).

As outlined in the *Wind Turbine Facilities Municipal Taxation Act* (2006) MODG will receive tax revenues per MW on an annual basis and as such, the royalty will annually increase as the Consumer Price Index rises. The Project is expected to enhance the community’s economic development by providing tax revenues of approximately $800,000 annually to MODG. Further to the municipal taxation, with the Project being situated on Crown lands owned by the province, there is anticipated lease payment of approximately $500,000 annually to the provincial government.

A renewable energy project in a community allows residents to gain a better understanding of wind technology and how wind power can help reduce reliance on fossil fuels. Energy literacy is an increasingly important skill in today’s economy, and the Project Team is committed to providing energy literacy to the surrounding communities and is available to answer questions and provide a better understanding of local and provincial energy issues.

Mitigation Measures
The economic impact to the LAA and RAA is positive; therefore, no mitigation is proposed.

Monitoring
A specific monitoring program for the economy is not recommended.

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

8.2 Land Use and Value

8.2.1 Existing Environment
The Study Area is primarily “Commercial Forest” crown land owned by the Province of Nova Scotia. Land use around the Study Area is varied and includes a few blueberry fields to the north and northwest, and a mix of “Resource Forest”, residential, and farmlands to the east, south, and northeast along Highway 4 and the surrounding roads. As Highway 104 to the north is the Trans-Canada Highway and is the primary point of access for people travelling from mainland Nova Scotia and the rest of Canada to Cape Breton and Newfoundland, there is significant traffic volume that fluctuates to some degree with tourism in the summer.

There are also several public protected lands and parks in the area (Drawing 7.6), including the Boylston Provincial Park and Tracadie River Wilderness Area to the west of Highway 16, along the southwest boundary of the Study Area. The Scotia Trail in Mulgrave is one of only a few points of interest in the area.

8.2.2 Effects Assessment

Project-Land Use and Value Interactions
Project activities have the potential to interact with land use and value during all phases of the Project (Table 8.7).

Table 8.7: Potential Project-Land Use and Value Interactions

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

Assessment Boundaries
The LAA for land use and value is the Guysborough Municipal District. The RAA is not applicable.

Assessment Criteria
Assessment criteria provided in Section 4.6 apply for land use and value as well. The VC-specific definition for magnitude is as follows:

- Negligible – no change in land value expected and surrounding land use can largely continue.
- Low – small measurable change in land value expected and/or minor limitations to surrounding land use.
- Moderate – moderate measurable change in land value and/or moderate limitations to surrounding land use.
- High – high measurable change in land value and/or widespread limitation to surrounding land use.

Effects
Due to the nature of wind turbines being tall structures with small footprints, they are highly compatible with other land uses like agriculture, forestry, and ground-based recreation. Forestry activities in the area will only be minimally disrupted by the Project from short term traffic disruptions for Project related infrastructure. As existing land users are primarily industrial in nature, upgraded roads and infrastructure generally stand to improve access, limit weather disruptions, and lessen impacts of poor roads on their equipment.

None of the points of interest noted above are expected to be materially impacted by the Project. A recent study mentions that given the traditional energy industry's impacts on conservation in both direct and indirect ways, wind energy can be seen as a complementary land use to conservation and protected areas in a broad way, as wind energy is not a carbon emitter (Wind

Europe, 2017). Given the context of Nova Scotia where the traditional energy source has primarily been coal, land use for wind energy can be seen as a positive step.

Potential effects on property value are often a concern of neighbouring residents due largely to anecdotal reports from appraisers of drastic declines in property values following the nearby installation of a wind energy facility (as reviewed in Gulden, 2011). Despite these concerns, many rigorous and statistically defensible studies have concluded that wind energy developments have had no significant effect on surrounding property values.

Prior to 2013, the most comprehensive study on the impact of wind farms on property values had been completed by Hoen *et al.* (2009). This research analyzed data on nearly 7,500 sales of single-family homes situated within 10 miles (16 km) of 24 existing wind farms in the United States. Eight different hedonic pricing models failed to generate statistically significant evidence that property values for houses located within 10 miles (16 km) of wind farms are influenced by the developments. Subsequent research by the same laboratory but employing further analyses confirmed these results (Hoen *et al*., 2010).

Carter (2011) analyzed home transactions in a rural landscape surrounding small (1-4 turbines) wind energy developments, while employing a hedonic model to statistically control for variables affecting all real estate transactions such as square footage, age of home, and school zone. This study concluded that proximity to the wind farms did not impact average selling price of homes; in fact, in one case, homes closer to a wind farm sold for significantly higher than those elsewhere (Carter, 2011).

A study by Hinman (2010) tracked property transactions in communities located close to a 240-turbine wind farm for an eight-year period that spanned pre-development and operation stages. Hinman (2010) found that before project approval, property values in the area decreased. This was attributed to a fear of the unknown effects that the development would have; an effect known as anticipation stigma. However, once the development became operational, property values recovered. This recovery was attributed to a greater understanding of the operational effects of the development. Anticipation stigma, however, was not detected in a similar study in Colorado (Laposa & Mueller, 2010), in which it was concluded that the announcement of a large wind energy development did not significantly reduce the selling prices of homes surrounding the proposed development.

Until recently, the primary limitation of previous research on the effects of wind energy facilities on surrounding home values has been that research has been based on relatively small sample sizes (data sets) of relevant home-sale data. The inability to account for the complexity of the various factors which affect property values has also been cited as a limitation to previous studies. In particular, data had been limited for homes located within about a half mile (800 m) of turbines, where impacts would be expected to be the largest: Hinman (2010) (sample size of 11); Carter (2011) (sample size of 41). This is in part because setback requirements generally result in wind facilities being sited in areas with relatively few dwellings, limiting the number of sales transactions available to be analyzed (Hoen *et al.* 2013). Although these smaller data sets are adequate to examine large impacts (*e.g.*, over 10%), they are less likely to reveal small effects with any reasonable degree of statistical significance.

A study published in August 2013 by Berkeley National Laboratory (principal authors) was conducted to address these gaps in data and included the largest home-sale data set to date. Researchers collected data from 51,276 home sales spanning 27 counties in nine states, related to 67 different wind facilities (Hoen *et al,*. 2013). These homes were within 10 miles (16 km) of 67 different wind facilities, and 1,198 of the sales analyzed were within 1 mile (1.6 km) of a turbine, giving a much larger data set than previous studies have collected. The data span the periods well before announcement of the wind facilities to well after their construction (Hoen *et al.,* 2013).

Two types of models were employed during the study to estimate property-value impacts: (1) an ordinary least squares model, which is standard for this type of study, and (2) a spatial-process model, which accounts for spatial variability. These models allow the researchers to control for home values before the announcement of a wind facility (as well as the post-announcement, pre-construction period), the spatial dependence of unobserved factors effecting home values, and value changes over time. A series of robust models was also employed to add an additional level of confidence to the study results (Hoen *et al.,* 2013).

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

A recent review based on housing and property values within specific radii of wind farms and other energy infrastructure by Brinkley and Leach (2019) finds that while most energy infrastructure has an impact on nearby land values, renewable energy projects (including wind farms) do not have statistically significant impacts. These findings are based on seven individual studies of varying scales that all consider the value of property relative to the proximity to wind power, whether a single turbine or more (Brinkley & Leach, 2019).

Research has consistently demonstrated that, in a variety of spatial settings and across a wide temporal scale, sale prices for homes surrounding wind energy facilities are not significantly different from those attained for homes sited away from wind energy facilities.

Mitigation Measures
The Project has been designed to minimize potential effects to land use and value through siting consideration of neighbouring landowners and residents. This has included the movement of specific turbines based upon stakeholder engagement and the results of desktop, field, and modelling studies. No specific mitigation related to land use and value is recommended.

Monitoring
A specific land use and value monitoring program is not recommended.

Conclusion
The impact to land use and value is expected to be negligible, and the effects are therefore considered not significant.

8.3 Traffic and Transportation

8.3.1 Existing Environment

The center of the Project is located approximately 12 km southeast of Highway 4 at Monastery and 12 km southwest of Highway 104 at Auld's Cove. The primary road running along the north/northwestern border of the Study Area is Old Mulgrave Road, which is approximately 7.5 km north of the center of the Study Area. Highway 16 runs along the western/southwestern boundary of the Study Area, from Monastery through Upper Big Tracadie, Lincolnville, and Tracadie Road before reaching Boylston to the south. Hayden Road runs from the Old Mulgrave Road in the north down through the center of the Study Area. Gero Road runs from Highway 16 eastward into the Study Area and provides access that is connected by trails and forestry tracks to Hayden Road. The eastern and southern boundaries of the Study Area are primarily forested and have relatively few access points, aside from woods trails for ATV use, and the Goose Harbour Lake Road which ends at Goose Harbour Lake in the southeast of the Study Area.

Throughout the Study Area, the roads are accessible by truck/SUV as well as other vehicles designed for rough dirt roads and tracks. During the summer months, there are few vehicles visiting the area aside from the rare drive-through or ATV user. In late summer the blueberry fields to the north and northwest of the Study Area are harvested, though very few, if any, of those users travel south towards the Study Area. Due to the relatively remote location and lack of inhabitants, as well as the relatively poor quality of the roads, there is very little through traffic in the summer.

During the fall and winter months, the Study Area is far more frequently visited, both for hunting and other recreation activities, including snowmobiling and ATV use. Smaller roads that cover the Study Area, many of which are dead ends, are primarily used for ATVs year-round, though most see very little traffic. Access is limited in the winter to users with specific equipment depending on the depth of snow, or who are travelling on foot. The Chedabucto Snowmobile Club maintain the trails in the area and charge membership fees that are related to the Snowmobile Association of Nova Scotia.

Preliminary transportation feasibility studies have been conducted which suggest moderate road upgrades necessary around Mulgrave, which would be the receiving terminal (i.e., Superport) for all major turbine components. Access routes to the site include Highways 344, 104, and 16 for blade transport, Highways 334 and 104 for tower transport, with other components mostly travelling on smaller municipal and resource-type roads directly from Mulgrave. Further transportation studies are in progress which will help confirm these access routes.

Air Navigation, communications, and navigation aids are addressed in Section 10.2.

8.3.2 Regulatory Context

The following permits and considerations are anticipated to be required for the transportation of turbine components:

- Work Within Highway Right of Way Permit (NSPW)
  - Required if removing access signs and guard rails.
- Overweight Special Moves Permit (Service NS and Internal Services)
  - Required to transport oversized and overweight components. In some cases, due to the size and weight of the components, some may only be transported on Sundays.
- Provincial road weight restrictions will also need to be considered, especially Spring Weight Restrictions, for heavier equipment and materials that will be transported to the Project Area.
- Access points will be designed with proper height and width to accommodate large trucks and will adhere to commercial stopping sight distances.

8.3.3 Effects Assessment

Project-Transportation Interactions

As on-site traffic is minimal, Project activities primarily have the potential to interact with transportation during the delivery and removal of turbine components (Table 8.8).

Table 8.8: Potential Project-Transportation Interactions

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

Assessment Boundaries

The LAA for transportation is MODG. The RAA is the transportation route.

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

- Low – small change in traffic levels and/or minimal disruptions to traffic flow and routing.
- Moderate – moderate change in traffic levels and/or moderate disruptions to traffic flow and routing.
- High – high change in traffic levels and/or high disruptions to traffic flow and routing.

Effects
The transportation route may require road modifications, including the removal of signage and guardrails. During the Project's construction phase, trucks and other vehicles will be frequently visiting the area resulting in increased vehicular sound and air emissions.

Mitigation Measures
- Install notices in public areas to inform residents of signage removal or road infrastructure alterations.
- Replace removed signage and guardrails immediately with appropriate temporary signage to ensure travelling public safety.
- Complete upgrades to roads and overhead wires, branches, and signs if conflicts arise.
- Complete modifications and associated reinstatement to relevant specifications.
- Avoid, to the extent possible, transportation through urban areas during high traffic times (e.g., 7-9 am and 3- 6 pm; Monday to Friday).
- Conduct all travel using safe work practices for transporting oversized loads.
- Utilize the minimum number of vehicles possible to minimize impacts to road-way flow and impacts on air quality due to exhaust.
- Ensure vehicles only visit and work on-site during normal daytime hours of operation, where possible, and avoid high-traffic times of day to reduce local traffic congestion.

Monitoring
A specific traffic monitoring program is not recommended.

Conclusion
The impact to traffic and transportation is expected to be low, extend to the RAA for a short duration, be intermittent, and reversible. Impacts related to transportation are considered not significant.

8.4 Recreation and Tourism

8.4.1 Existing Environment
The Project is located near the border of Antigonish and Guysborough Counties, and has no major tourism center nearby, being situated between Monastery in the Northumberland shore region and Guysborough (town), Mulgrave, and Sand Point in the Northumberland Shore region.

The communities of Lincolnville, Boylston, Monastery, Mulgrave, and Guysborough are all home to a variety of primarily outdoor recreational activities. In the summer, ATV use on the various trails that are used for snowmobiling in the winter, and the use of other outdoor facilities are the primary recreational draws. Boylston Provincial Park is located approximately 8 km south of the Project and is often frequented by hikers and picnickers in the summer. Osprey shores, a 9-hole, par 36 course that was open to the public, is located 15 km south of the Study Area. It was closed in 2018 and has been converted to a vineyard, though associated accommodations are still active and open to the public, though only seasonally.

Despite the lack of direct tourism and recreation destinations within the Study Area, there are many tourists who pass near the area on Highway 104 to the north. It is the primary access route to Cape Breton Island and Newfoundland, as well as part of the Trans-Canada Highway. There is a Big Stop restaurant and several other tourist attractions in Auld's Cove, approximately 15 km northeast of the Study Area.

The standard deer hunting season in Nova Scotia stretches from the last Friday in October through the first Saturday in December. There is no hunting allowed on Sundays, except for the first two Sundays of the deer hunting season. During field surveys, several deer hunters were encountered on the site, along with blinds and tree stands that appear to have been used for hunting. Other mammalian hunting or trapping may occur on the site, though no signs were observed during field surveys.

Several fish are confirmed to be present in the various lakes and several avian species were observed. There are numerous trails that lead to the edges of the lakes, granting reasonably unobstructed access, indicating possible fishing and/or waterfowl hunting in this area.

Most recreation within the Study Area is concentrated on the already developed roads and trails. ATV use in the warmer months and snowmobile use in the winter account for most of the recreational use; however, other uses exist.

8.4.2 Effects Assessment

Project-Recreation and Tourism Interactions
Project activities have the potential to interact with recreation and tourism during all phases if access is temporarily limited to facilitate work (Table 8.9).

Table 8.9: Potential Project-Recreation and Tourism Interactions

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

Assessment Boundaries
The LAA for recreation and tourism is MODG. The RAA is not applicable.

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

- Negligible – no expected changes to recreation and tourism.
- Low – small measurable change to tourism expected and/or minor limitations to recreation use.
- Moderate – moderate measurable change to tourism and/or moderate limitations to recreation use.
- High – high measurable change to tourism and/or widespread limitation to recreation use.

Effects
The 2017 Nova Scotia Visitor Exit survey, administered by Tourism Nova Scotia in 2015 and 2017 combined with results published in 2019, shows little information about attractions that could be related to the region surrounding the Project. No spatial data is available regarding the places visited within province, limiting the understanding of the impact that tourism has on the communities that surround the Project. Given that the main attractions discussed in the exit survey report are coastal scenery, the world's highest tides, lobster consumption, and the attractions in the Halifax Regional Municipality, the communities surrounding the Project do not appear to be significant tourist destinations, indicating that the Project is not likely to have a significant impact on tourism in the area.

It is difficult to determine with certainty how tourists will react to a wind power development. Wind farms are objects of fascination for many and thus could generate tourism for the local community, while others consider them to be an "eyesore". Some wind farms attract thousands of visitors per year and the benefits of even drawing a fraction of that number of visitors to a community can be felt by many businesses including shops, restaurants, and hotels (CanWEA, 2006a). Pincher Creek, Alberta developed a 19 MW wind farm in 1993. Since that time, tourism revenue from visitors from as far away as Russia has generated $5,000 in annual sales of clothing and souvenirs branded with the “Naturally Powerful Pincher Creek” logo (CanWEA, 2006a). The North Cape Wind Farm, a 10.56 MW wind facility located near Tignish, Prince Edward Island, has become a regional attraction, bringing in over 60,000 visitors per year. PEI’s provincial government constructed a restaurant and gift shop at the site, resulting in a capital expenditure of $1.4 million. At the time of publication, the restaurant and gift shop were generating approximately $260,000 in annual revenue and employing 20 seasonal workers from mid-May to the end of October (CanWEA, 2006b).

A 2002 study by Market and Opinion Research International interviewed tourists visiting Argyll and Bute, Scotland and asked them about their attitudes towards the presence of wind farms in the area. Of those who knew about the surrounding wind farms (40% of those interviewed), 43% felt that wind farms had a positive effect on the area, 43% felt it made no difference, and 8% felt it had a negative effect (Market and Opinion Research International, 2002).

Guysborough County, including the region that is surrounding the Study Area, is a very rural landscape with relatively commercial or residential development outside of the major population centres and concentrated communities. With the primary industries being related to natural resources, there are a number of forested areas that have been managed for timber harvest and subsequent silviculture. The Porcupine Mountain Quarry in Auld’s Cove directly adjacent to the Canso Causeway is clearly visible from Cape Breton and the causeway itself. Further industrial impacts to the landscape are seen in the immediate vicinity of the Study Area with the Guysborough Waste Management Facility and landfill being situated approximately 6.5 km to the southwest. For further information on the viewplanes and landscape impacts, see Section 10.4.

The turbines will consist of a small footprint on leased Crown land. The Project Team is committed to working with local recreational groups to ensure continued access to the area and associated trails, within the bounds of all safety considerations. As discussed above, the presence of turbines is highly compatible with most land-based recreation activities and is not expected to limit the usability of the area.

Mitigation Measures

- Continue to work with local recreation groups to ensure continued access within the Project Area.

Monitoring

A specific tourism and recreation monitoring program is not recommended.

Conclusion

The impact to tourism and recreation is expected to be negligible to low, extend to the LAA for a medium duration, be continuous, and reversible. Impacts related to tourism and recreation are considered not significant.

8.5 Other Undertakings in the Area

There are no projects of similar scale or design in Guysborough County, though there is a single Turbine near Mulgrave with an operating capacity of 2.3 MW that was erected through the Community Feed-In Tariff Program in 2014. Across the Strait of Canso at Point Tupper there is an 11-turbine Project erected in 2010, generating a nominal capacity of 22 MW which is owned by Renewable Energy Services Limited and NS Power. Sable Wind, a wind project owned by MODG, is located near Canso, approximately 47 km to the southeast. This project is comprised of 6 turbines for a total nominal power output of 13.8 MW.

9.0 ARCHAEOLOGICAL RESOURCES

9.1 Archaeological Resource Impact Assessment

9.1.1 Overview

The purpose of the ARIA is to highlight areas of potential archaeological sensitivity associated with the Project. Boreas Heritage Consulting Inc. was contracted to conduct the ARIA, which was directed by Sara Beanlands.

9.1.2 Regulatory Context

The *Special Places Protection Act,* RSNS 1989, c 438 provides the Province of Nova Scotia with a mandate to protect important archaeological, historical, and palaeontological sites and remains, including those underwater. A permit is required for any archaeological or palaeontological exploration or excavation in Nova Scotia. The permit system ensures that work is completed based on established standards by qualified applicants.

This ARIA was conducted in accordance with the terms of Heritage Research Permit A2022NS033, issued by NSCCTH – Special Places Program.

As archaeological work can often result in findings or information of a confidential or sensitive nature, a summary is provided in the EA, with the detailed findings provided directly to NSCCTH for review. It is understood that the findings and recommendations of the ARIA are considered "draft" until the report is accepted by NSCCTH.

9.1.3 Assessment Methodology

The objectives of the ARIA were to:

- Evaluate archaeological potential within the Assessment Area.
- Identify and delineate areas considered to exhibit high potential for encountering archaeological resources.
- Provide detailed and accurate information on the results of the survey.
- Provide comprehensive recommendations so that appropriate archaeological resource management strategies can be devised.

To achieve these ends, Boreas Heritage designed an assessment strategy consisting of a desktop component (background screening) and a field component (archaeological reconnaissance).

The desktop component examined three elements: the environmental context, the archaeological context, and the historical context of the Assessment Area. The environmental context is examined to identify past and current environmental influences or conditions that may elevate archaeological potential (e.g., topography, local resources, and potential for agriculture). The archaeological context is examined to identify how people used and occupied the surrounding landscape based on evidence from previously registered archaeological sites and past archaeological work conducted near the Project. The historical context is examined to identify how people used and occupied the local area based on evidence from published archival documents, ethno-historic records, local oral traditions, historic maps, local and/or regional histories, scholarly texts, and available property records.

In Nova Scotia, the Maritime Archaeological Resource Inventory (MARI) is maintained by the Nova Scotia Museum, on behalf of NSCCTH. Reports from past archaeological assessments and academic research conducted near the Project provide archaeological context, which informs the interpretation and evaluation of any potential archaeological resources identified during the field component of the ARIA.

Additionally, the desktop component involves a general review of topographic maps, coastal charts, and aerial photographs to identify topographical and hydrological attributes that correlate with high archaeological potential (e.g., waterfalls/rapids as focal points for fishing or requiring portage, submerged marine terraces representing former coastline). These attributes are also incorporated into the archaeological potential model, developed by Boreas Heritage.

The field component involves an on-site visual and non-intrusive examination of the Assessment Area. Parallel pedestrian transects are completed, at intervals of 20 to 30 m (maximum of 50 m), across the Assessment Area to visually assess archaeological potential. These transects assist in maintaining effective coverage. Structured pedestrian transects assist in the recognition of topographic and/or vegetative anomalies that may inform the extent and nature of previous disturbance factors in the Assessment Area (e.g., clear-cutting, ploughing, construction earthworks), or suggest an elevation in archaeological potential, including evidence of buried archaeological resources (e.g., small knolls, apple trees in the forest, overgrown depressions or abandoned roads).

The process and results of the field component are documented in field notes and with digital photographs. Upon identification of areas of high archaeological potential, or confirmed archaeological resources, these locations and features are sufficiently documented to make informed archaeological resource management recommendations. Confirmed archaeological resources, as determined by NSCCTH, will result in the registration of the site(s) in the MARI database.

9.1.4 Assessment Results

Based on the results of the ARIA, Boreas Heritage identified seven areas of high archaeological potential within the Assessment Area. The Project design was modified to ensure avoidance of one of these areas, while the other six will be subjected to a shovel testing program if they cannot be avoided during the detail design phase.

Ground disturbance associated with the transmission interconnection line is expected to be minimal and specific to the placement of power poles. Once the detailed design phase identifies the areas of disturbance, these areas will be investigated under a separate permit from NSCCTH, prior to the construction of the transmission interconnection line. Should archaeological resources be identified, the design will be modified to ensure avoidance is achieved. The EA Branch and NSCCTH will be engaged throughout this process. No ground disturbance associated with the transmission interconnection line will occur until a separate ARIA is completed and accepted by NSCCTH.

All remaining portions of the Assessment Area are considered to exhibit low archaeological potential for encountering archaeological resources. As a result, Boreas Heritage recommends these areas be cleared by NSCCTH of any further requirement for future archaeological assessment.

9.1.5 Effects Assessment

Project-Archaeological Resources Interactions

Project activities could interact with archaeological resources during earth moving activities (Table 9.1).

Table 9.1: Potential Project-Archaeological Resources Interactions

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

Assessment Boundaries

The LAA for archaeological resources is the Assessment Area (Drawing 2.2). The RAA is not applicable.

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

- Negligible – activities have no potential for encountering archaeological resources during ground disturbance
- Low – activities have a low potential for encountering archaeological resources during ground disturbance
- Moderate – activities have a moderate potential for encountering archaeological resources during ground disturbance
- High – activities have a high potential for encountering archaeological resources during ground disturbance

Effects
The ARIA resulted in the identification of seven areas (HPA-01 to HPA-07) considered to exhibit high potential for encountering archaeological resources. Six of these areas (HPA-01 and HPA-00) are associated with watercourse crossings and will be subject to shovel testing if they cannot be avoided during the detail design phase. HPA-07 is an area of identified historic activity with a cellar depression and adjacent stone wall. The turbine that was previously planned near HPA-07 was subsequently removed from the layout, such that the Project will completely avoid this area.

All remaining portions of the Assessment Area are considered to exhibit low archaeological potential for encountering archaeological resources. As a result, Boreas Heritage recommends these areas be cleared by NSCCTH of any further requirement for future archaeological assessment.

Mitigation
The following mitigation measures are recommended:

- Develop procedures in the EPP related to the potential unexpected discovery of archaeological items or sites during construction. This would include halting any work immediately upon discovery of suspected resources and contacting NSCCTH. If the resources are suspected to be of Mi'kmaq origin, the Executive Director of KMKNO would also be contacted.
- Maintain avoidance of HPA-07.
- Conduct shovel testing in other areas of high potential prior to ground disturbance if they cannot be avoided during the detail design phase.
- Conduct additional archaeological assessment if, during the detail design phase, it is determined that ground disturbance is required in areas not previously assessed. The EA Branch will be notified in advance and will be provided with the acceptance letter from NSCCTH prior to completion of any disturbance in those areas.

Monitoring
No monitoring programs are recommended.

Conclusion
With the implementation of the above mitigation measures, the potential for encountering archaeological resources is low to moderate. Effects would occur once, be short-term, be restricted to the LAA, and be irreversible (to be confirmed based on any identified resources, as applicable). Effects are considered not significant.

10.0 OTHER CONSIDERATIONS

10.1 Human Health

The Project will be completed in the safest manner possible in accordance with applicable health and safety related standards and requirements and the wind farm developer's established health, safety, and environmental program. The wind turbine model chosen for this Project will comply with international wind class standards and incorporate safety features to reduce the risk of lightning strikes, operation during ice build-up, and general malfunctions. In addition, wind turbine siting considerations were incorporated into the Project's design to reduce potential impacts on nearby receptors.

Potential human health impacts associated with air quality, shadow flicker, sound, effects from climate change, and other natural environmental hazards on the Project, and accidents and malfunctions are addressed in the following sections:

- Section 7.1.1 – Atmosphere and Air Quality
- Section 10.3 – Shadow Flicker
- Section 10.5 – Sound
- Section 12.0 - Effect of the Environment on the Undertaking
- Section 13.0 – Accidents and Malfunctions

Other potential effects to human health include electromagnetic fields (EMFs), ice throw, and electrical fires, which are discussed in the sections that follow.

10.1.1 Electromagnetic Fields

EMFs are a form of naturally occurring energy that is produced through the use of equipment or electrical appliances, not unique to wind turbines or farms. EMFs are concentrated near the source and quickly dissipating with distance (Health Canada, 2020). Sources of low frequency EMFs may be associated with the following Project components:

- Wind turbines
- Transmission lines
- Underground cables
- Generator transformers

Several studies and reports have demonstrated that EMFs generated by wind turbines and associated infrastructure are not considered to be a concern to human health (CMOH, 2010; Knopper et al., 2014; & McCallum et al., 2014). Therefore, impacts to human health from Project emitted EMFs are negligible.

10.1.2 Ice Throw

Ice throw and ice fall (or shedding) occurs when ice builds up and releases from the turbine's rotor blades, tower, or nacelle under specific temperature and humidity conditions. Ice fragments can either be thrown from the rotor due to centrifugal and aerodynamic forces or fall to the ground during idling or shutdown periods (CREA, 2020).

Typically, ice buildup is associated with high winds or extreme weather events when the turbines are already shutdown. In addition, wind turbines have built-in ice or vibrational sensors that will shut down the turbine in the event of an ice buildup. Ice throw typically only occurs due to a malfunction of the control system or during start-up when speeds are low. The risk of injury or damage as a result of ice throw is only present within close proximity to the turbine during conditions of ice buildup. The maximum throwing distance of accumulated ice from a turbine is determined using the following equation (CREA, 2020):

$$d_t = 1.5 * (D + H)$$

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

Based on the above equation and turbine model specifications (150 m rotor diameter and 120 m hub height), the maximum throwing distance associated with the Project's turbines is 405 m. Turbines for the proposed Project have been located over 600 m from the nearest seasonal residence and over 900 m from the nearest permanent residence. The public road within closest proximity to a turbine is NS-16 which is approximately 1.2 km southwest from the nearest turbine. Therefore, there is little to no risk associated with ice throw to the public using these roads. However, there is a collection of logging roads and trails that exists throughout the Study Area, which are frequented by recreationalists for snowmobiling, hunting, and ATV use.

Mitigation measures to protect recreation users and site workers will include:

- Continue engagement and education with local recreational users regarding the safe continued use of lands within the Study Area.
- Install signage illustrating and warning of potential hazards associated with ice throw and fall around wind turbines.
- Equip staff and workers accessing the Project Area for maintenance or other purposes with necessary personal protective equipment (PPE) and associated safety protocols and procedures to mitigate risk of injury and/or fatality, especially during potential icing conditions.

With the implementation of these mitigation measures, the impacts to human health from ice throw are negligible.

10.1.3 Electrical Fires

Wind turbines contain the key elements required for fire: fuel, oxygen, and a source of ignition. These elements are housed in the turbine nacelle, which is a compact and enclosed space at a height of 120 m. Fires may be ignited by lightning, an electrical malfunction, and mechanical malfunction, or during maintenance. The height and remote nature of the turbines may make the early detection and effective control of fires difficult. However, these factors also reduce the direct impacts of electrical fires to human health. Evidence indicates that the occurrence of fires in wind turbines is rare. Between the years of 1995 and 2012, an average 11.7 fires were reported globally on an annual basis, resulting in four injuries and no fatalities over this time (Uadiale et al., 2014). With ~200,000 operational turbines worldwide in 2011, fires were reported in 0.006% of turbines (Uadiale et al., 2014). It is believed, however, that turbine fires are under reported, and the proportion of fires occurring in turbines is closer to 0.05% (Uadiale et al., 2014). This percentage is still very small, and wind turbine fires remain rare in comparison to fires occurring in other energy industries (Whitlock, 2015).

The wind energy industry has implemented various standards and guidelines to minimize the chances of fires occurring in turbines. This Project specifically has turbines at least 600 m from the nearest non-participating seasonal building, and approximately 1.2 km from the nearest public road. The turbines chosen have fire prevention systems comprised of four elements: preventive design solutions, lightning protection, arc detection, and heat and smoke detection to limit fire ignition. A fire prevention and evacuation plan will be implemented for Project personnel as part of the EPP, in addition to general safety protocol and training. Impacts to human health from electrical fires are negligible.

10.1.4 Conclusion

The impact to human health is expected to be negligible, and the effects are therefore considered not significant.

10.2 Electromagnetic Interference

10.2.1 Overview

The rotating blades and support structures of wind turbines can interfere with various types of electromagnetic signals emitted from telecommunication and radar systems (RABC & CanWEA 2020).

EMI created by a wind turbine can be classified into two categories: obstruction and reflection. Obstruction occurs when a wind turbine is placed between a receiver and a transmitter, creating an area where the signal is weakened and/or blocked. Reflection is caused by the distortion between a raw signal and a reflection of the signal from an object. Scatter is a sub-category of reflection caused by the rotor blade movement.

The EMI assessment identified point-to-point, broadcast systems, radar, navigation, and communications systems susceptible to the effects of windfarm interference. The specific characteristics of a wind turbine will influence the type and magnitude of the interference. Other factors that influence interference include blade dimension and design, tower height, diameter of the supporting tower, as well as the material used for blade and tower construction.

10.2.2 Assessment Guidelines

The Radio Advisory Board of Canada (RABC) and Canadian Wind Energy Association (CanWEA) developed guidelines for assessing the EMI potential from a wind turbine development: Technical Information and Coordination between Wind Turbines and Radiocommunication and Radar Systems (RABC & CanWEA, 2020); hereafter referred to as the RABC Guidelines.

These guidelines outline a consultation-based assessment protocol that establishes areas, called “consultation zones”, around transmission systems, based on the type and function of the system.

10.2.3 Assessment Methods

Consultation is generally the best method of notification, and this process typically begins with a letter distribution to those parties affected by the development. A summary of the RABC Guidelines for determining consultation zones is provided in Table 10.1.

Table 10.1: RABC Guidelines Recommended Consultation Zones

Systems	Consultation Zone
Point-to-Point Systems above 890 MHz	**1 km**
Broadcast Transmitters (AM, FM, and TV stations)	AM station: **5 km** for omnidirectional (single tower) antenna system **15 km** for directional (multiple towers) antenna system FM station: **2 km** TV station: **2 km**
Over-the-Air Reception (TV off-air pickup, consumer TV receivers)	Analog TV Station (NTSC): **15 km** Digital TV (DTV) station (ATSC): **10 km**
Cellular Type Networks, Land Mobile Radio Networks, and Point-to-Point Systems below 890 MHz	**1 km**
Satellite Systems (Direct to Home, Satellite Ground Stations)	**500 m**
Air Defence Radars, Vessel Traffic Radars, Air Traffic Control Radars, and Weather Radars	DND Air Defence Radar: **100 km** DND or Nav Canada Air Traffic Control Primary Surveillance Radar: **80 km**

Systems	Consultation Zone
	DND or Nav Can Air Traffic Control Secondary Surveillance Radar: **10 km** DND Precision Approach Radar: **40 km** Canadian Coast Guard Vessel Traffic Radar System: **60 km** Military or Civilian airfield: **10 km** Environment Canada Weather Radar: **50 km**
VHF OmniRange	**15 km**

To conduct an EMI assessment, the following information regarding turbine design and placement is generally required to complete notifications:

- Turbine Universal Transverse Mercator (UTM) coordinates
- Number of turbines
- Ground elevation
- Tower/hub height of each turbine
- Nacelle height
- Rotor diameter
- Turbine blade sweep diameter (or length of blades)
- Turbine base diameter
- Substation/converter location coordinates and height(s) along with new transmission line(s) to connect to a grid

Response time and feedback from the various organizations varies and can take up to 12 weeks. If turbine type, layout or design changes, many organizations will need to be re-consulted prior to proceeding.

10.2.4 Assessment Results

Consultation with relevant agencies was completed and results are provided in Table 10.2. Reponses are provided in Appendix N.

Table 10.2: EMI Consultation Results

Signal Source	Operator	Consultation Results
Air defense and air control radar systems DND Radio Communications	Department of National Defense	Correspondence sent September 2022. Letter of non-objection received November 2022. Updated layout to be submitted January 2023.

Signal Source	Operator	Consultation Results
Maritime vessel traffic system radars	Canadian Coast Guard	Correspondence sent September 2022. Letter of non-objection received November 2022. Updated layout to be submitted January 2023.
VHF omnidirectional range Primary air traffic control surveillance radar	NAV Canada	Correspondence sent September 2022. Land Use file number received November 2022. Correction request received December 2022. Updated layout to be submitted January 2023.
Weather radar	ECCC	Correspondence sent September 2022. Letter of non-objection received October 2022. Updated layout to be submitted January 2023.
Radiocommunication Systems	RCMP Guysborough Police Port Hawkesbury Police	Correspondence sent September 2022. Response received from the RCMP in October 2022 requesting coordination with Bell, who are acting on behalf of the RCMP in the province with leased towers. No response received from Guysborough Police or Port Hawkesbury Police. Updated layout to be submitted January 2023.
Regulator	Innovation, Science, and Economic Development Canada	Correspondence sent September 2022 Response received in October 2022 requesting a reception analysis, as the proposed turbines are within 15 km of an analog TV station in Port Hawkesbury. Updated layout to be submitted January 2023.
Telecom	Bell Eastlink Seaside Communications Rogers Communications NCS Managed Services Inc.	Correspondence sent September 2022. Letter of non-objection received from Bell September 2022. Acknowledgement received from Eastlink; no response received from Seaside, Rogers Communications, or NCS Managed Services Inc. Updated layout to be submitted January 2023.

Signal Source	Operator	Consultation Results
Emergency Services	Mulgrave Volunteer Fire Department Auld's Cover Fire Hall Tracadie & District Volunteer Fire Department Port Hawkesbury Volunteer Fire Department	Correspondence sent September 2022 No responses received. Updated layout to be submitted January 2023.

10.2.5 Effects Assessment

Project-EMI Interactions
Project activities only interact with electromagnetic signals during operations (Table 10.3).

Table 10.3: Potential Project-EMI Interactions

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

Assessment Boundaries
Assessment boundaries align with the consultation boundaries established by the RABC Guidelines (Table 10.1).

Assessment Criteria
Assessment criteria provided in Section 4.6 apply for EMI. The VC-specific definition for magnitude is applied to each operator individually as follows:

- Low – letter of no objection received.
- Moderate – organization requests additional consultation.
- High – letter of objection received.

Effects
As shown in Table 10.2, responses from six of 17 operators have been received, with four indicating no objection, one requesting a correction, and one requesting a reception analysis, as proposed turbines are within 15 km of an analog TV station in Port Hawkesbury.

Mitigation
The following general mitigation measures regarding EMI will be implemented:

- Ensure operators are consulted on any future layout updates.
- Complete a reception analysis for a local analog TV station, as requested by and in consultation with Industry Innovation, Science, and Economic Development Canada.
- Continue consultation with operators who have not yet responded to the notification letters.

Monitoring
No monitoring programs are recommended.

Conclusion
Results are characterized as moderate magnitude, within the consultation zones defined by RABC Guidelines, medium duration, continuous, reversible, and not significant.

10.3 Shadow Flicker

10.3.1 Overview

Shadow flicker can occur when rotating blades cast flickering shadows during times of direct sunlight. The magnitude of shadow flicker is determined by the position and height of the sun, wind speed and direction, geographical location, time of year, cloud cover, turbine hub height and rotor diameter, and proximity to the turbine.

For shadow flicker to occur, the following criteria must be met:

- The sun must be shining and not be obscured by clouds/fog.
- The source turbine must be operating.
- The wind turbine must be situated between the sun and the shadow receptor.
- The wind turbine must be facing directly towards, or away from, the sun such that the rotational plane of the blades (i.e., rotor plane) is perpendicular to the azimuth of incident sun rays. For this to occur, the wind direction would have to be parallel to the azimuth of the incident sun rays throughout the day.
- The line of sight between the turbine and the shadow receptor must be clear. Light-impermeable obstacles, such as vegetation, tall structures, etc., will prevent shadow flicker from occurring at the receptor.
- The shadow receptor has to be close enough to the turbine to be in the shadow.

10.3.2 Regulatory Context

There are no municipal, provincial, or federal guidelines related to shadow flicker, but many jurisdictions (including NSECC) have adopted the industry standard of no more than 30 hours of shadow flicker per year, or no more than 30 minutes of shadow flicker on the worst day of the year at residential receptors.

10.3.3 Assessment Methodology

The shadow flicker assessment was completed through modelling to achieve the following objectives:

- To identify nearby receptors that may potentially experience shadow flicker from the Project's operation.
- To quantify and assess the duration and frequency of shadow flicker for nearby residents under worst-case scenarios.
- To determine if applicable guidelines are met/exceeded.
- To mitigate and minimize shadow flicker experienced by nearby residents, as necessary.

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

The initial analysis was conducted using the WindPRO version 3.5.552 software package under worst-case scenario conditions (i.e., maximum amount of shadow) which assumes that all the criteria listed in Section 10.3.1 are always met.

As the worst-case scenario uses highly conservative assumptions, resulting in modelling conditions that are not possible to occur in practice, a real-case scenario was developed to better represent site and receptor characteristics. The real-case scenario included the following changes to the criteria listed in Section 10.3.1:

- Incorporation of average daily sunshine hours from the Charlottetown weather station (Table 10.4).

Table 10.4: Sunshine Data Used for the Real-Case Scenario

Month	Average Daily Sunshine Hours*
January	3.37
February	4.18
March	4.42
April	5.04
May	6.34
June	7.54
July	7.95
August	7.19
September	5.76
October	3.98
November	2.63
December	2.31

*Source: Charlottetown Weather Station (WindPro Weather station)

The real-case scenario is still conservative as no line-of-sight obstacles (e.g., trees, vegetation) were considered and the model assumed that the turbines were always in operation, which is not the case.

10.3.4 Assessment Results

A total of 88 potential receptors were identified within 2 km of the Assessment Area (Drawings 10.1A-10.1C). Under worst-case scenario conditions (meeting criteria described in Section 10.3.1 above), eleven potential receptors exceed 30 hours of shadow flicker per year and/or 30 minutes of shadow flicker on the worst day (Table 10.5). Detailed results showing all potential receptors within 2 km of the Study Area are provided in Appendix O.

Table 10.5: Potential Receptors Impacted by Shadow Flicker – Worst-case Scenario

Receptor ID*	Receptor Description	Hours of Shadow Flicker per Year	Minutes of Shadow Flicker per Day (on the worst day)
AK	Camp; missing window	258:34	109
AV	Seasonal cottage	50:26	51
AN	Seasonal cottage	53:34	54
I	Camp; missing windows	46:15	42
AQ	Seasonal cottage	44:00	38
J	Seasonal cottage	40:48	39
AM	Abandoned camp; collapsing	35:34	26
H	Abandoned camp; broken wall, hole in roof	47:17	38
D	Seasonal cottage	42:51	30
AL	Camp	21:03	32
BN	Seasonal cottage	28:46	30

*Receptor ID corresponds to labelling on Drawing 10.1A-10.1C.

The model was subsequently re-run using the sunshine data in Table 10.4. Real-case scenario results provided in Table 10.6 and Drawing 10.1A-10.1C. Detailed results are provided in Appendix O.

Table 10.6: Structures Impacted by Shadow Flicker – Real-case Scenario

Receptor ID*	Receptor Description	Hours of Shadow Flicker per Year**
AK	Camp; missing windows and door	89:41
AV	Seasonal cottage	15:08
AN	Seasonal cottage	19:45
I	Camp; missing windows	15:27

Receptor ID*	Receptor Description	Hours of Shadow Flicker per Year**
AQ	Seasonal cottage	13:25
J	Seasonal cottage	13:42
AM	Abandoned camp; collapsing	16:23
H	Abandoned camp; broken wall, hole in roof	16:16
D	Seasonal cottage	16:35
AL	Camp	8:13
BN	Seasonal cottage	8:39

*Receptor ID corresponds to labelling on Drawings 10.1A-10.1C.

**WINDPRO cannot calculate minutes per day for a real-case scenario.

One potential receptor exceeds the recommended guideline of 30 hours of shadow flicker per year. The structure, which is located northeast of turbine 14, was confirmed in the field to be a small, single level structure, with no windows and missing doors. It appeared to be abandoned and uninhabitable and is therefore not considered to be a receptor.

10.3.5 Effects Assessment

Project-Shadow Flicker Interactions
Project activities only interact with shadow flicker during wind turbine operations (Table 10.7).

Table 10.7: Potential Project-Shadow Flicker Interactions

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

Assessment Boundaries
The LAA for shadow flicker includes a 2 km area around the Assessment Area (Drawings 10.1A-10.1C. The RAA is not applicable for shadow flicker.

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

- Negligible – no measurable shadow flicker predicted at receptor location(s).
- Low – measurable shadow flicker predicted at receptor location(s), but results are below guidance.
- High – shadow flicker predicted to exceed guidance at receptor location(s).

Effects
Modelling for the real-case scenario predicts that all receptors will experience less than 30 hours of shadow flicker per year. This is still considered a conservative assessment because the real-case scenario still assumes the wind turbines are always in operation (i.e., rotors always spinning) and does not account for screening by trees, outbuildings, or other local structures. In addition, none of the structures in Table 10.6 are permanent residences and some structures appear to have been abandoned and/or are uninhabitable.

Mitigation
No mitigation is recommended.

The Project will develop a complaint response protocol, which will consider complaints related to shadow flicker and outline a process to investigate complaints. Mitigation to resolve complaints, if determined to be necessary, will be completed on a case-by-case basis in consultation with the affected landowner and may include the provision of screening, the development of a turbine-specific curtailment plan, or a negotiated form of compensation.

Monitoring
No monitoring programs are recommended.

Conclusion
Results are characterized as low magnitude, within the LAA, medium duration, intermittent, reversible, and not significant.

10.4 Visual Impacts

10.4.1 Overview

The development of wind turbines has the potential to change the visual landscape and/or aesthetics of a local area. The level of change varies depending on the significance of the landscape, local topography, and the degree to which the turbines alter or modify the landscape. Locations of concern may include:

- Public viewpoints
- Protected areas
- Areas of local significance
- Recreational areas (hiking trails, biking routes, etc.)

Lighting associated with wind turbines may also result in visual impacts, especially during the nighttime.

10.4.2 Regulatory Context

There are no provincial or federal guidelines related to viewscape.

Operational turbine lighting is regulated by NAV Canada and Transport Canada.

10.4.3 Assessment Methodology

Visual simulations were undertaken to assess the wind turbines impact on the visual landscape and local aesthetics. Locations for the visual assessment were selected based on accessible areas where turbines were expected to be visible within the area surrounding the Project and close proximity to communities. The following locations were selected (Drawing 10.2A-10.2E):

- View from in front of the Nova Scotia Community College (Strait Area Campus) (coordinates provided in Drawing 10.2B)
- Lincolnville from Highway 16 (coordinates provided in Drawing 10.2C)
- Creignish from Route 19 (coordinates provided in Drawing 10.2D)
- Off ramp to Monastery from Highway 104 (coordinates provided in Drawing 10.2E)

Photos were taken using a Canon EOS REBEL T7 camera with a 50 mm lens. Precise location, time, direction of view, and weather conditions at the time of the photo were also recorded.

The visual simulations were completed using WindPro software that incorporates elevation, turbine location, and camera/photo location information to simulate what the landscape will look like after the wind turbines have been constructed. Weather conditions (clear sky, overcast, etc.) and visibility (clear, fog, etc.) can be selected during the process to demonstrate the visual aesthetics of the Project over various environmental conditions.

The result is a series of photos showing the landscape from selected locations with the turbines in place.

10.4.4 Assessment Results

Visual simulations are provided in Drawings 10.2A-10.2E.

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

10.4.5 Effects Assessment

Project-Visual Aesthetics Interactions

Project activities only interact with visual aesthetics during operations (Table 10.8).

Table 10.8: Potential Project-Visual Aesthetics Interactions

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

Assessment Boundaries
The LAA for visual effects includes the observer locations. The RAA is not applicable for visual effects.

Assessment Criteria
Assessment criteria provided in Section 4.6 apply for visual effects. The VC-specific definition for magnitude is applied to each observer location individually as follows:

- Negligible – Project components cannot be seen from the observer location.
- Low – Project components may be seen from the observer location, but do not stand out or are not discernible in the view (i.e., low exposure on the horizon).
- Moderate – Project components can be seen from the observer location but are not a prominent feature in the view.
- High – Project components are a prominent feature in the view from the observer location.

It is noted that the magnitude criteria for visual effects is considered a neutral criteria as the perception of a change to the visual landscape can be adverse or positive depending on the individual observer.

Effects
Based on the simulations, turbines are visible from all observer locations. Photos were taken in spring with no foliage masking.

Operational lighting could be visible from the turbines during the night. However, potential impacts to residents are expected to be limited due to the distance between the Project and nearest permanent residence, which is over 900 m. Lighting intensity and flashes will be minimized, as allowable by Transport Canada; and the exterior turbine maintenance lights will be turned off prior to maintenance staff leaving the site.

Mitigation
No mitigation is recommended related to viewscapes.

The following mitigation is recommended regarding turbine lighting:

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

Construction activities will be limited to daytime hours when possible. It is noted that the turbine may be erected during the evening as the activity must be completed when the wind is less than 8 m/s as a safety measure. On-site lighting will be pointed downward to minimize light throw.

Monitoring
No monitoring programs are recommended.

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

10.5 Sound

10.5.1 Overview

The assessment of sound considered both construction and operational generated noise from the Project.

During construction, heavy equipment, machinery, and light vehicles will emit sound to the surrounding environment from activities associated with the development of wind turbine pads, roads, the transmission interconnection and grid connection, along with the subsequent assembly of wind turbines. To quantify potential impacts, noise levels of equipment anticipated to be used for the Project's construction were used to calculate noise levels at set distances from the Assessment Area in consideration of nearby receptors.

During the operational phase of the Project, wind turbines will emit sound to the surrounding environment from mechanical equipment operation and the turbine rotors interaction with the surrounding air (aerodynamic sound). Design and engineering evolution of wind turbine components (e.g., anti-vibration products) have reduced, but not eliminated, mechanical and aerodynamic sound and its associated impacts. To quantify potential impacts of turbine generated noise on nearby receptors, detailed sound modeling was completed.

10.5.2 Regulatory Context

Changes to the acoustic environment during construction and operational activities could result in displacement, annoyance, and interference of communication, sleep, and/or working efficiency. As such, sound levels are regulated at the various government agencies levels (Table 10.9).

Table 10.9: Summary of Sound Level Regulations and Guidelines

Regulated By	Regulation/Guidance	Sound Level (dBA)	Hours / Duration
For Residential Receptors			
Nova Scotia Department of Environment and Labour (now NSECC)	Guidelines for Environmental Noise Measurement and Assessment (NSECC, 1990)*	≤ 65	0700 to 1900
		≤ 60	1900 to 2300
		≤ 55	2300 to 0700
NSECC	Guide to Preparing an EA Registration Document for Wind Power Projects in Nova Scotia (NSECC, 2021)	≤ 40	During the operation of wind turbines
Guysborough County	Municipality of the District of Guysborough Nose Control By-Law (Municipality of the District of Guysborough, 2011)	65	0600 to 2300
		55	2300 to 0600
For Occupational Safety			
Workplace Health and Safety Regulations & Canadian Centre for Occupational Health and Safety (CCOHS)	Noise – Occupational Exposure Limits in Canada (Workplace Health and Safety Regulations & CCOHS, 2022)	85	8-hour maximum

*Note: NSECC is in the process of updating these guidelines (NSECC, 2022e) which are currently in consultation phase. Any changes to the guidelines as a result of this update will be referenced/incorporated as part of the Project's EMP.

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

10.5.3 Assessment Methodology

Ambient Sound
Aerial imagery and field observations were used to identify nearby sources of sound and characterize the ambient sound within the Study Area.

Construction Sound
The assessment of construction sound is based on desktop studies and addresses Project-related effects on human receptors. The objectives aim to achieve the following:

- Establish the construction sound levels produced by the Project.
- Identify nearby receptors that may be exposed to construction sound produced by the Project.
- Determine if the applicable guidelines are met/exceeded.
- Mitigate and minimize any impacts experienced by nearby receptors.

Receptors (including sensitive receptors such as schools, daycares, and senior residences) located within 2 km of the Assessment Area were identified using GIS data from the Nova Scotia Geomatics Centre and aerial imagery.

Note, sound levels and impacts from blasting activities have not been included in this assessment as these activities are not anticipated. If blasting is determined to be required during construction, the Proponent will notify NSECC and apply for any required permits and approvals. Any potential impacts, mitigation, and subsequent required monitoring will be described in the Project's EPP.

Operational Sound
The operational sound assessment was completed through a combination of desktop studies and modelling with the following objectives in mind:

- Identify receptors/dwellings within the vicinity of the Project.
- Identify existing operational turbines within 3 km of the Project.
- Identify and assess any potential impacts on these receptors, including cumulative effects from neighbouring turbines, if present.
- Avoid and/or mitigate impacts of Project generated sound on nearby receptors.

The sound assessment identified receptors within a 2 km radius of the Assessment Area. The assessment was completed using the WindPRO version 3.5.552 software package. For the purposes of this model, receptors included all structures identified in GIS data from the Nova Scotia Geomatics Centre, as well as any additional identifiable structures based on aerial imagery. No attempt to distinguish sheds and outbuildings from dwellings or cottages was made. Any structures located on "Project lands" were not included in the assessment.

A review of EAs for wind projects was conducted to identify any existing operational turbines within 3 km of the Project. The Mulgrave Community Wind Power Project EA was registered in December 2013 and is located 3 km from the Project. A review of the sound modelling results from the EA indicated that sound levels from the turbine are less than 40 dBA at a distance of between 443 m and 784 m. Therefore, sound levels from this turbine will not act cumulatively with the Project.

The model followed ISO 9613-2 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method and calculations, and was based on the following input information:

- UTM coordinates for the wind turbines.
- 1/1 Octave band sound power level data, either provided by the manufacturer or calculated by WindPro, for the wind turbines.
- UTM coordinates for receptors (all non-Project participant structures within a 2 km radius of the Assessment Area were evaluated).
- A wind speed of 10 m per second, the speed at which the highest sound power level output is achieved (based on test data from the manufacturer).
- Topographic data for the surrounding area.

The ISO 9613-2 calculation method assumes meteorological conditions that are ideal for noise propagation, including a ground temperature of 10°C and 70% relative atmospheric humidity. A ground factor of 0.7 was applied to the model, representing predominantly porous ground (i.e., capable of vegetative growth) interspersed with hard surfaces (e.g., water).

Two turbines (T13 and T18) were adapted with serrated blades to further minimize sound levels in areas where receptors are clustered.

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

10.5.4 Sound Assessment Results

Ambient Sound
When evaluating sound levels produced by the Project, it is important to understand ambient sound existing in and around the Study Area pre-development (NRC, 2007).

The Study Area is surrounded by primary/secondary roadways including Highway 104 (north), Route 16 (west), and Route 344 (east/south). These roadways are travelled daily by vehicular traffic emitting different levels of sound, including transport trucks and motorcycles. Several developments also contribute to ambient sound levels within the Study Area including:

- Porcupine Mountain Quarry (3.6 km northeast)
- Guysborough County Landfill Site (0.7 km south)
- Active forestry (throughout and surrounding the Study Area)

Sounds associated with these activities include operation of heavy machinery, blasting, tree felling, logging trucks, etc. Recreational and local traffic also exists within the Study Area, increasing ambient sound levels from cars, ATV, dirt bikes, etc. Lastly, in addition to anthropogenic sources, there are also natural sources of sounds originating from wildlife, wind, water, and vegetation.

Construction Sound
During construction activities, sound will predominantly be generated through the operation of construction equipment and heavy machinery such as cranes, backhoes, excavators, dump trucks, graders, and transportation vehicles. A summary of sources and anticipated volumes of sound produced during the Project's construction have been provided in Table 10.10.

Table 10.10: Decibel Limits of Construction Equipment Required for the Project

Equipment	Average Noise Level Ranges (in dBA)
Road, Transmission Line, Grid Connection, and Turbine Pad Development	
Backhoe	85-104[1]
Concrete Truck/Pump	103-108[2]
Dozer	89-103[1]
Dump Truck	84-88[1]
Excavator	97-106[2]
Harvesting Equipment (log truck, manual faller, etc.)	85-103[3]
Roller	95-108[2]
ATV	97[4]
Loaders	88[3]
Pickup Trucks	95[4]
Tracked Drilling Units	91-107[5]
Tracked Dump Truck/Decks	91[6]
Tracked Man Lift/Bucket Machines	85[6]
Tracked Radial Boom Derricks/Cranes	93-98[2/6]
Turbine Assembly	
Crane	78-103[1]
Handheld Air Tools	115[2]
Compressor (drilling, pneumatic tools, etc.)	85-104[7]

Note that measurements shown are relevant to the decibel level ranges within close proximity (i.e., less than 15 m of distance) between a receptor and the relevant piece of equipment.

Sources: [1]WorkSafe BC (undated)
[2]Transport Scotland (undated)
[3]WorkSafe BC (2016)
[4]Government of Oregon (undated)
[5]The Driller (2005)
[6]SCE (2016)
[7]Government of Ontario (2021)

The range of decibels anticipated for the Project's construction activities will be between 78 to 115 dBA (from a single piece of equipment within 15 m from the source). Construction activities are anticipated to occur across the spring and summer months of 2023.

Assuming that sound attenuates at the standard rate of 6 dBA per doubling in distance from a given point source, approximate sound levels experienced at incremental distances during construction activities for the Project are provided in Table 10.11. The attenuation rate of sound presented below does not consider local landscape/topography or buildings, and therefore, is considered a "worst-case" scenario for sound levels produced by a single piece of equipment.

Table 10.11: Attenuation of Construction Related Sounds

Case	Example Equipment Type	Sound Level @ 15 m (dBA)*	Point Source Sound Levels (dBA) at Incremental Distances					
			50 m	100 m	200 m	500 m	1,000 m	2,000 m
Minimum	Crane	78	67.5	61.5	55.5	47.5	41.5	35.5
Median	Pickup/ATV	96	85.5	79.5	73.5	65.5	59.5	53.5
Maximum	Handheld Air Tools	115	104.5	98.5	92.5	84.5	78.5	72.5

*Approximate point source sound levels, based on data collected in Table 10.11 above. Combined sound levels produced by multiple pieces of equipment operating simultaneously have not been included in the assessment.

Operational Sound

A total of 88 potential receptors were identified within 2 km of the Study Area. Results of the sound modelling (presented as a heat map) are shown on Drawing 10.3 and detailed results are provided in Appendix P. No operational turbines exist within 3 km of the Project; therefore, only the Project turbines were modelled.

One potential receptor exceeds the recommended guideline for operational sound of 40 dBA, at 45.8 dBA. The structure, which is located northeast of turbine 14, was observed in the field to be a small, single level structure, with no windows and missing doors. It appeared to be abandoned and uninhabitable and is therefore not considered to be a receptor.

Information from the turbine manufacturer confirmed that tonality would be limited to 3 dB at 1.5 m above the ground, 500 m downwind from the turbine. As the nearest non-participating seasonal receptor is greater than 600 m from a turbine and the nearest permanent receptor is greater than 900 m from a turbine, tonality is not expected to be a concern. Therefore, low frequency sound is not expected to be a concern and additional modelling for low frequency sound was not completed. A literature review related to infrasound/low frequency sound is provided in Appendix P.

10.5.5 Effects Assessment

Project-Sound Interactions

Project activities will interact with the acoustic environment during all phases of the Project. Sound related to the decommissioning phase is not specifically addressed because sound levels are expected to be comparable to construction levels (Table 10.12).

Table 10.12: Potential Project-Sound Interactions

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

Assessment Boundaries
The LAA for sound includes a 2 km buffer around the Assessment Area (Drawing 10.3). The RAA is not applicable for sound.

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

Construction Sound
- Negligible – sound levels from Project activities are expected to be ≤55 dBA at residential and sensitive receptor locations.
- Low – sound levels from Project activities may measure between 55-65 dBA at residential and sensitive receptor locations.
- Moderate – sound levels from Project activities may exceed 65 dBA at residential and sensitive receptor locations, but only during high-impact activities (intermittently).
- High – sound levels from Project activities may exceed 65 dBA at residential and sensitive receptor locations during multiple activities.

Operational Sound
- Low – measurable sound levels predicted at receptor location(s), but results are below NSECC guidance.
- High – sound levels predicted to exceed NSECC guidance at receptor location(s).

Effects
During construction of the Project, decibel limits above 55 dBA at residential receptors can result in disruptions of sleep during nighttime hours while sounds above 65 dBA may cause annoyance and disturbance during daytime hours. Sounds produced during construction have the potential to exceed these thresholds at some residential receptors located within close proximity to activities at some locations within the Project Area.

However, all structures located within 900 m of the Project are seasonal camps/cottages and not permanently occupied. Furthermore, many were observed to be abandoned and/or are uninhabitable. Given that the construction footprint is widespread, Project-related construction noise potentially exceeding NSECC guidance at individual receptors would occur over a very short time frame and may not overlap with the use of these properties. Furthermore, the median sound level from construction is similar to sound produced from an ATV or pick-up truck, which is already a common source of sound within the Study Area, as are logging trucks and harvesting equipment. Therefore, most Project-related construction sound will be consistent with existing sound levels. Activities producing higher levels of sound such as blasting (if required) or handheld air tools will be less frequent and last for a very short duration.

All confirmed receptors comply with the NSECC guidance for operational sound.

Mitigation
To minimize construction sound and the potential to disturb receptors during construction, the following general mitigation/protective measures will be implemented:

- Use noise suppressants (e.g., mufflers) on vehicles/equipment.
- Limit vehicle idling.
- Conduct construction activities within the recommended daytime hours of 7:00 am to 10:00 pm.
- Include mitigation and monitoring for blasting in the Project's EPP, if geotechnical investigations determine it is required.

No mitigation is recommended for operational sound.

The Project will develop a complaint response protocol, which will consider complaints related to sound and outline a process to investigate complaints. Mitigation to resolve complaints, if determined to be necessary, will be completed on a case-by-case basis in consultation with the affected landowner. Pre-construction sound levels at key receptor locations will be measured as part of this process to establish baseline conditions for future reference (if needed).

Monitoring
No monitoring programs are recommended.

Conclusion
Construction phase results are characterized as high magnitude, within the LAA, short duration, intermittent, reversible, and not significant.

Operational phase results are characterized as low magnitude, within the LAA, medium duration, intermittent, reversible, and not significant.

11.0 EFFECTS OF THE UNDERTAKING ON THE ENVIRONMENT – SUMMARY

11.1 Summary of Effects of the Undertaking on the Environment

Table 11.1 summarizes the results of the effects assessment for each VC.

Table 11.1: Effects Assessment - Summary

VC	Magnitude of Effects	Geographic Extent of Effects	Timing and Duration of Effects	Frequency of Effects	Reversibility of Effects	Significance Level	Mitigation and/or Monitoring Required?
Atmosphere and Air Quality	Low to negligible – Minimal to no changes are expected to ambient air quality	Within the Project Area	Seasonal aspects not applicable; short-term duration	Intermittent	Reversible	Not significant	Mitigation required; no monitoring required
Climate Change	Positive – A positive effect on GHG emissions is expected	Within the Study Area	Seasonal aspects not applicable; medium-term duration	Continuous	Irreversible	Significant (positive)	Mitigation required; no monitoring required
Geophysical Environment	Moderate – Changes to local topography/geology are possible as geologic hazards exist within proximity to the Assessment Area; impacts to the quality/quantity of groundwater wells are possible (wells exist within 800 m of the Assessment Area).	Within the Assessment Area	Seasonal aspects not applicable; short-term duration	Intermittent	Reversible	Not significant	Mitigation required; monitoring may be required
Waterbodies and Watercourses	Moderate - Small loss of aquatic habitat and altered hydrology expected but can be managed with routine measures.	Within the Assessment Area	Seasonal aspects applicable; short-term duration	Single event	Reversible	Not significant	Mitigation and monitoring required

VC	Magnitude of Effects	Geographic Extent of Effects	Timing and Duration of Effects	Frequency of Effects	Reversibility of Effects	Significance Level	Mitigation and/or Monitoring Required?
Fish and Fish Habitat	Low – Small loss of fish habitat or small impact to fish behaviours	Within the Assessment Area	Seasonal aspects applicable; short-term duration	Single event	Reversible	Not significant	Mitigation and monitoring required
Wetlands	Moderate – Loss of wetland habitat and impact to wetland functions, but wetland area loss will not impact the hydrology of the wetland's watershed and/or the impacted wetland areas are not part of a WSS	Within the Assessment Area	Seasonal aspects applicable; short-term duration	Single event	Reversible	Not significant	Mitigation and monitoring required
Terrestrial Habitat	Low – Some loss of terrestrial habitat, but overall habitat functions remain intact	Within the Assessment Area	Seasonal aspects not applicable; long-term duration	Single event	Reversible	Not significant	Mitigation required; no monitoring required
Terrestrial Flora	Low – Small loss of habitat supporting terrestrial flora SOCI, but no terrestrial flora SOCI individuals lost.	Within the Assessment Area	Seasonal aspects not applicable; long-term duration (for habitat, NA for individual SOCI)	Single event (for habitat, NA for individual SOCI)	Reversible	Not significant	Mitigation required; no monitoring required
Terrestrial Fauna	Low – Small loss of habitat supporting fauna, but no impacts to fauna behaviours expected	Regions surrounding the Assessment Area that may fall within the habitat range of	Seasonal aspects applicable; long-term duration (for habitat, NA for	Continuous	Reversible	Not significant	Mitigation and monitoring required

VC	Magnitude of Effects	Geographic Extent of Effects	Timing and Duration of Effects	Frequency of Effects	Reversibility of Effects	Significance Level	Mitigation and/or Monitoring Required?
		each species, bounded by pre-existing infrastructure and roads or other large crossing areas	individual SOCI)				
Bats	Moderate – Minimal loss of individuals or impacts to bat behaviours, but these impacts will only be experienced by individuals rather than entire populations	Within the Assessment Area	Seasonal aspects not applicable; medium-term duration	Intermittent	Reversible	Not significant	Mitigation and monitoring required
Avifauna	Low - Small loss of important habitat supporting avifauna and/or impacts to migratory avifauna are expected to be low	Within the Assessment Area	Seasonal aspects applicable; medium-term duration	Intermittent	Reversible	Not significant	Mitigation and monitoring required
Economy	Positive – A positive effect on the economy is expected	Within Nova Scotia	Seasonal aspects not applicable; medium-term duration	Continuous	Irreversible	Significant (positive)	No mitigation or monitoring required
Land Use and Value	Negligible – No change in land value expected and surrounding land use can largely continue					Not significant	No mitigation or monitoring required

VC	Magnitude of Effects	Geographic Extent of Effects	Timing and Duration of Effects	Frequency of Effects	Reversibility of Effects	Significance Level	Mitigation and/or Monitoring Required?
Traffic and Transportation	Low – Small change in traffic levels and/or minimal disruptions to traffic flow and routing	Within the transportation route	Seasonal aspects not applicable; short-term duration	Intermittent	Reversible	Not significant	Mitigation required; no monitoring required
Recreation and Tourism	Low to negligible– Small to no measurable changes to tourism, and/or minor limitations to recreation use	Within the MODG	Seasonal aspects applicable; medium-term duration	Continuous	Reversible	Not significant	Mitigation required; no monitoring required
Archaeological Resources	Low to moderate – Activities have a low moderate potential for encountering archaeological resources during ground disturbance	Within the Assessment Area	Seasonal aspects not applicable; short-term duration	Single event	Irreversible (to be confirmed based on any identified resources, as applicable)	Not significant	Mitigation required; no monitoring required
Human Health	Negligible – no expected impacts to human health					Not significant	No mitigation or monitoring required
Electromagnetic Interference	Moderate – Organization requests additional consultation	Within consultation zones as defined by RABC Guidelines	Seasonal aspects not applicable; medium-term duration	Continuous	Reversible	Not significant	Mitigation required; no monitoring required
Shadow Flicker	Low – Measurable shadow flicker predicted at receptor location(s), but results are below guidance	Within 2 km buffer around Study Area	Seasonal aspects applicable; medium-term duration	Intermittent	Reversible	Not significant	No mitigation or monitoring required

VC	Magnitude of Effects	Geographic Extent of Effects	Timing and Duration of Effects	Frequency of Effects	Reversibility of Effects	Significance Level	Mitigation and/or Monitoring Required?
Visual Impacts	Moderate – Project components can be seen from the observer location but are not a prominent feature in the view	Within observer locations	Seasonal aspects not applicable; medium-term duration	Continuous	Reversible	Not significant	Mitigation required; no monitoring required
Sound: Construction Phase	High – Sound levels from Project activities may exceed 65 dBA at residential and sensitive receptor locations during multiple activities	Within 2 km buffer around Study Area	Seasonal aspects not applicable; short-term duration	Intermittent	Reversible	Not significant	Mitigation required; no monitoring required
Sound: Operation Phase	Low – measurable sound levels predicted at receptor location(s), but results are below NSECC guidance	Within 2 km buffer around Study Area	Seasonal aspects not applicable; medium-term duration	Intermittent	Reversible	Not significant	No mitigation or monitoring required

11.2 Summary of Mitigation Measures

A compiled list of mitigation measures identified throughout the EA is provided below.

Atmospheric Environment

General mitigation measures for fugitive emissions, exhaust emissions, and GHG emissions include:

- Conduct grading and site preparation in phases to minimize disturbed soil areas until just prior to construction activities.
- Stabilize exposed soil surfaces by sloping or using vegetation, stone, soil, or geotextiles to prevent dust and airborne particles.
- Compact and/or ridge disturbed soil to prevent dust formation.
- Cease dust-generating construction activities during periods of excessive wind.
- Enclose or cover soil storage and/or stockpile areas.
- Wet (with water) aggregate and soil stockpiles to control dust.
- Design storage areas and material stockpiles with prevailing wind directions in mind.
- Wet roadways and heavy traffic areas with water or dust suppressant technologies to minimize airborne emissions.
- Tie down, cover, and/or store loose site materials and/or products prior to inclement weather and wind events to prevent materials from becoming airborne.
- Wash down vehicles and equipment using hoses and water to remove accumulated mud/dirt on undercarriages, tracks, or wheel wells.
- Ensure Project personnel adhere to all safety protocols and wear appropriate PPE in the event of significant fugitive emissions events (i.e., wind storms, dust storms).
- Enforce site speed limits to minimize dust generation.
- Ensure equipment meets all applicable provincial and air quality regulations and emissions standards.
- Ensure equipment is fueled using low-sulphur diesel (to reduce SO_x air emissions).
- Maintain engines and exhaust systems according to the manufacturer's specifications and the recommended maintenance schedule.
- Remove from service malfunctioning equipment and/or equipment generating excess amounts of smoke, odour, or noise, until an assessment and necessary repairs can be completed.
- Remove from service construction equipment with improperly functioning emissions control systems.
- Restrict the idling of equipment where feasible.
- Use locally sourced materials, where possible, to reduce CO_2, CH_4, and NO_x emissions associated with transport.
- Incorporate the shortest construction/transport routes where possible to minimize the use of fossil fuels during construction.
- Recover and recycle construction and demolition waste, where possible.
- Recycle and compost workforce waste (i.e., food waste). Diverting this waste will reduce methane generated in landfills as it decomposes.

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

Geophysical Environment

General mitigation measures for avoidance of geologic hazards and groundwater resources include:

- Conduct blasting, if required, in accordance with provincial legislation and subject to terms and conditions of applicable permits.
  - Ensure all blasts are conducted and monitored by certified professionals.
  - Ensure all protective measures outlined in the EPP are implemented in advance of blasting activities.

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

Aquatic Environment
General mitigation measures for impacts to watercourses, waterbodies, fish and fish habitat, and wetlands include:

- Educate Project personnel on the sensitivity of aquatic habitats, including wetlands and watercourses.
- Ensure wetlands and watercourses are clearly marked and avoid impacts to the watercourse/wetland and adjacent riparian habitat to the extent possible.
- Ensure all crossings are installed by a certified Watercourse Alteration Installer/Sizer, and designed to avoid any permanent diversion, restriction or blockage of natural flow, such that the hydrologic function of the watercourse is maintained.
- Revegetate along the watercourse edge and above the ordinary high-water mark to facilitate the stabilization of the area and restoration of fish habitat, where required.
- Redesign existing watercourse crossings to facilitate habitat upgrades, including unblocking culverts and making waterways more conducive to fish passage.
- Locate new crossings away from potential salmonid spawning areas, such as pools with a dominant substrate of small-to-medium sized gravel (DFO, 2022a).
- Avoid impacts to wetlands to the extent possible (including alteration, compaction, or

otherwise).
   - Where unavoidable, complete wetland alterations in accordance with the NS Wetland Conservation Policy and the wetland alteration process during the permitting stage, which includes a requirement to compensate for lost wetland habitat and functions.
   - Design wetland crossings to occur at the narrow part of the wetland or the wetland's edges, to the extent possible.
   - If travel through wetlands is required, use geotextile matting, time work to occur during frozen ground conditions, or travel through the drier portions of the wetland, as appropriate.
- Conduct work between June 1 and September 30 to avoid sensitive periods in the life cycles of fish, to facilitate a better control of water flow, and to allow for a faster revegetation period (NSECC, 2015b).
- Develop a site-specific erosion and sedimentation plan during the detailed design phase.
   - The plan will target the disturbance to banks (as required) and adjacent land, and will address the type of control structures, proper installation techniques, grading, maintenance and inspection, timing of installation, and revegetation.
- Limit the area of exposed soil and the length of time soil is exposed without mitigation (e.g., mulching, seeding, rock cover).
- Limit the slope and gradient of disturbed areas to minimize the velocity of surface water runoff.
- Ensure surface run-off containing suspended materials or other harmful substances is minimized.
- Direct run-off from construction activities away from wetlands.
- Maintain existing vegetation cover and riparian vegetation, where possible.
- Integrate water management systems including diversion and collection ditches, roadside drainage channels, vegetated swales, and stormwater retention ponds.
- Design any necessary alterations in a way that maintains the natural grade of a watercourse, to ensure the hydroperiod remains as it was pre-alteration.
- Fit any watercourse crossings with appropriately sized infrastructure, as prescribed by a certified Watercourse Alteration Installer/Sizer.
- Integrate outlet protection features to dissipate flow velocities and decrease erosion at the outflow.
- If concrete is to be utilized, ensure it is pre-cast and cured for at least one week prior to use at a crossing site (NSECC, 2015b; NSECC, 2015c).
- Utilize untreated, rot-resistant timber (e.g., hemlock, tamarack, juniper, or cedar) below the ordinary highwater mark to avoid the leaching of toxic preservatives into waterways (NSECC, 2015b; NSECC, 2015c).
- Utilize vegetated swales for the phytoremediation of contaminated runoff.
- Utilize rock material that is clean, coarse granular, non-ore-bearing, non-watercourse-derived, and non-toxic to aquatic life (NSECC, 2015b; NSECC, 2015c).
- Use of quarried, crushed materials for road construction to reduce the introduction of invasive vascular plant species.

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

- Minimize overall area to be cleared, road density, habitat fragmentation, and habitat isolation by utilizing pre-existing roads and previously altered areas (i.e., clearcuts).
    - Desktop and field assessments identified important habitat features, particularly old-growth forest and animal refugia, to be avoided during the design phase.
- Restore cleared areas as much as possible to reduce impacts from habitat loss and promote continued growth of terrestrial flora, primarily through revegetation of road rights-of-way, and limit effects of fragmentation.
    - Revegetate cleared areas using native seed mixes, and particularly use seed mixes that do not contain clover to avoid attracting deer to the area.
    - Augment connectivity by creating semi-artificial pathways such as wildlife corridors, greenbelts, and vegetated buffers around wetlands and watercourses, where possible.
- Complete clearing during winter months when bats are overwintering in caves (end of September to late April), where possible.
- Adhere to ECCC guidelines on clearing windows for nesting migratory birds. Vegetation clearing activities will be conducted outside of the nesting period that is generally from April 1 to September 30 each year. Timing of clearing activities are generally dependent on seasonal conditions.
- Continue to review habitat modelling results, field survey results, and guidance from NSNRR through the detail design phase.
- Minimize road salting to avoid attracting ungulates to roadsides.
- Minimize loss of flora SOCI from areas with known occurrences during the design phase.
    - Desktop and field assessments identified important habitat features with terrestrial flora SOCI locations to be avoided during the design phase.
    - As required, buffers will be enforced around known locations of terrestrial flora SOCI within close proximity to the Assessment Area.
    - Where flora SOCI or their buffers overlap with the Assessment Area, the Project Area will utilize only the pre-existing road and the area opposite the road from the flora/buffer.
- Educate Project personnel about the potential for plant or lichen SOCI during construction.
    - Guidance will be provided to Project personnel to raise awareness of terrestrial flora SOCI that are known to exist within the Study Area to increase the number of trained eyes looking for these species.
- Consult with NSNRR if an unexpected flora SAR/SOCI is encountered.
    - Transplantation or seed collection will be suggested as a contingency plan during consultation if flora SOCI are unexpectedly encountered and cannot be avoided.
    - A separate plan for transplantation will be developed along with a monitoring protocol to determine the success of this mitigation measure if it is determined to be required.

- Ensure equipment is as clean as possible to prevent the introduction of non-native species into previously untouched areas.
    - Because exotic species are already present within the Study Area, care will be taken when travelling from developed areas to intact areas so that plant material is not transferred between locations, such as by inspecting vehicles prior to moving between area.
- Ensure that if purple loosestrife is being removed during clearing, care should be taken to dispose of the plants appropriately
    - Burning or composting will increase the spread of the plant.
    - Once removed, plants should be double-bagged and left in the sun to rot before disposing.
- Install traffic signs to alert road users of speed limits and the presence of wildlife in the area.
    - Inform all Project-related staff working on the site of dangers to wildlife and create awareness around wildlife hotspots on the site.
- Minimize Project-related traffic to reduce chances of wildlife or avifauna collisions and traffic-related stress to wildlife.
- Impose restrictions to site access if deemed necessary due to a substantial increase in wildlife or avifauna collisions and mortality.
- Avoid removal of vegetation/habitat alteration in key habitat areas during sensitive windows for priority species, where possible, including:
    - Mainland moose – late May to early June (birthing season) and September to October (breeding season)
    - Fisher – March to April
    - Four-toed salamander – March to April (nesting) and autumn (mating)
    - Bats – late April to late September
- Minimize loss of important habitat required by priority species (i.e., for reproduction events), including:
    - Mainland moose – wetlands and isolated islands/peninsulas
    - Fisher – large snags, large woody debris, or live standing trees in intact forests
    - Four-toed salamander – sphagnum bogs
    - Bats – Abandoned mines, large diameter (≥25 cm) snags and hollow trees (over-day roosting habitat)
    - Avifauna – wetlands, waterbodies, and old growth forest.
- Prevent injury/mortality of bats by avoiding important habitat (i.e., hibernacula, migration routes, and migratory stopovers) along with placement of turbines away from freshwater habitats demonstrated to bat activity, which has been incorporated into the Project's design/development.
- Maintain avoidance of topographic funnels, such as within valleys, for turbine placement to reduce the likelihood of interactions with concentrated bird movements.
- Install avian deflectors on powerlines, including any powerline spans, or areas of line that will be identified in the EPP as requiring mitigation based on monitoring results.
- Maintain all equipment and machinery on the site so that a level of good working condition is kept to reduce noise and vibration emissions. Where practical, install

vehicles and machinery with noise muffling equipment to limit disturbance.
- Restrict on-site lighting, especially at night, to limit disturbance.
- Prohibit harassment and feeding of wildlife by Project personnel.
- Maintain good housekeeping practices during construction to avoid indirectly feeding birds, and potentially attracting nuisance wildlife.
- Develop a spill response plan, and an emergency response plan within the EPP to mitigate the impacts of spills, hazardous substances, and other emergencies.
- Develop a fire response plan in accordance with provincial standards.
- Develop a site reclamation plan in accordance with engineering standards and in consultation with NSECC and NSNRR.

Socio-Economic Environment
General mitigation measures for traffic, transportation, recreation, and tourism include:

- Install notices in public areas to inform residents of signage removal or road infrastructure alterations.
- Replace removed signage and guardrails immediately with appropriate temporary signage to ensure travelling public safety.
- Complete upgrades to roads and overhead wires, branches, and signs if conflicts arise.
- Complete modifications and associated reinstatement to relevant specifications.
- Avoid, to the extent possible, transportation through urban areas during high traffic times (e.g., 7-9 am and 3- 6 pm; Monday to Friday).
- Conduct all travel using safe work practices for transporting oversized loads.
- Utilize the minimum number of vehicles possible to minimize impacts to road-way flow and impacts on air quality due to exhaust.
- Ensure vehicles only visit and work on the site during normal daytime hours of operation, where possible, and avoid high-traffic times of day to reduce local traffic congestion
- Continue to work with local recreation groups to ensure continued access within the Project Area.

Archaeological Resources
- Develop procedures in the EPP related to the potential unexpected discovery of archaeological items or sites during construction. This would include halting any work immediately upon discovery of suspected resources and contacting NSCCTH. If the resources are suspected to be of Mi'kmaq origin, the Executive Director of KMKNO would also be contacted.
- Maintain avoidance of HPA-07.
- Conduct shovel testing in other areas of high potential prior to ground disturbance if they cannot be avoided during the detail design phase.
- Conduct additional archaeological assessment if, during the detail design phase, it is determined that ground disturbance is required in areas not previously assessed. The EA Branch will be notified in advance and will be provided with the acceptance letter from NSCCTH prior to completion of any disturbance in those areas.

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

- Continue engagement and education with local recreational users regarding the safe continued use of lands within the Study Area.
- Install signage illustrating and warning of potential hazards associated with ice throw and fall around wind turbines.
- Equip staff and workers accessing the Project Area for maintenance or other purposes with necessary PPE and associated safety protocols and procedures to mitigate risk of injury and/or fatality, especially during potential icing conditions.
- Implement a prevention and evacuation plan for Project personnel as part of the EPP, in addition to general safety protocol and training.
- Ensure signal operators are consulted on any future layout updates.
- Complete a reception analysis for a local analog TV station, as requested by and in consultation with Industry Innovation, Science, and Economic Development Canada.
- Continue consultation with operators who have not yet responded to the notification letters.
- Develop a complaint response protocol, which will consider complaints related to shadow flicker and outline a process to investigate complaints. Mitigation to resolve complaints, if determined to be necessary, will be completed on a case-by-case basis in consultation with the affected landowner and may include the provision of screening, the development of a turbine-specific curtailment plan, or a negotiated form of compensation.
- Limit vehicle idling.
- Conduct construction activities within the recommended daytime hours of 7:00 am to 10:00 pm.
- Include mitigation and monitoring for blasting in the Project's EPP, if geotechnical investigations determine it is required.

12.0 EFFECTS OF THE ENVIRONMENT ON THE UNDERTAKING

The following section discusses potential effects of the natural environment, including natural hazards and weather events, on the infrastructure and operation of the Project. Potential sources of effects from the environment are described below, including mitigation and design strategies for reducing the significance of residual effects.

The primary mitigative measure employed during the construction and operation of the Project will be to educate and train site personnel. Environmental and safety orientations will be conducted prior to the start of construction and all staff will be informed of the potential effects of the environment on the Project. Staff responsible for the operation and maintenance of the Project will be trained on the design and operation of the turbine, including applicable operating procedures, safety protocols, and evacuation plans. To further mitigate damages that cannot be controlled by education and training alone, turbines will all be equipped with safety mechanisms to limit damage resulting from extreme weather events.

12.1 Climate Change

Climate change is the persistent change in the state of the climate which lasts for decades or longer (IPCC, 2018). With an estimated lifecycle of 25-30 years, this Project can be considered on the same temporal context as climate change. Climate change may impact the Project through increased occurrences of extreme weather, precipitation, and subsequent flooding. In addition, increased weather extremes due to climate change and sea level rise may impact turbines, powerlines, and/or roadways, causing washouts and/or damage to infrastructure.

12.1.1 Temperature

The projected rising temperatures may impact many phases of the Project and on-site personnel. For example, longer and more intense heat waves may increase heat-related illnesses and deaths and increase the risk of food and water-borne contamination. Hotter and drier conditions also increase the risk of droughts and wildfires during construction and operation activities (GOC, 2019c). Requirements for stopping work or taking regular breaks to cool down and rehydrate will be mandated throughout the Project lifetime to protect Project personnel. If it is unsafe to work due to severe conditions, a stop-work-authority may be issued.

Warmer temperatures can also spread forest and agricultural pests and disease vectors (i.e., ticks) to the Project location. Invasive plant species are discussed in greater detail in Section 7.4.2.

12.1.2 Sea Level Rise

The Project Area is located in the northeastern extent of Mainland Nova Scotia, approximately 4 km from the Canso Strait. The southeastern portion of the Study Area has the lowest average elevation, with the lowest point at approximately 76 masl. On average, the elevation of the Study Area is approximately 125 masl, and the lowest point of the Project Area is between 115 masl. The proposed turbine locations are between 130-175 masl and should therefore experience minimal to no impacts from rising sea levels. Although the roads leading to the southern edge of the Project Area have the lowest elevation, these roads are at least 7.8 km from the ocean and are therefore unlikely to be impacted by rising water levels within the lifespan of the Project.

12.1.3 Flooding

Flooding may increase due to rising sea levels (Section 12.1.2) and more frequent severe precipitation associated with climate change. Due to the effects of ocean warming, climate change is predicted to produce more intense precipitation, which may result in increased flood risk (US EPA, 2022c). The Project was designed to mitigate the risks of flooding by concentrating the road and turbine layout in high elevation areas, designing roadside ditches next to all roads to encourage drainage of rainwater off the roads, and by maintaining vegetated roadsides to absorb excess water.

12.2 Natural Hazards

12.2.1 Severe Weather Events

Nova Scotia is subject to severe weather events including flooding, blizzards, hurricanes, and wildfires, all of which may lead to negative outcomes including power outages, health related emergencies, infrastructure damage, and road damage, and therefore may pose direct risks to wind farm infrastructure (GOC, 2018). Heavy rainfall is a common, highly probable natural hazard in Nova Scotia. Short duration heavy rainfall is defined as 25 mm or more of rain within one hour, while long duration heavy rainfall can range from 25 mm of rain or more within 24 hours during winter, or 50 mm of rain or more within 24 hours during summer (ECCC, 2020). Heavy rain has the potential to flood the Project Area, making the roads impassable. Project design features noted in Section 12.1.3 will also mitigate the effects of heavy rainfall.

Wind and lightning, which may be associated with heavy rainfall or hurricane conditions, may increase the risk of mechanical issues or electrical fires. Restricted access to the site during severe weather events may limit the ability to shut down the system to prevent damage. To mitigate this risk, the turbines will be equipped with an automatic shut down when thresholds for wind are reached and will also be designed with a built-in grounding system for lightning strikes.

12.2.2 Turbine Icing

Turbine icing occurs when ice accumulates on the surface of turbine blades, a condition created by specific temperatures and levels of humidity or the presence of freezing rain. The chances of turbine icing increase when the blades reach 150 m above ground, where the lower clouds may contain supercooled rain (Seifert et al., 2003). Turbine icing may lead to ice throw or ice fall, and the distance and direction in which the ice is thrown/falls is dependent on factors such as wind speed, rotor speed, rotor azimuth, the position of the ice on the blade, and the characteristics of the ice itself. Due to the numerous factors contributing to where these ice fragments may land when thrown/fallen, the likelihood of a human being struck is insignificant and thus the risk of injury is minute (LeBlanc, 2007). The impacts from turbine icing on human health are discussed further in Section 10.1.1. To further reduce the risk of injury from ice throw or falling ice, restricted site use may be enforced when the ideal weather conditions for turbine icing are present. Education of operators, adequate signage warning of falling ice, and the requirement to wear hardhats around operational turbines will also be implemented. Additionally, the turbines will be equipped to automatically shut down when thresholds for ice formation or low temperatures are detected.

12.2.3 Wildfire

The Nova Scotia government employs a Fire Weather Index (FWI) during the forest fire season to determine fire danger across the forested areas in Nova Scotia (NSNRR, 2021i). The FWI during the summer months (mid-June to September 2022) across the Study Area ranged from low (0-5) to moderate (20-30). During this period, 58 days had a score of 0-5, 22 had a score of 5-10, 23 had a score of 10-20, and 3 days in early August scored 20-30 (NRCan, 2022b). A higher FWI score indicates that if a fire were to start it would be of high intensity and pose greater danger than a lower FWI score. Federal and provincial FWI data is updated daily, with the closest provincial weather stations to the Study Area being ‘Meagher’s Hill’ (NSNRR, 2021i; NRCan, 2022b). Although most days in the wildfire season had a low FWI score, to mitigate potential risk of wildfire, safety protocols will be put into place such as implementing a fire prevention and site evacuation plan. Furthermore, the FWI will be checked regularly at nearby weather stations during summer months to determine the potential for highly dangerous wildfires. Precaution should be taken when undergoing construction or maintenance activities that could result in fires on days when FWI scores are >5.

12.3 Potential Residual Effects

Environmental effects associated with climate change and natural hazards may result in a potentially significant effect on the Project. However, implementing mitigative and adaptive strategies would reduce and limit the likelihood of impacts on all phases of the Project. Therefore, the residual effects associated with climate change and natural hazards are considered not insignificant.

13.0 ACCIDENTS AND MALFUNCTIONS

Without proper mitigation, accidents and malfunctions can interact with many VCs and potentially result in adverse effects. However, implementing preventative measures limits the probability of occurrence, and having appropriate response procedures in place reduces the magnitude of residual effects.

Accidents, malfunctions, and unplanned events considered for this Project include:

- Erosion and Sediment Control Failure
- Fire
- General Hazardous Material Spill

The safety of on-site personnel is a vital Project component; however, it is not specifically considered in the EA, as workplace occupational health and safety is regulated by the policies, procedures, plans, and codes of practice set in the Nova Scotia *Occupational Health and Safety Act*, S.N.S. 1996, c. 7.

13.1 Erosion and Sediment Control Failures

Failure of erosion and sedimentation controls may result in potential adverse effects on VCs (primarily during construction), most notably to watercourses, wetlands, and fish and fish habitat. Erosion and sedimentation controls may fail due to extreme weather conditions (e.g., flooding), improper installation, improper maintenance, and unforeseen accidents (e.g., collisions). Failure of these control measures may release sediment into the environment, impacting water quality and aquatic and terrestrial habitats.

Mitigation measures to limit the probability of an occurrence and reduce the magnitude and extent of potential effects include:

- Implement all mitigation related to erosion and sediment control provided in Sections 7.3.1, 7.3.2, and 7.3.3.
- Develop and implement an erosion and sedimentation control plan for all phases of the Project.

- Ensure erosion and sediment controls are installed per the manufacturer's specifications.
- Heed Environment Canada's special weather warnings to ensure proper care is given to stabilize erosion and sediment controls in advance of and following extreme weather events.
- Conduct regular monitoring of all the erosion and sediment controls and repair or replace them as necessary.
- Ensure erosion and sediment controls are functioning effectually, and that additional supports or controls are available on hand and able to be applied to support these efforts.
- Ensure workers are trained to properly install and repair erosion and sediment controls.

13.2 Fires

An accidental fire could potentially adversely affect the atmospheric environment (emissions), vegetation, and wildlife during all Project phases.

Mitigation measures to limit the probability of an occurrence and reduce the magnitude and extent of potential effects include:

- Prohibit the use of campfires or burning within the Project Area by staff and contractors.
- Dispose of all flammable waste regularly at an approved facility.
- Implement mitigation related to chemical and fuel storage (Section 13.3).
- Smoke in designated areas only.
- Equip heavy machinery and turbines with fire suppressant equipment and ensure it is available during construction.

13.3 General Hazardous Material Spills

Hazardous spills resulting from fuel (i.e., storage, refueling, operation of combustion vehicles) and other on-site chemicals may occur during the Project's construction and operations activities. Hazardous spills can adversely impact air, soil, surface water, groundwater quality, human health, and safety. In addition, hazardous spills may risk the health of aquatic, avian, and terrestrial wildlife. The severity of the impacts will depend on the nature of the hazardous material and the quantity spilled.

Mitigation measures to limit the probability of an occurrence and reduce the magnitude and extent of potential effects include:

- Develop a Spill Prevention and Response Plan as part of the Project's EPP, which will set out spill prevention and response procedures.
- Ensure all fuels, lubricants, and chemicals are stored in designated containers and areas.
- Provide secondary containment in storage areas (where possible).
- Ensure the equipment used is inspected and free of fluid leaks.

- Ensure fuel storage areas, refueling, and/or equipment lubrication are located a minimum of 30 m from any surface and groundwater feature (i.e., watercourse, well).
- Ensure refueling of machinery and equipment is conducted on an impervious surface.
- Ensure any equipment servicing is completed off-site. If this is not possible, ensure the work is completed on an impervious surface.
- Ensure the storage of all dangerous goods comply with the Workplace Hazardous Material Information System (WHMIS).
- Ensure all mobile equipment has spill kits stocked with soaker pads, oil-absorbing materials, and containment booms.
- Locate stationary spill kits or spill drums at work areas utilizing mobile equipment, hazardous fluids and/or in proximity to environmentally sensitive areas (i.e., wetlands or watercourses).
- Stock spill kits with the appropriate quantity and type of material for the anticipated product type(s) and volume(s) in use.
- Ensure site workers are trained in the use of on-site spill kits.

With the implementation of the above preventative measures, the likelihood of an accident or a malfunction is low. Appropriate response plans will be put in place to ensure any interactions with VCs from an accident or malfunction are limited and the effects can be quickly contained.

14.0 CUMULATIVE EFFECTS ASSESSMENT

14.1 Overview

Cumulative effects are changes to environmental, social, and economic values caused by the combined effect of past, present, and potential future human activities and natural processes (Government of British Columbia, u.d). Concerns are often raised about long-term changes that may occur not only as a result of a single action but of the combined effects of each successive action on the environment (Hegman et al., 1999). While a single undertaking might not cause significant adverse effects, multiple undertakings may result in incremental impacts, referred to as cumulative effects. These cumulative effects may potentially result in an overall impact to a VC of interest.

14.2 Other Undertakings in the Area

There are no wind farm developments of similar scale/design located in Guysborough County; however, there is one 2.3 MW turbine along with two smaller turbines (sizes unknown, identified via aerial imagery) located near Mulgrave approximately 3 km northeast of the Assessment Area (McCallum Environment Ltd, 2013). The nearest larger scale wind farm development is located across the Strait of Canso in the Point Tupper Industrial Park, approximately 8.5 km east. This is a 22 MW wind farm known as the Point Tupper Wind Farm, consisting of 11 turbines (2 MW each), that was developed to supply renewable energy to the NS Power grid (CBCL, 2008). Within the Point Tupper Industrial Park, there is also one wind turbine located near the marine terminal that was existing prior to the development of the Point Tupper Wind Farm (CBCL, 2008).

Table 14.1 summarizes other industrial activities/developments near the Assessment Area (within approximately 5 km).

Table 14.1: Nearby Industrial Activities

Development	Development Activity	Status of Activity	Activity Location	Distance to AA*
Forestry	Harvests, thinning, plantations, & other treatments.	Active	Throughout Study Area	Within AA
Mulgrave Water Treatment Plant	Drinking Water Treatment Facility	Active	Grant Lake Dam Road, Mulgrave, NS	2.0 km northeast
Guysborough Landfill	Landfill	Active	151 Waste Management Road, Boylston Road, NS	3.3 km south
Porcupine Mountain Quarry	Quarry	Active	7 Upper Quarry Road E, Mulgrave, NS	4.2 km northeast
Grant Lake Reservoir, Summers Lake Reservoir, Mattie Lake Reservoir	Reservoirs	Active	Grant Lake, Summers Lake, and Mattie Lake	0.9 km to 3.5 km northeast

*Distance to nearest point of the Assessment Area

14.3 Cumulative Effects Assessment

Cumulative effects were assessed for the Project by taking into consideration the potential residual effects of significance (as identified in VC sections) in relation to the activities that have taken place in the past, those that currently exist, and those that can be reasonably expected to be developed within the area surrounding the Project (i.e., undergoing regulatory approval/under construction). Table 14.2 summarizes the potential for VCs to have cumulative impacts with other undertakings in the area.

Table 14.2: Potential for Cumulative Effects on Identified VCs

VC	Cumulative Effects Expected	Reasoning
Atmosphere	No	Residual positive impacts regarding provincial GHG emissions from the use of renewable energy resources.
Geology	No	The Project will not impact the geologic environment outside the Project Area or interact with nearby industrial activities.
Waterbodies & Watercourses	No	The Project is maximizing use of existing roadways, minimizing the disturbance of surface freshwater resources. Residual impacts will be mitigated, monitored, and be contained within the Assessment Area.
Fish & Fish Habitat	No	The Project is maximizing use of existing roadways, minimizing the disturbance of fish

VC	Cumulative Effects Expected	Reasoning
		and fish habitat. Residual impacts will be mitigated, monitored, and be contained within the Assessment Area.
Wetlands	No	The Project is maximizing the use of existing disturbed areas to minimize impacts to wetlands. In accordance with provincial permitting requirements, all impacted wetlands will be compensated for, such that there is no residual effect.
Terrestrial Habitat	No	The lands slated for wind farm development are currently under sustainable forest management license to PHP. Any harvesting required for establishment of the wind farm will be accounted for in harvest planning and accounted for in the ongoing Annual Allowable Cut for the area in question.
Terrestrial Flora	No	Avoidance of SOCI has been achieved.
Terrestrial Fauna	No	Avoidance of SOCI has been achieved.
Bats	Potential	Nearby wind developments. Potential for wind turbine related injury/mortality of bats.
Avifauna	Potential	Nearby wind developments. Potential for wind turbine related injury/mortality of avifauna.
Economy, Land Use, Transportation, & Recreation/Tourism	No	Residual impacts are anticipated to be low to negligible, or positive.
Archeological Resources	No	Avoidance of archaeological, historical, or culturally significant areas.
Human Health	No	Residual impacts to human health are not anticipated.
EMI	No	No potential to interact with nearby industrial activities.
Shadow Flicker	No	Shadow flicker produced by the Project is within guidelines. Nearest wind development is 3 km away and will not act cumulatively with the Project.
Visual Aesthetics	No	NA
Sound	No	Sound levels from the operation of wind turbines are below guidance thresholds. Nearest wind development is 3 km away and will not act cumulatively with the Project..

The following VCs are assessed for cumulative effects:

- Bats
- Avifauna

Bats & Avifauna
Bats and avifauna are discussed in terms of cumulative effects based on the Project's proximity to other wind developments (Point Tupper Wind Farm and Mulgrave Community Wind Power Project) along with the cumulative potential for injury/mortality of SAR.

The Point Tupper Wind Farm is a relatively small wind farm development with only 12 wind turbines (~78 m hub height) in total. This development is within a heavy industrial park located on Cape Breton Island and is surrounded by large scale industrial facilities (e.g., shipping terminal, coal generation plant, etc.). As part of the EA for the project, pre-construction avian surveys were completed, and the EA determined that impacts to avifauna would not be significant. In addition, the proponent is required to complete post-construction bat and bird monitoring (results are not publicly available but were required to be submitted to NSECC) (CBCL, 2008).

The Mulgrave Community Wind Power Project consists of one 2.3 MW turbine with a hub height of 98 m (along with two smaller turbines) near the town of Mulgrave. As part of the EA for the project, pre-construction avian and bat monitoring was completed and the EA determined that residual impacts on avifauna and bats are low. Based on the small scale of the existing wind power projects nearby and their respective EA conclusions, the anticipated cumulative effects on bats and avifauna from the operation of the combined wind developments are anticipated to be not significant.

Other infrastructure/development near the Study Area (and associated with the Project) also has the potential to cause injury/mortality to bats and avifauna as a result of collision with infrastructure such as power lines and highways/road networks. The cumulative effect on bats and avifauna from the operation of the Project in combination with surrounding infrastructure and development is also anticipated to be not significant (Zimmerling et al. 2013). Further, Strum Consulting has completed various post-construction surveys for wind farms across the Province of NS which have found low avifauna and bat mortality rates.

15.0 CONCLUSION

In accordance with A Proponent's Guide to Environmental Assessment (NSECC, 2017), the studies, regulatory assessments and VC evaluations described within this EA Report have been considered both singularly and cumulatively, for all phases of the Project.

The results of this assessment indicate that inconsideration of the Project's mitigative and protection measures, adverse residual effects are not anticipated to be significant.

16.0 CLOSURE

This EA Report was completed by Strum Consulting, an independent, multi-disciplinary team of consultants with extensive experience with submission of EA Registration documents for undertakings within Atlantic Canada.

The EA Report was prepared and reviewed by:

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Curriculum vitae for EA Report contributors and Project Team members are provided in Appendix Q.

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APPENDIX B: MEKS STUDY

Goose Harbour Lake Wind Farm Project
Guysborough Co., NS
MEKS

Membertou GEOMATICS SOLUTIONS

December 2022
Version: Draft

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Executive Summary

This Mi'kmaq Ecological Knowledge Study, also commonly referred to as a MEKS or a Traditional Ecological Knowledge Study (TEKS), was developed by Membertou Geomatics Solutions (MGS) for STRUM with regards to the proposed Goose Harbour Lake Wind Farm Project.

This MEKS mandate is to consider land and water areas in which the proposed project is located and to identify what Mi'kmaq traditional use activities have occurred, or are currently occurring within, and what Mi'kmaq ecological knowledge presently exists regarding to the area. In order to ensure accountability and ethic responsibility of this MEKS, the MEKS development has adhered to the "Mi'kmaq Ecological Knowledge Protocol, 2nd Edition". This protocol is a document that has been established by the Assembly of Nova Scotia Mi'kmaq Chiefs, which speaks to the process, procedures and results that are expected of a MEKS.

The Mi'kmaq Ecological Knowledge Study consisted of two major components:

- **Mi'kmaq Traditional Land and Resource Use Activities**, both past and present,
- A **Mi'kmaq Significance Species Analysis**, considering the resources that are important to Mi'kmaq use.

The Mi'kmaq Traditional Land and Resource Use Activities component utilized interviews as the key source of information regarding Mi'kmaq use within the Project Site and Study Area. The Project Site includes the development of approximately 30 wind turbines and supporting roads on lands in Guysborough Co., Nova Scotia.

Project Site (orange areas) and Study Area (purple outline) are identified by the Project Team.

The Study Area will consist of an area within a 5 km radius around the Project Site.

Interviews were undertaken by the MEKS Team with Mi'kmaq knowledge holders from the First Nation communities of Paq'tnkek, Pictou Landing and We'koqma'q. The interviews took place between October to November 2022.

Interviewees were shown topographical maps of the Project Site and Study Area and asked to identify where they undertake their activities as well as to identify where and what activities were undertaken by other Mi'kmaq, if known. This MEKS processed information from Fourteen

(14) interviewees, including interviewees from other recent studies, within the analysis portion. Permission was requested of the interviewee(s) to have their information incorporated into the GIS data. These interviews allowed the team to develop a collection of data that reflected the most recent Mi'kmaq traditional use in this area, as well as historic accounts.

All interviewee's names are kept confidential and will not be released by MGS as part of a consent agreement between MGS and the interviewee to ensure confidentiality.

The data gathered was also considered in regard to its significance to the Mi'kmaq people. Each species identified was analyzed by considering their use as food/sustenance resources, medicinal/ceremonial plant resources and art/tools resources. These resources were also considered for their availability or abundance in the areas listed above, and their availability in areas adjacent or in other areas outside of these areas, their use, and their importance, with regards to the Mi'kmaq.

Historic Review Summary

The Project Site(s) and Study Area centered on Long Lake, west of Goose Harbour Lake Reservoir and within both ***Epekwitk aqq Piktuk*** District (Territory) and ***Eskikewa'kik*** District (Territory).

There are very few known archaeological finds/sites found within the vicinity of the Study Area due to little development. Development can be building and road construction including agricultural land use that accidentally finds precontact and early Mi'kmaq archaeological sites, features or artifacts.

There sparse potential natural resources within the Study Area concerning stone of suitable properties for tools and weapons for early peoples. There are no reported sources of Black Ash within the Study Area nor that part of the Province. Black Ash was and is a valuable resource for tool handles and craft-basket making to early peoples then and to the Mi'kmaq today.

Much of the local history of the area was centered around Canso and Guysborough areas. Canso has a recorded history as early as the 1500's and was an important fishing station for European fishing fleets and Mi'kmaq trading until the British established fortifications at Canso.

Paqtnkek Mi'kmaw Nation is the nearest Mi'kmaq community located approximately 19km west of the center of the Project Site and Study Area. Paqtnkek Mi'kmaw Nation is on Paqtnkek-Niktuek No. 23, consisting of 204.8 hectares (506 acres). Other Paqtnkek lands today include 43.4 hectares (107 acres) at Welnek No. 38, located 18km east of Antigonish.

A review of Specific Claims shows no current and active First Nation Claims within the Project Site Study Area. Paqtnkek Mi'kmaw Nation has one "Invited to Negotiate" and "Active" Specific Claim concerning loss of land in 1827 with the Crown Grant to Peter McChesney without surrender.

Traditional Use - Project Site Summary

Based on the data documented and analyzed, it was concluded that there is reported Mi'kmaq use reported on the Project Site.

Activities in the Project Site include trout and salmon fishing happening along with deer, partridge and rabbit hunting.

Overall, the majority of activities took place as Recent Past and Historical Past categories. There were no active usage areas reported.

Traditional Use - Study Area Summary

Trout and Salmon fishing, along with deer, partridge and rabbit hunting were also the activities reported by interviewees in the highest frequency. There was other fishing, hunting, and gathering activities reported as well.

Overall, the activities took place primarily in the Recent Past (82%) and Historic Past (18%).

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1.0 INTRODUCTION

1.1 Membertou Geomatics Solutions

Membertou Geomatics Solutions (MGS) is a Membertou First Nation company that was developed as a result of the 2002 Supreme Court Marshall Decision. MGS was established as a commercially viable company that could provide expertise in the field of GIS Services, Database Development, Land Use Planning Services and Mi'kmaq Ecological Knowledge Studies (MEKS). MGS is one of many companies established by the Membertou First Nation – Membertou Corporate Division and these companies provide employment opportunities for aboriginal persons and contribute to Membertou's efforts of growth and development. As well, Membertou's excellent management and accountability of their operations is further enhanced by their ISO 9001:2015 certification.

For the development of this MEKS, MGS brings to the table a team whose expertise and skills with land documentation have developed a sound MEKS. The team skills include knowledge of historical Mi'kmaq research, GIS data analysis, Mi'kmaq ecological and cultural knowledge, and Mi'kmaq community connections.

1.2 Goose Harbour Lake Wind Farm Project

Port Hawkesbury Paper, through its sister entity, Goose Harbour Lake Wind Farm Project, is proposing to build a 130-megawatt (MW) wind farm on lands in Guysborough County that are currently under sustainable forest management license to Port Hawkesbury Paper.

The proposed wind farm will have a total installed capacity of approximately 130 MW, with approximately 30 wind turbines currently envisioned (*depending on the final selection of wind turbine technology).

2.0 MI'KMAQ ECOLOGICAL KNOWLEDGE STUDY SCOPE & OBJECTIVES

2.1 Mi'kmaq Ecological Knowledge

The Mi'kmaq people have a long-existing, unique and special relationship with the land and its resources, which involves the harvesting of resources, the conservation of resources and spiritual ideologies. This relationship is intimate in its overall character, as it has involved collective and individual harvesting of the resources for various purposes, be it sustenance, medicinal, ceremonial and/or conservation. This relationship has allowed the Mi'kmaq to accumulate generations of ecological information and this knowledge is maintained by the Mi'kmaq people and has been passed on from generation to generation, youth to elder, ***kisaku kinutemuatel mijuijij***.

The assortment of Mi'kmaq Ecological Information, which is held by various Mi'kmaq individuals, is the focus of MEKS, also commonly referred to as Traditional Ecological Knowledge Studies (TEKS). When conducting a MEKS, ecological information regarding Mi'kmaq/Aboriginal use of specific lands, waters, and their resources are identified and documented by the project team.

Characteristically, MEKS have some similar components to that of an Environmental Assessment; yet differ in many ways as well. Among its purpose, Environmental Assessments measure the impact of developmental activity on the environment and its resources. This is often done by prioritizing significant effects of project activities in accordance with resource legislation, such as the Federal *Species at Risk Act* and the Nova Scotia *Endangered Species Act*.

Mi'kmaq Ecological Knowledge Studies are also concerned with the impacts of developmental activities on the land and its resources, but MEKS do so in context of the land and resource practices and knowledge of the Mi'kmaq people. This is extremely important to be identified when developing an environmental presentation of the Study

Area as Mi'kmaq use of the land, waters and their resources differs from that of non-Mi'kmaq. Thus, the MEKS provides ecological data which is significant to Mi'kmaq society and adds to the ecological understandings of the Project Site and Study Area.

2.2 Mi'kmaq Ecological Knowledge Study Mandate

Membertou Geomatics Solutions was contacted by STRUM to undertake a MEKS for the proposed project. This project will require the documentation of key environmental information in regard to the project activities and its possible impacts on the water, land and the resources located here. The MEKS must be prepared as per the **Mi'kmaq Ecological Knowledge Study Protocol** (MEKSP) ratified by the Assembly of Nova Scotia Mi'kmaq Chiefs on November 22, 2007, and the 2nd Edition released in 2014.

Note: Due to the current Covid19 pandemic, this study was delayed due to Covid19 restrictions and safety concerns regarding conducting interviews within Mi'kmaq communities.

MGS proposed to assist with the gathering of necessary data by developing a MEKS which will identify Mi'kmaq traditional land use activity within the Project Site and in the surrounding areas. This MEKS had gathered, identified, and documented the collective body of ecological knowledge which is held by individual Mi'kmaq people. The information gathered by the MEKS team is documented within this report and presents a thorough and accurate understanding of the Mi'kmaq's use of the land and resources within the Project Site/Study Area.

It must be stated, however, that this MEKS preparation and/or acceptance of this report is not considered Consultation within itself, nor is it deemed to fulfill the Duty to Consult owed by the Crown to the Mi'kmaq. This report does not replace any Consultation process that may be required or established in regard to Aboriginal people. As well, this report cannot be used for the justification of the Infringement of S.35 Aboriginal Rights that may arise from the project.

2.3 Mi'kmaq Ecological Knowledge Study Scope & Objective

This MEKS will identify Mi'kmaq ecological information regarding Mi'kmaq traditional land, water and resource use within the Project Site/Study Area. The data that the study will gather and document will include traditional use from both the past and present time frames. The final MEKS report will also provide information that will identify where the proposed project activities may impact the traditional land and resource of the Mi'kmaq. If such possible impact occurrences are identified by the MEKS then the study will also provide recommendations that should be undertaken by the proponent. As well, if the MEKS identifies any possible infringements with respect to Mi'kmaq constitutional rights, the MEKS will provide recommendations on necessary steps to initiate formal consultation with the Mi'kmaq.

2.4 MEKS Project Site and Study Area

This MEKS will focus on the Project Site. This Project Site is on lands in Guysborough County that are currently under sustainable forest management license to Port Hawkesbury Paper.

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The Study Area will consist of a larger area that falls within a 5km radius around the Project Site.

Figure 1. Project Site (orange areas) and Study Area (purple outline) are identified by the STRUM.

3.0 METHODOLOGY

3.1 Interviews

As a first step to gathering traditional use data, the MEKS team had initiated dialogue with knowledge holders from First Nation communities of Paq'tnkek, Pictou Landing and We'koqma'q, given their close proximity with the Project Site. Interviews were also conducted through an online portal that was recently developed by Membertou

Geomatics Solutions. This online portal allows Mi'kmaq individuals the ability to provide traditional knowledge and use with regards to the proposed project.

Knowledge holders were contacted by the MEKS team members and interviews were conducted between October and November 2022.

For this MEKS, fourteen (14) informants provided information in regard to past and present traditional use activities. These individuals were from the communities of Paq'tnkek Pictou Landing and We'koqma'q. All of the interviews that were completed following the procedures identified within the Mi'kmaq Ecological Knowledge Protocol (MEKP) document. Prior to each interview, interviewees were provided information about the MEKS, including the purpose and use of the MEKS, an agreement of non-disclosure of their personal information in any reports, and the future use of the traditional use information they provided. Information gathered from other studies conducted in the area were utilized in this study as well.

Interviewees were asked to sign a consent form, providing permission for MGS to utilize their interview information within this MEKS. During each interview, individuals were provided a map of the Project Site/Study Area and asked various questions regarding Mi'kmaq use activities, including where they undertook their activities or where they knew of activities by others, when such activities were undertaken, and how that type of resource was utilized. Other information gathered could be species habitats, changes in species populations, and/or general information about the land related to its' use. When required or preferred, interviews were conducted in the Mi'kmaq language.

3.2 Literature and Archival Research

With regards to this MEKS, various archival documents, maps, oral histories and published works were reviewed in order to obtain accurate information regarding the past or present Mi'kmaq use or occupation relevant to the Project Site and Study Area.

As part of the historical review process, it should be noted there may be other sources of Historical and Archaeological data available but may have restricted access or not uncovered within this project's Historical Review. A complete listing of the documents that were referenced is outlined within the *Sources* section.

3.3 Field Sampling

Methodology

Field sampling, or site visits, are conducted as another method to gather and document plants, trees, animal signs/tracks, fish and wildlife habitats, or any other land feature which would hold significance to the Mi'kmaq (food or sustenance, social, cultural, or ceremonial purposes).

Site visits consist of site reconnaissance (to evaluate the entrances to the site, terrain characteristics, and evaluation of any other information that would affect safety or logistics of the site visit), logistics planning, as well as capturing "observation points" with the assistance of a Mi'kmaq knowledge holder. Observation points are stops along the site visit where species or landmarks significant to the Mi'kmaq were observed to be occurring. These are taken at approximate set intervals, or whenever a species or feature was deemed worthy to be noted by the knowledge holder. While every effort is made to ensure the Project Site receives a good coverage of observation points, weather, vegetation, available paths and trails, or difficult terrain can cause some data gaps.

Site visits took place in November of 2022. MGS staff, accompanied by a Mi'kmaq knowledge holder from We'koqma'q First Nation, along with a STRUM staff member, conducted the site visit of the Project Site. Throughout the site visit various species (and subspecies) of plants, trees, and animal signs/tracks were observed.

Site Visit Observations

Observation	# of observations	Observation	# of observations
Yellow Birch	32	Sorrel	3
Moss	26	Bear sign	2
Black Spruce	26	Blueberry	2
Maple	26	Blackberry	2
Ferns	26	Goldenrod	2
Golden Thread	21	Juniper	2
White Birch	21	Mountain Ash	2
White Spruce	21	Rabbit sign	2
Alder	3	Raspberry	2
American Beech	3	Aspen	1
Foxberry	3	Cranberry	1
Partridge Berry	3	Willow	1

Table 1. Summary of observation points

Figure 3. Mixed growth stand found within the Project Site

4.0 MI'KMAQ LAND, WATER AND RESOURCE USE

4.1 Overview

The Mi'kmaq Land, Water and Resource Use Activities component of the MEKS provides relevant data and analysis in regard to Mi'kmaq traditional use activities that are occurring or have occurred within the Study Area. It identifies what type of traditional use activities are occurring, it provides the general areas where activities are taking place and it presents an analysis regarding the significance of the resource and the activity as well.

The Mi'kmaq traditional use activities information that is provided by interviewees is considered both in terms of "Time Periods" and in regard to the "Type of Use" for a given resource. The Time Periods that the MEKS team differentiates traditional use activities by are as follows:

"Current Use" – a time period within the last 10 years
"Recent Past" – a time period from the last 11 – 25 years ago
"Historic Past" – a time period previous to 25 years past

The "Type of Use" categories include spiritual use, and sustenance use, such as fishing, hunting or medicinal gathering activities.

Finally, the study analyzes the traditional use data in consideration of the type of land and resource use activities and the resource that is being accessed. This is the Mi'kmaq Significant Species Analysis, an analysis which ascertains whether a species may be extremely significant to Mi'kmaq use alone and if a loss of the resource was to occur through project activities, would the loss be unrecoverable and prevent Mi'kmaq use in the future. This component is significant to the study as it provides details as to Mi'kmaq use activities that must be considered within the environmental understanding of the Project Site and Study Area.

By analyzing the traditional use data with these variables, the MEKS thoroughly documents Mi'kmaq traditional use of the land and resources in a manner that allows a detailed understanding of potential effects of project activities on Mi'kmaq traditional use activities and resources.

4.2 Limitations

By undertaking a desktop background review and interviews with Mi'kmaq participants in traditional activities, this study has identified Mi'kmaq Traditional Use activities that have occurred or continue to occur in the Study Area and Project Site. This has allowed the study to identify traditional use activities in a manner that the MEKS team believes is complete and thorough, as required by the MEKP. Historical documents within public institutions were accessed and reviewed and individuals from nearby Mi'kmaq communities were interviewed. The interviews were undertaken with key Mi'kmaq community people, identified by the MEKS team, who are involved and are knowledgeable regarding traditional use activities. Through the historical documentation review and the interview process, the MEKS team is confident that this MEKS has identified an accurate and sufficient amount of data to properly reflect the traditional use activities that are occurring in the Study Area.

The MEKS process is highly dependent on the information that is provided to the team. Because only some of the Mi'kmaq traditional activity users and not all Mi'kmaq traditional activity users are interviewed, there is always the possibility that some traditional use activities may not have been identified by this MEKS.

At the time of this report, it should be noted that due to the ongoing Covid19 pandemic, MGS noticed a decline in interview participation as well as a decline in traditional use activities occurring during the pandemic. The Covid19 pandemic is still a concern within Mi'kmaq communities.

4.3 Historical Review Findings

Historic Review

The traditional lands of the Mi'kmaq are collectively known as Mi'kma'ki. The sources reviewed provided very general boundaries of 7 Districts of Mi'kma'ki and have just enough detail to give an approximation of boundaries along the coast but not much detail for the interior boundaries. (1)(2)(3)(4)

Using the general boundaries provided by the sources, MGS interpreted the source maps and recreated boundaries of the 7 Districts of Mi'kma'ki in more detail. The sources included relevant maps, significant watersheds, some major rivers and landscape features, as the defining features on the ground.

The Project Site(s) and Study Area is within both ***Epekwitk aqq Piktuk*** District (Territory) and ***Eskikewa'kik*** District (Territory.

Epekwitk (Lying in the Water) ***aqq Piktuk*** (The Explosive Place)	This District combines the entire Island of Prince Edward Island with all the lands and waters draining into the Northumberland Strait and St. Georges Bay from Mainland N. S. east of Abercrombie Point to Cape Blue. The District includes the East River of Pictou watershed and eastward including Antigonish Harbour, Pomquet Harbour and the Tracadie River, Little Tracadie River watersheds.
Eskikewa'kik (Skin Dressers)	Eskikewa'kik includes all lands and waters draining into the Atlantic from St. Margarets Bay including Big Indian Lake, Chebucto (Halifax), Eastern Shore, Strait of Canso to Cape Blue on St. Georges Bay. The District includes the entire Musquodoboit River watershed, a portion of the Shubenacadie River to and including the Stewiacke River watershed draining into Cobequid Bay. In addition, Eskikewa'kik includes the West St. Marys River watershed, East St. Marys River watershed, Country Harbour River watershed as well as the Salmon River and Milford Haven River watersheds draining into Chedabuctou Bay.

The district boundaries may be adjusted after review by the Mi'kmaq and Maliseet Communities. Until that time, the other Districts of Mi'kma'ki outside the Study Area are proposed as follows (1)(2)(3)(4):

Mi'kmaq Political Districts with Maliseet, Passamaquoddy and partial Penobscot Traditional Territories. (1)(2)(3)(4)

Sipekni'katik (Wild Potato Area) This District includes all lands and waters draining into the Northumberland Strait from MacFarlane Point, Wallace Harbour to and including the Middle River of Pictou watershed. Sipekni'katik also includes all the lands and waters draining into Cobequid Bay, Minas Basin and Bay of Fundy from Five Islands Carrs Brook and Economy River watersheds to and including North River and Salmon River, Avon River, Cornwallis River watersheds to MacNeily Brook near Margaretsville. In addition, Sipekni'katik includes all lands draining into St. Margarets Bay and Mahone

Bay including the Ingram River watershed to and including eastern shore of the LaHave River.

Siknikt (Drainage Area) All the lands and waters draining into the Gulf of St. Lawrence and Northumberland Strait south of Escuminac Point, N. B. to and including the Wallace River watershed and Wentworth Valley. All the lands and waters draining into Cobequid Bay, the Minas Basin, and Bay of Fundy west of Five Islands N. S. and including the Petitcodiac River watershed and all drainage along the Bay of Fundy coast to Mispec Point on the east side of St. John Harbour.

Kespek (Last Land) All the land and waters draining into the Gulf of St. Lawrence north of Escuminac Point, N. B. including the Miramichi River watershed and north to include the Gaspe' Peninsula and south shore of the St Lawrence River. This was the last land to be added to Mi'kmaq territory after a war with the Iroquois.

Kespukwik (Last Flow, Land Ends) This District includes all the lands and waters draining into the Bay of Fundy from approximately Margaretsville, the Gulf of Maine coast and the Atlantic to the western shore of the LaHave River. The LaHave River Watershed may have divided by east and west districts with the eastern watershed a portion of Sipekni'katik and the western watershed is a portion of Kespukwik. Champlain's early map of the LaHave River show two separate Mi'kmaq communities on either side of the river located near Upper Kingsburg and at Green Bay near Petite Riviere (LaHave Islands Marine Museum, 2016). This may indicate a community of each district sharing the LaHave River.

Unama'kik (Land of Fog) ***Aqq Ktaqmkuk*** (Land Across	This District combines all of Cape Breton Island with the Southern Coast of Newfoundland.

Ice

Evidence from deep-ocean sediments indicate that there have been at least 16 glacial periods that lasted approximately 100 thousand years each. The last glacial period was the Wisconsin Glaciation which began 75 thousand years ago and ended between 12 and 10 thousand years ago. During this period, early glaciers flowed across the Atlantic Region in an eastward direction shifting to the south in later ice flows. The last of the glaciers were formed locally within the region while being fed by the high amounts of precipitation. By 13 thousand years ago the ice sheets had receded to the approximate coastline of today and then only residual ice caps remained in highland areas at approximately 12 thousand years ago. (5)

The present-day landscapes began to emerge from under ice some 12,000 years BP for Cobequid Bay which was ice free at that time. The ice continued to melt and reveal barren landscapes of deep till deposits being eroded and transported about by meltwater. The ice also left exposed and thinly covered erosion resistant bedrock at higher elevations. The sea level rose some +60m over the next 6000 years reaching near present day level and coastline. At 11,000 years BP, remnant ice caps topped the Antigonish Highlands, Cobequid Hills, South Mountain of the Annapolis Valley and Cape Breton

Highlands. These ice caps and another ice block centered in Chedabuctou Bay, advanced a short distance each during the Younger-Dryas cold period of approximately 11,000-10,500 BP. (5)(6)

The Younger Dryas Period was a cold period that saw local ice centers such as the Pictou-Antigonish ice cap advance flows again in directions radiating from their center ridges. (6) Sources have the Younger Dryas Period a northern hemisphere cold event lasting 1000 years to 1500 years. (7)(8) The impacts of the Younger Dryas Period were not consistent across the northern hemisphere as there were varied regional impacts influenced by local conditions. (9) Nova Scotia sources have the cold period lasting approximately 200 years based on analysis of lake sediment and peat beds throughout the Province. (6)(10) During the Younger Dryas Period, previously colonized plants that followed the previously receding glaciers were then covered in permanent snowfields and some large mammals became extinct. (10)

The entire Study Area was ice-free by 10,000 BP and left a landscape of mostly glacial ground moraine of a silty till plain with water lain deposits of deltas, outwash fans and esker systems within the lowlands. The elevated Mulgrave Plateau sedimentary bedrock was slightly more erosion resistant to the ice than the lowlands and left a gentle topography of till plain and low Drumlins. Thin till cover is found on the bedrock induced high-ground locations. (10)

Between 10,000 and 8,000 years B.P., there was no Northumberland Strait as it exists today but rather a land connection with Prince Edward Island during the peak of mantel rebound at approximately 9000-year BP. The combination of lower global sea levels than today and the rebound of the mantel beneath the Gulf of St. Lawrence once free of the weight of ice sheets, Prince Edward Island was connected to Mainland Nova Scotia and New Brunswick. (22) (23) (11)(12) The Magdalen Islands was a large roundish island of over 100km wide east to west and separated from the mainland mass including the ancient shore of P.E.I. by an approximately 32km wide channel. The ancient shore of the

Magdalen Island was approximately 50 km north of present-day East Pont of P. E. I. (11)(12)(13)

Based on present-day nautical charts and multi-beam surveys of the Northumberland Strait bottom in the area of the Confederation Bridge, the ancient land connection high point and east-west drainage divide was approximately 36 km northwest of the present-day Confederation Bridge, midway between Shemogue Head, N. B. and Cape Egmont, P. E. I. From this point, surface water drained southeast feeding tributaries of a larger river that eventually flowed eastward, close to the present-day P.E.I. shore between Guernsey Cove P. E. I. and Pictou Island N. S. before emptying into a bay between East Point, P. E. I. and Sight Point, Cape Breton Island. (11)(12)(13)(14)

On the other side of the 9000-year B.P. drainage divide between Cape Egmont P. E. I. and Shemogue Head, N. B., surface drainage was northwest until rounding West Point P. E. I. where the direction was north-northeast until emptying into a bay between Point Escuinac, N. B. and Cape Gage. P. E. I. (11)(12)(13)

There are very few Precontact archaeological sites found within this portion of the province including the Eastern Shore. Most Archaeological sites are found accidentally during development and the Project Study Area has seen little development. The sparsely populated areas have few opportunities to accidentally find archaeological sites, features or artifacts.

There are various period delineations being used for Archaeology in the Province and Maritime publications which differ in the number of periods, names, and time spans. The Archaeological Periods Table below places the periods in context with each other. It is useful to provide these various periods for reference and context when reviewing archaeological reports and placing in time the artifacts and features found. (15)(16)

Artifacts are archaeological objects that can be recorded and removed from the site such as flakes (chips from tool or point manufacture), arrow/spear tips (points), tools, bones, preforms (unfinished tool or point blanks) and pottery sherds. Features are archaeological finds that cannot be removed from the site and can only be recorded such as charred or discoloured ground, a storage pit or Historic Period building foundations as some examples.

		Archaeological Periods	* (Dates are Approximate)	
Time	Natural History of N. S.	* Periods	* Northeastern Periods	* Maritime Region Tradition
11,000 B.P.	< Paleo-Indians		< Paleo-Indian	< Paleo-Indian
	11,000 - 10,000 yrs. B.P.	< Early Period	11,000 - 10,000 yrs. B.P.	11,000 - 10,000 yrs. B.P.
	↓	10,600 - 6,000 yrs. B.P.	↓	↓
10,000 B. P.	< Great Hiatus	|	< Early Archaic	—
	10,000 - 5,000 yrs. B.P.	|	10,000 - 8,000 yrs. B.P.	?
	?	|	↓	?
8,000 B.P.	?	|	< Middle Archaic	?
	?	|	8,000 - 6,000 yrs. B.P.	?
	?	↓	↓	?
6,000 B.P.	?	< Middle Period	< Late Archaic	< Laurentian
	?	6,000 - 3,000 yrs. B.P.	6,000 - 2,500 yrs. B.P.	+/- 5,000 yrs. B.P.
	< Archaic Period	|	|	< Maritime Archaic
	5,000 - 3,500 yrs. B.P.	|	|	5,000 - 3,700 yrs. B.P.
4,000 B.P.	↓	|	|	< Susquehanna Tradition
	< Susquehanna Tradition	|	|	4,000 - 3,500 yrs. B.P.
	3,500 - 2,500 yrs. B.P.	|	|	—
	|	↓	↓	?
3,000 B.P.	|	< Late Period	< Ceramic (Woodland)	< Maritme Woodland
	|	3,000 - 500 yrs. B.P.	3,000 - 500 yrs. B.P.	+/- 3,000 yrs. B.P.
	↓	|	|	- Present
2,500 B.P.	< Ceramic Period	|	|	|
	2, 500 - 500 yrs. B.P.	|	|	< Middlesex
	|	|	|	+/- 2400 yrs. B.P.
2,000 B.P.	|	|	|	|
	↓	↓	↓	↓
500 B.P	< Contact Period	< Historic Period	< Historic	< Mi'kmaq, Maliseet and
	500 -100 yrs B.P.	500 yrs B.P. - Present	500 yrs B.P. - Present	European Traditions
	—	↓	↓	↓
Present (1950)	—	—	—	—

Archaeological Periods (15)(16)

It is during this fluctuating climate period that the earliest signs of people on the lad at the Debert-Belmont encampment sites that were utilized by early peoples of the Paleo-Indian Archaeological Period of 11,000 to 10,000 BP. Located within the transition from the Minas Lowlands (620) to the Cobequid Slopes (350) the archaeological rich area of the Debert Paleo-Indian Site, is a National Historic Site of Canada. The area of the former RCAF Station Debert has been explored over the last 60 some years since the first site discovery in 1948 and extensively explored from 1962-1964 with new discoveries added since that time near Belmont. (17)(18)

The existing known sites are scattered within a large area north of Plains Road atop prominent ground overlooking the Debert River Valley and Cobequid Basin. It is believed that these were strategic seasonal camps to hunt Caribou migrating from the Cobequid Hills (340) to the Minas Lowlands (620) of Cobequid Bay for calving. Some 5000 stone artifact of points, knives and hide scrapers of the Paleo-Indian Period have been retrieved from the area.

Although disturbed by the former base development, these sites appear to be undisturbed by the ice advance of the Younger-Dryas period and there may have been ice-free corridor between ice sheets from the Minas Basin through to the Northumberland Strait through present-day Pictou Harbour at that time. With the lower sea levels at that time, Prince Edward Island were one landmass with the Northumberland Lowlands (530). The Magdellan Islands were a large low-lying island close offshore. The Debert-Belmont area would be an Ideal location to find migrating herds of the wildlife of the time. (17)(18)

Local History

Much of local history concerning the presence and activities of early Mi’kmaq, is centered around Canso which has a long history of Mi’kmaq and early European interactions.

The Mi’kamaq Traditional Territory of Eskikewa’kik. was an important region for the Mi’kmaq. Unama’kik (Cape Breton Island) was the traditional residence of the Grand Chief and political center of Mi’kmaq Territory due to being far removed from Iroquois and Inuit enemies. (19) Eskikewa’kik was also far removed from enemies and was a crossing point between Unama’kik and the mainland Atlantic Coast and other mainland territories. (20)

Being the most easterly point of the Mainland, combined with the barren shores and islands made Chedabucto Bay and the Canso area an attractive and important landing early in the 17th century. Early European fishermen would dry their catch on the gravelly shores before returning to their home ports with their holds filled with dried fish. Fishermen would set up temporary seasonal fish drying camps on the level beaches and were trading with the Mi'kmaq during their stay. (21)

In 1606, after 8 weeks at sea the French ship Jonas arrived at Canso with lawyer turned adventurer Marc Lescarbot onboard. Lescarbot authored records of his experiences and of the early days of Champlain's Port Royal. When they arrived at Canso, they were approached by 2 Basque long-boats under sail with one boat crewed by fishermen out the French port of St. Marlo and the other was captained and crewed by Mi'kmaq who painted a large moose on their sail. (21)

During their long association with the Basque the Mi'kmaq became excellent sailors which would be later exploited by the French to harass the English fishing fleets. The Mi'kmaq also developed a trading language that Lescarbot described as half Basque but was functional enough to enable communication with the new arrivals on the Jonas. (21)

The French had also had a long association with fishing the Eastern Shore of the Province and trading with the Mi'kmaq beginning as early as 1504. (22) In 1518, Baron de Lery of France attempted to establish a settlement in Acadia but found the climate disagreeable and left cattle at Canso and Sable Island before returning to France and did not return. (22)

Canso was a favorite port of fishermen and traders as indicated in 1609 by an old Mariner named Scavalet who claimed to have made 40 previous voyages to Canso. (22)

The Strait of Canso is an obvious corridor route for all forms of life including early man and continues to be so today. However, there is scarce evidence that early peoples through to the 19th century Mi'kmaq inhabited the area. Other than a fishing station at

Pirates Cove, Non-Mi'kmaq settlement in the Strait of Canso area started with the late arrival of the St. Augustine Loyalists in 1784. (20) McNairs Cove, known as the Town of Mulgrave today, was first settled in 1800. (23) Prior to this there is an absence of Mi'kmaq in local history sources of an early history of the Study Area.

Guysborough and Canso were the center of interest in the early settlement of Chedabuctou Bay. Canso has a long history of being visited by fishermen of several nations and has a history of sporadic warfare with the Mi'kmaq while under later British Rule. Guysborough was a trading and fishing station established by Nicholas Denys sometime about 1659 Denys' operation consisted of fortifications named Fort Chedabuctou at the mouth of Guysborough Harbour and behind the beach bar. (24) There were 20 acres of cleared land and the fort employed up to 120 men when it was attacked and destroyed in 1667 over territorial and rival trade disputes. With the presence of a trading station in the area, there would have been a Mi'kmaq presence nearby with much foot traffic and canoeing along the network of river routes. (24)

The French were trading in the Chedabuctou Bay area as early as 1629 when a French captain built a house at Fort Point and traded with the Mi'kmaq until1635 when it was attacked by enemies whom were not specified in the source. (25)

During the early 1680's, the Mi'kmaq had an encampment in the area of the present-day Guysborough town site. (25) During this time the French established Fort St. Louis on the ruins of Fort Chedabuctou early in the 1680's which was later captured in 1690 by Sir William Phips. (24) The British had established fortifications at Canso in 1720 thereby diminishing the former fort's importance in the region. (26)

Under British rule, the region's history begins to fade between the 1690' and 1780's although the Acadians of Chedabuctou appear to have remained on their lands during the province wide expulsion of the Acadians in 1755. There were 14 Acadian families at Chedabuctou in 1764. (h) (26) It was at this time the last of the Acadians at Chedabuctou left for Isle Madame and St. Pierre et Miquelon leaving abandoned homes, farms and industry. (25)

In 1783 there was a mass movement of people and disbanded British troops who were displaced by war and persecution in the former British 13 Colonies. From as far south as Florida, people and the military moved north to British Territory.

Most sources reviewed briefly mention the Mi'kmaq in the region's history and with the exception of sporadic warfare at Canso between the French backed Mi'kmaq and both English and New England ships and subjects, most sources report a more congenial existence between the Mi'kmaq and the influx of peoples in the area. However, unlike the Loyalists who were able to escape war and persecution by the Americans and flee to friendly territory, the Mi'kmaq existed within unfriendly British territory since the French loss of Acadia and later Ile Royale. (20)

In 1783 the War of Independence was winding down and the British Military and those loyal to the crown from all along the 13 colonies as far south as Florida, were on the move north to British Territory. Those amassed at New York had to be shipped out elsewhere and Regiments were disbanded rather than transported to another theater. The evacuation of New York began in the fall of 1783. At the same time there was an evacuation of St. Augustine, Florida where an estimated 17,000 to 18,000 were evacuated and some of those arrived in Halifax in July of 1784. These arrivals from the south were reported to be the 4th wave of 4 waves of Loyalists to the Region and the most destitute of the Loyalist settlers. In addition to their misery the choice lots were taken by the previous arrivals and they were in no position to request another location so they settled in the Strait of Canso area and abandoned their plantation life for a life of fishing. (25)

On the Cape Breton Island shore, settlement was a mix of Acadians on Isle Madame, some Scots via St. Johns Island (PEI) in the early 1770's and some were early Loyalists who arrived prior or during the 1783 War of Independence. The early waves of loyalists in 1784 that took over the choice Acadian lands near Guysborough and there was the late arrival of the St. Augustine Loyalists who settled the shores of the Strait of Canso and later the Irish who settled the Port Hood Area. (28)

Sources place the Mi'kmaq along the Strait of Canso at McNairs Cove and Melford Point in 1856 petitions by concerned citizens for relief supplies from the Government for Mi'kmaq. (28)

A review of the 1876 A. F. Church County Map, Guysborough County, shows no indication of Mi'kmaq settlements ("Indian Camp") within the vicinity of McNairs Cove, Melford Point or Indian Harbour. A review of the entire 1876 map shows no indication of Mi'kmaq settlements or encampments although the Mi'kmaq Burial Ground at Glenelg and the "Colored Settlement" at Birchtown, north of Guysborough are shown on the map. (29)

Traditional Hunting Territories

In earlier Historic Period years, the warmer months were times of abundance with surrounding areas of coastal camps providing fish, shellfish, fowl and eggs. Offerings were made to spirits but the Mi'kmaq rarely stockpiled enough food for the entire winter. They brought with them from the coast smoked and sun-dried seafood, dried and powdered hard-boiled eggs. Berries were boiled and formed into cakes and were sun-dried. Grease and oils from boiled marrow and fat were stored and transported in animal bladders. Root vegetables such as *segubun* (wild potato) which was similar to today's sweet potatoes and wild nuts were also part of the winter food supply. (30)

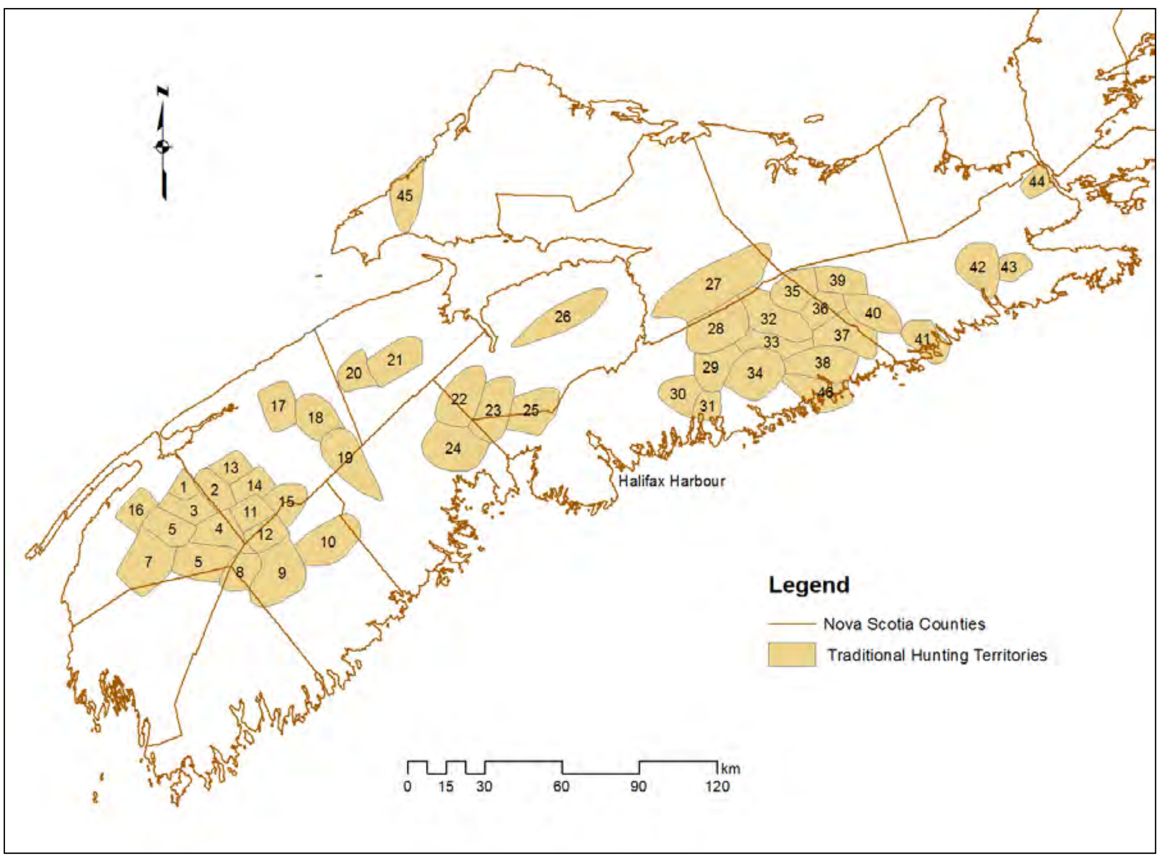
Month	Seasonal Locations	Seasonal Groupings	Food Resource
Jan.	Sea Coast	Bands	Smelt, Tomcod, Seals & Walrus Beaver, Moose, Bear, Caribou
Feb.	Inland	Bands & Family Units	Smelt, Tomcod (ending) Seals & Walrus, Beaver, Moose, Bear, Caribou

(Period of Winter Famine Begins)			
Mar. (Period of Winter Famine)	Inland	Bands & Family Units	Smelt, Seals & Walrus (ending) Scallops, Crab, Urchins, Winter Flounder, Beaver, Moose, Bear, Caribou
April (Period of Winter Famine ends)	Sea Coast	Villages	Smelt, Winter Flounder, Scallops, Crab, Urchins, Sturgeon, Brook Trout, Alewife, Herring, Spring Bird Migrations, Beaver, Moose, Bear, Caribou
May	Sea Coast	Villages	Smelt, Scallops, Crab, Urchins, Sturgeon, Salmon, Brook Trout Alewife, Codfish, Capelin, Shad, Mackerel, Skates, Herring, Spring Bird Migrations, Beaver, Moose, Bear, Caribou
Jun.	Sea Coast	Villages	Scallops, Crab, Urchins, Sturgeon, Salmon, Brook Trout Alewife, Codfish, Capelin, Shad, Mackerel, Skates Lobsters, Spring Bird Migrations, Beaver, Moose, Bear, Caribou
Jul.	Sea Coast	Villages	Scallops, Crab, Urchins, Codfish, Capelin, Shad, Mackerel, Skates Lobsters, Spring Bird Migrations, Beaver, Moose, Bear, Caribou, Strawberries, Raspberries
Aug.	Sea Coast	Villages	Scallops, Crab, Urchins, Codfish, Skates Lobsters, Beaver, Moose, Bear, Caribou, Strawberries, Raspberries, Blueberries, Ground Nuts
Sept.	Sea Coast	Villages	Scallops, Crab, Urchins, Codfish, Skates, Salmon, Herring, Eels, Fall Bird Migrations, Beaver, Moose, Bear, Raspberries, Blueberries, Ground Nuts, Cranberries
Oct.	Small Rivers	Villages	Scallops, Crab, Urchins, Smelt Codfish, Skates, Salmon, Herring, Eels, Brook Trout, Fall Bird Migrations, Beaver, Moose, Bear, Blueberries, Ground Nuts, Cranberries
Nov.	Inland	Bands	Smelt, Tomcod, Turtles, Seals, Beaver, Moose, Bear, Ground Nuts, Cranberries
Dec.	Rivers	Bands	Smelt, Tomcod, Turtles, Seals, Beaver, Moose, Bear, Ground Nuts,

Mi’kmaq Annual Subsistence (31)

Mi'kmaq had an intimate knowledge of the ecology of their territory and fit their lives to seasonal cycles of the vegetation and animals and fish. Due to climate conditions, agriculture for food was a risk for Mi'kmaq. (32) Highly mobile Bands consisting of several related families would assemble at favorite coastal camp sites in warmer seasons. In the fall and winter, the camps would disperse into small groups of 10-15 people for winter hunting. (32)

It was the duty and responsibility of the chief of each political district to assign the hunting territories to families and any changes were made in the presence of the Council of Elders which met in the spring and fall of every year. (30) Hunting districts of approximately 200-300 square miles were assigned to families. (32)



Mainland Nova Scotia Traditional Hunting Territories (33)

The territories were usually surrounding lakes and rivers and were passed on to sons unless there were no sons where the district was then assigned to another family. (33) The Mi'kmaq respected the boundaries of the assigned territories and only took from the land what they needed for the family to survive thereby preserving game and fish for the family's future survival. (30)

The hunting territories of the mainland Nova Scotia were numerous compact interior territories that encompassed the watersheds of interior lakes and rivers as Mi'kmaq did most their game hunting during colder months of the year when they moved inland from the summer coastal camps (30)(33) Cape Breton Island Mi'kmaq hunting territories are larger and more regional, encompassing saltwater coastal shorelines and interior river systems. (33)

Map Reference	Name of Family	Geographic Territory
44	Peter Anthony (half-breed)	Mill Village River, near Port Mulgrave

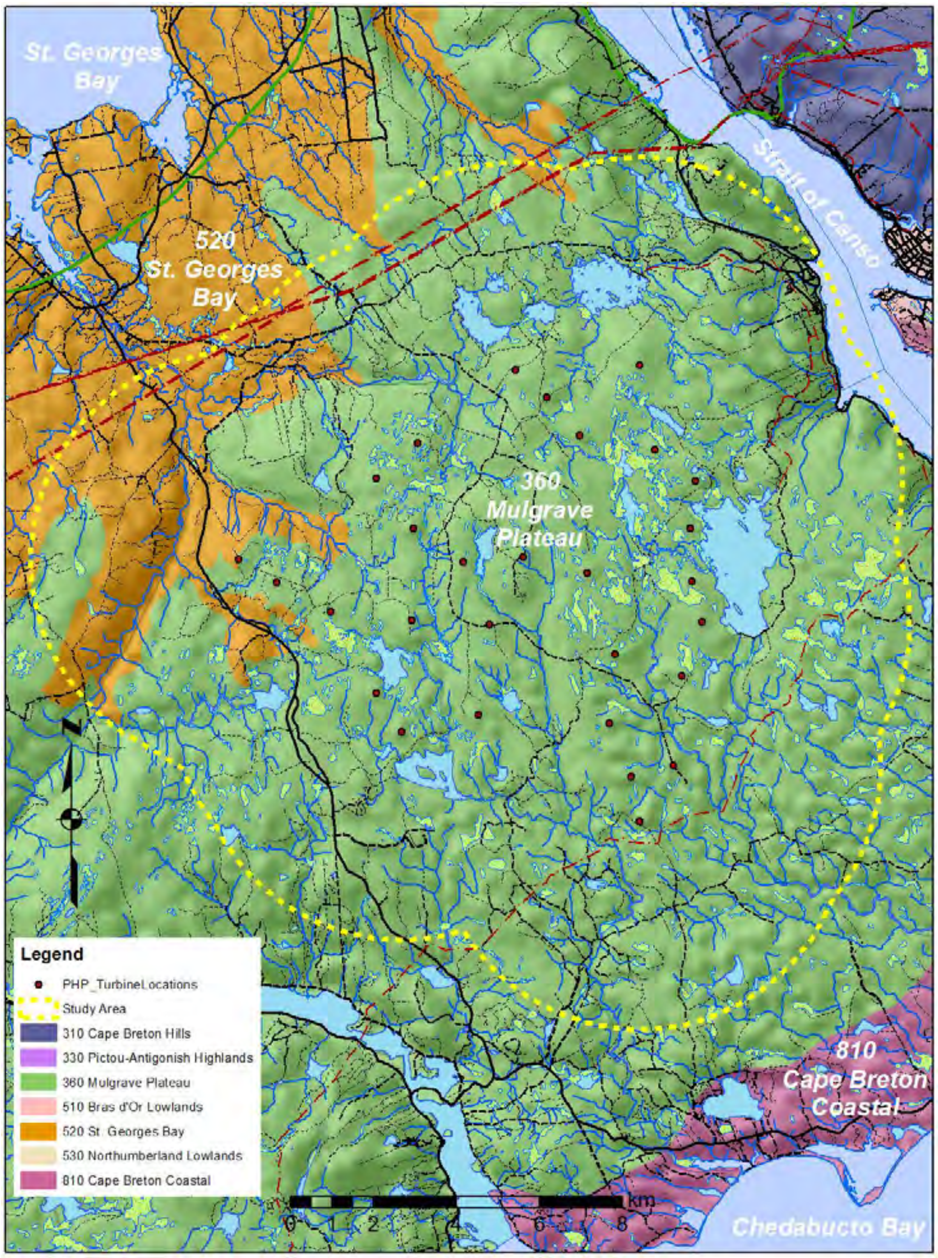
Mainland Nova Scotia Traditional Hunting Territories Recorded Circa 1919 (33)

The last known Traditional Hunting Territory the along the Strait of Canso and Mulgrave area is within the Study Area. Territory No. 44 assigned to Peter Anthony covers the area of Mill Village River, near Port Mulgrave. *(33)* The territorial reference numbers pertain to the source's original reference system and it is unknown if territorial numbers were assigned by Chiefs.

N. S. Ecological land Classification

The Project Site(s) and Study Area are centered approximately at Long Lake, located 5km west of Goose Harbour Lake are almost entirely within the Mulgrave Plateau (360) Ecodistrict with the exception of the northwest portion within the St. Georges Bay (520) Ecodistrict. (34)

The Mulgrave Plateau (360) Ecodistrict covers a large area of this portion of the Province. The Study Area of the combined 5km Buffers from the turbine Project Sites, extends north to St. Georges Bay inland shores, east to the Strait of Canso including Cape Porcupine, McNairs Cove and Pirate Harbour at Mulgrave. The Study extents extend south to Manchester, located north of Trunk 344 and east of Highway 16. The east extents of the Study Area reach Maynies Lake and including South Maitland just west of the Tracadie River. (34)



Nova Scotia Ecological Districts

The St. Georges Bay (520) Ecodistrict extends southward into the elevated Mulgrave Plateau (360) and Study Area following the lowland watercourse valleys flowing north into St. Georges Bay. Extending south into the Study Area, the St. Georges Bay (520) Ecodistrict follows the Tracadie River, Hurlburt Brook, Silvy Brook and upstream the drainage for Archies Lake. The St. Georges Bay (520) Ecodistrict also follows upper reaches of the Little Tracadie River flowing into flowing into Linwood Harbour and the Wrights River flowing into Harve Boucher. (34)

This pattern of lowland extending into elevated plateau continues westward between the St. Georges Bay (520) and Mulgrave Plateau (360) Ecodistricts until Lochaber Lake in the west including the South River flowing into Antigonish Harbour. The Mulgrave Plateau (360) south extents are Salmon River Lake and Salmon River flowing into Chedabucto Bay, as well as the chain of lakes west through South River Lake and to Lochaber Lake. (34)

The St. Georges Bay (520) Ecodistrict is flat till plain of gentle to moderate relief with a mean elevation of 130m with the Study Area in the 150m to 175m elevation range. The plateau has extensive areas of imperfectly drained tills and some low-level drumlins. The Drumlins support Red Maple and Yellow Birch with Sugar Maple on lower slopes. The undulating plateau supports softwood forest of Balsam Fir, White Spruce and Black Spruce. The deeper and richer soils support a mixed forest cover of Yellow Birch, Red Maple hardwoods and White Spruce, Balsam Fir softwoods. The shallow soils over bedrock have stunted Black Spruce, Tamarack and Red Maple Forest cover. The plateau steep slopes and ravines are well drained and support a mix of tolerant hardwoods and softwoods of Red Spruce and Hemlock. (34)

The Study Area and Mulgrave Plateau (360) Ecodistrict has at least nine significant lakes including Clam Harbour Lake, Sheppard Lake, Five Mile Lake and westward with reservoirs Summers Lake, Matties Lake, Grant Lake. Two smaller lakes of West Lakes and Long Lake are west of the largest lake reservoir of Goose Harbour Lake, south of

Mulgrave. There are extensive wetlands of Shrub Swamps and Open Bogs, east and west of Goose Harbour Lake with a large Heathland area east of Goose Harbour Lake. The wetlands habitats support rare wetland plants, endangered Mainland Moose, the Wood Turtle and Butterflies. (34)

The Study Area is drained by north flows of the Tracadie River, Little Tracadie River and Wrights River to St Georges Bay. Flows to the east and into the Strait of Canso to include MacKaskills Brook, McNairs Brook, Murry Brook, West Brook and East Brook. Much of the south portion of the Study Area drains south to Roman Valley River and Milford Haven River. The St Francis Harbour River reaches and drains the southeast portion of the Study Area and flows into Chedabucto Bay. (34)

The underlying bedrock of the Mulgrave Plateau (360) within the Study Area is almost entirely underlain with Horton Group of deformed Sedimentary rock with contact edges between other bedrock type occurs at the approximate Study Area bounds on the Strait of Canso and south near Manchester, just north of Milford Haven River/Guysborough Harbour (35)

A review of Geology shows no potential sources of Rhyolite stone within the Study Area. Outside and southwest of the Study Area, and southwest of Milford Have River, is a horizontal distorted narrow band of Sunnyville Formation of Basalt, Andesite, Rhyolite and Tuff. The band of potential utility stone runs inland northwest from the mouth of the Salmon River, to roughly Glenco. (35)

The till cover over the bedrock varies throughout the Study Area with deeper cover on lowland slopes and river valleys with thin till found on the higher plateaus.

Rhyolite properties of hardness and workability were valued by early peoples for stone tools and weapon points. The bedrock has thin till cover on the hill tops and exposes potential areas of quarrying Rhyolite or utility stone by early peoples. Another potential source of Rhyolite is the Colluvial Deposits along steep valley and ravine walls, (36)

Another important natural resource to Mi'kmaq that is difficult to find, is Black Ash hardwood. A review of i-Naturalist found no reported finds of Black Ash within the Study Area nor within that part of the Province. (37)
Black Ash is a natural resource prized by the Mi'kmaq to craft into products for own use and sale. The source was referenced i-Naturalist for nearby geo-locations of Black-Ash which was desk-top-reviewed by this study and shows no identified locations within the Study Area. (37)(38)

Black ash is typically found in poorly drained areas that are often seasonally flooded. It is most common on peat and muck soils but also grows on fine sands over sands and loams. Although this species can tolerate still semi-stagnant conditions, there is a preference for swampy woodland stream and river banks with moving water. It is often associated with species such as Red Maple (Acer rubrum), Speckled Alder (Alnus rugosa), Balsam Poplar (Populus balsamifera), and Black Spruce (Picea mariana). The species is shade intolerant, and seedlings, saplings and sprouts need partially opened forest canopies. (38)

The George River Metamorphic Suite of Quartzite and the Proterzoic-Devonian Granite underlie Cape Porcupine. The Study Area may touch on the Fountain Lake Group, Clam Harbour River Formation of Siltstone, Sandstone, Wacke and Conglomerate found just north of Milford Haven River. (39)

The St. Georges Bay (520) Ecodistrict consists of low elevation topography of rounded hills of 30m to 60m elevation, surrounding St. Georges Bay from Sutherlands Cove, north of Port Hood, south to Archies Pond and across the Strait of Canso to Havre Boucher. From here, the ecodistrict further lines the south shore of St. Georges Bay that includes Linwood Harbour, Tracadie Harbour, Pomquet Harbour and Antigonish Harbour. The St. Georges Bay (520) continues north along the western shore of St. Georges Bay, squeezing by Crystal Cliffs and through the community of Morristown to Lakevale on the east coastline of Cape George.

With the exception of the Cape Breton coastline, The St. Georges Bay (520) ecodistrict extends far inland from the coast up to 30km to foot of The Keppoch highlands southwest of Antigonish. Within the Study Area, the St. Georges Bay (520) ecodistrict occupies the lowland area west of Tracadie Harbour. The St. Georges Bay (520) Ecodistrict occupies lowland areas extending south into the Mulgrave Plateau (360 following river cuts into the plateau. (34)

Underlying the St. Georges Bay (520) ecodistrict is sedimentary bedrock of Sandstone, Shale and Limestone covered with varied thickness of Gravelly, and Gravelly-Clay Tills up to 30m of bedrock cover. Gypsum outcrops and Karst topography are found within the ecodistrict along with significant glacial deposits of Outwash Plains, Kames and Terraces found in valley corridors within the ecodistrict. (34)

Forest cover over the gently rolling hills is mostly tolerant hardwood forest of Sugar Maple, Yellow Birch, Beech and White Ash on crests and upper middle slopes. The middle to lower slopes has Yellow Birch dominated mix woods with Black Spruce, Red Maple and Tamarack covering poor nutrient and wet soil conditions.) (34)

North portion of St. Georges Bay (520) ecodistrict is known for the sandy beaches and dune structures supplied by sediment of eroded sandstone. The ecodistrict also has shrub swamps and shallow marshes along river valleys as well as a Karst topography of sink holes, crumbling cliffs, caves and vertical shafts. (34)

Post Contact History

The late1700’s was a critical time in Mi’kmaq history when the Mi’kmaq population was decimated by disease and Mi’kmaq way of life was disappearing. It was at this time that England encouraged settlement on Acadian lands that had been abandoned after the Acadian Deportation in 1755. The New England Planters arrived between 1760 and 1766 to occupy former Acadian farms. Mi’kmaq and Acadian place names were replaced with English names. (40)

Surviving Mi’kmaq Placenames include:

Mi’kmaq Placenames (41)

Antigonish County

Afton	Paqtnkek	above the water (but at a distance from the ocean)
Antigonish	Nalikitquniejk	many meanings found, but still uncertain
Antigonish Harbour Island	Alusulue'katik	at the measles place
Barrios Beach	Tuitn	at the flow out
Bayfield	Niktue'k	at the forks
Cape Blue	Mikjikjue'katik	place of turtles
Cape George	Memkejk	at the clear field
Cape Jack	Ki'kli'kwe'ji'jk	place of the little chickens
Glassburn Cove or Black River	Amasipukwejk	long river
Harris Island	Pkue'kati'jk	at the little place of the spruce gum
Havre Boucher	Nuloqnejk	meaning uncertain
Heatherton	Niktue'k	at the forks
Indian Gardens	Mekwasek	at the red hue
Indian Point	Klujjiewey Kaqmik	where the cross stands
Knyodart Brook	Walatqek	cove-like
Linwood	Tlaqatiku’jk	at the little encampment
Mahoneys Beach	Tuitn	at the flow out
North Lake	Ji'ka'we'katik	place of the bass
Old Ship Yard	Kji-pa'tlia'suiktuk	at the Bishop's place
Pomquet	Poqmkek	holes made for fishing
Pomquet Beach	Pataluti'jk	at the little table
Pomquet Ferry	Pqutamo'taqnek	at the ferry crossing place
Pomquet Island	Paqtnkek Mnikuk	island off shore near Paqtnkek
Pomquet River	Amasipukwejk	long river
Poplar Grove	Mitia'qmikeji'jk	at the little poplar grove

South River	Peskipuktukwek	at the branching off place (refering to South River)
South Side Pond	Mun'te'jk	at the little sack
Summerside	Walne'k	at the cove
Tracadie	Tlaqatik	At the encampment
William Point	Maqtewatqek	at the black foresty area (Refer to William's pt.)

Guysborough County

Andrew Passage	Asoqmikata'skukwek	walking through a muddy plain
Black Point	Maqtewatqek	at the black foresty area
Canso	Qamso'q	across a body of water
Canso Lake	Kwimue'katik	place of the loons
Cape Argos	Mekwe'k Kwesawey	at the red point
Cape Porcupine	Matuesuatp	porcupine head
Chedabucto Bay	Setapuktuk	flowing far back
Clam Harbour	E'se'katik	at the place of clams
Cole Harbour	Wanpa'q	calm water
Cook's Cove	L'nui-wutanji'j	little Native settlement
Cooper Lake	Plamkikmejk	at the Salmon place
Country Harbour	Anakwe'katik	at the flounder place
Country Harbour Head	Wi'sikk	shaped like a beaver's den
Durell Island	Siplo'kaqnek	at the long flat stretched island
Ecum Secum	Mekwe'saqnuk	at the red bank
Elis Cove	Wiskɨpoq	salt water
Gaulman Point	Asoqmita'sinukek	at the crossing place
Glasgow Head	Qam'so'qu'jk	little crossing place
Goose Harbour Lake	Sinumkw Walney	Goose Harbour (more precisely Bay)
Grassy Island	Waqlusanji'jk	at the little fort
Guysborough	Se'tta'ne'katik	the place of Saint Anne
Holland Harbour	Wskitiamka'taqnek	where canoes are carried across a sandbar
Hunting Lake	Paqasimkwajk	at the place where you hunt while wading in the water
Indian Harbour	Mimnoqnek	at the witch hazel place
Indian River	L'nui-sipu	Indian River
Isaac Harbour	Anakwe'katik	at the flounder place
Larrys River	Pkue'katik	at the spruce gum place
Liscomb Harbour	Me'katewik	place of the big eels
Liscomb Lake	Ke'kwapskuk	at the high cliffs
Marie Joseph	Kloqweju'k	at the sculpin ground place
Melopseketch Lake	Milapskikejk	at the varied shaped rocks
Middle Melford	Sa'n Miso'ek	at Jean Michaud's place

Mulgrave	Tui'knek	at the out flow
Mulgrave Hill	Nisiamkek	at the sloping hill
Mussel Cove	An'kata'lue'katik	at the place of the mussels
Oyster Ponds	Su'ne'katik	at the cranberry place
Philips Harbour	Pilipkomimk	at Philips Harbour (English derivation of Phillip)
Pirates Harbour	Tepkiso'katik	at the separation place
Porcupine Head	Matuesuatp	porcupine head
Sand Point	Kwesawamkiaq	where sand piles
St. Marys River	Napu'saqnuk	at the place of stringing beads
West River Lake	Pne'katik	at the bird egg laying place
Whitehead	Qamso'qu'ji'jk	across the small body of water

A second wave of approximately 1000 English settlers known as the Yorkshire Migration arrived in Nova Scotia between 1771 and 1776. The Yorkshire Emigrants were recruited from northern England to occupy Acadian farms and increase British presence among the planters and republican sentiments. The Yorkshire Emigrants landed at Fort Cumberland in 1772. (42)

American Revolution was fought and won by the Americans. Loyalists (citizens loyal to England) and British soldiers and officers were looking for land and British protection. These Loyalists arrived in large numbers between 1783 and 1784 and founded numerous new Cumberland settlements (43)

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The land grants to the Loyalist and the Scottish-Irish emigrants that followed was wide spread throughout Nova Scotia and most all remaining lands in Nova Scotia were granted to emigrants who left their home countries.

The Mi'kmaq traditional territories were granted away to successive waves of by then immigrants looking to work land granted them. During these times of immigrant settlers Mi'kmaq were not granted title to land but rather were granted "Licenses of occupation during pleasure". The land was owned by the Crown and reserved for particular Mi'kmaq Bands. The first of these licenses in Nova Scotia was granted in the 1780's and locations were typically coastal and ravine sites long frequented by Mi'kmaq. In 1820 the reserve system was started and each county was instructed to set aside lands near sites frequented by Mi’kmaq. A number of reserves of approximately 1000 acres each was planned for each county of Nova Scotia totaling 22,050 acres for exclusive use by the Mi’kmaq. This produced little action and it was the Mi’kmaq themselves that pushed for reserve lands. However, what the Mi’kmaq received was not always of their choosing and if their reserve was good land, it was subject to encroachment by settlers. (32)

There was a period beginning in the early 1800’s when Mi’kmaq were encouraged to remain in a single location. Attempts were made to introduce Mi’kmaq to farming and centralizing Mi’kmaq on large reserves such as Indian Brook I. R. 14 located at Shubenacadie, East Hants Co. (32)

Today, Paqtnkek Mi’kmaw Nation is the nearest Mi’kmaq community located approximately 19km west of the center of the Project Site and Study Area. Paqtnkek Mi’kmaw Nation is on Paqtnkek-Niktuek No. 23 consisting of 204.8 hectares (506 acres). Other Paqtnkek lands today include 43.4 hectares (107 acres) at Welnek No. 38, located 18km east of Antigonish and the shared lands with Pictou Landing First Nation at Franklin Manor No, 22, Cumberland County. Franklin Manor No. 22 is located 35km south of Amherst on Indian Brook, consisting of 212.5 hectares (525 acres). (44)

A review of Specific Claims shows no current and active First Nation claims within the Project Study Area. Paqtnkek Mi’kmaw Nation had a number of Specific for loss of land which all have been “Settled”, “Concluded” or “Other” (File Closed). Paqtnkek Mi’kmaw Nation has one “Invited to Negotiate” and “Active” Specific Claim concerning loss of land in 1827 with the Crown Grant to Peter McChesney without surrender. (45) Further research places the land in question near Sonora, on the east shore of the mouth of St. Marys River, Guysborough County (46)

4.4 Mi’kmaq Traditional Use Findings

The traditional use data gathered for this MEKS was drawn from one primary source: interviews with Mi’kmaq individuals who reside in the surrounding Mi’kmaq communities and those who are familiar with or undertake these types of activities. This data was acquired through interviews with interviewees that allowed the study team to identify the various traditional use activities, resources and areas that are currently or have been used by the Mi’kmaq, and any information that was gathered in previous MEKS in the area. Interviewees were asked to identify areas within the Study Area and Project Site where they knew of traditional use that had taken place, or currently in use. These interviews took place from October and November 2022.

To easily identify the traditional use data findings of this study, the analysis has been broken down into two groups. The first is the Project Site analysis, and the second is the Study Area.

Unless otherwise stated, areas identified by interviewees are considered to be utilized by the Mi’kmaq currently, in the recent past, and/or the historic past.

Project Site

The Project Site, as well as locations in the *immediate* vicinity (within 50 meters) of the Project Site, will be considered when analyzing traditional use activities.

Fishing

Trout and Salmon fishing was identified within the Project Site in areas surrounding Clam Harbour Lake and Silvey Brook

(see Appendix B, map “Goose Harbour Lake Wind Farm Project MEKS – Mi’kmaq Traditional and Current Fishing Areas”)

Hunting

Deer, partridge and rabbit hunting activity was identified in the Project Site near Neds Lake and Shepherd Lake.

(see Appendix C, map "Goose Harbour Lake Wind Farm Project MEKS – Mi'kmaq Traditional and Current Hunting Areas").

Gathering

There were no gathering activities reported within the Project Site.

Study Area

As mentioned previously, the MEKS data is also drawn from the Study Area. The purpose of this portion of the study is to portray other land characteristics and land use activities that may have been missed in a narrow Project Site data analysis.

Fishing

Trout and Salmon was identified the most in the Study Area. (see Appendix D, map "Goose Harbour Lake Wind Farm Project MEKS – Mi'kmaq Traditional and Current Fishing Areas").

Ten (13) Trout fishing areas were identified in the areas of:

- Linwood Station
- Grant Lake
- Goose Harbour Lake
- Clam Harbour Lake
- Shepherd Lake
- Meaghers Lake
- Levi Harts Pond

Nine (9) salmon fishing areas were reportedly fishing near:

- Linwood Station
- Silvey Brook
- Leets Lake
- Shepherd Lake
- Birchtown Lake
- Meaghers Lake

Other species identified in the Project Site are Mackerel (2 areas), Elver (1 area), Stripped Bass (1 area), Lobster (1 area), and Squid (1 area). (see Appendix B, map "Goose Harbour Lake Wind Farm Project MEKS – Mi'kmaq Traditional and Current Fishing Areas")

Hunting

Deer, partridge and rabbit were the only species identified in the Study Area.

Eight (8) Rabbit hunting areas were found to be located:

- Meaghers Hill
- Upper Big Tracadie
- Mattie Settlement to McNairs Brook

Seven (7) Deer hunting areas were found to be located:

- Meaghers Hill
- Upper Big Tracadie
- Mattie Settlement to McNairs Brook

Four (4) Partridge hunting areas were found to be located:

- Upper Big Tracadie
- Neds Lake

(see Appendix C, map “Goose Harbour Lake Wind Farm Project MEKS – Mi’kmaq Traditional and Current Hunting Areas”).

Gathering

Spruce (3), Fur (3), Chantrel (2), and Blueberry (1) were the gathering activities reported within the Study Area. The Areas include:

- Meaghers Hill
- Clam Harbour Lake
- East Brook

(see Appendix D, map “Goose Harbour Lake Wind Farm Project MEKS – Mi’kmaq Traditional and Current Gathering Areas”).

4.5 Mi’kmaq Significant Species Process

In order to identify possible project activities which may be of significance to the Mi’kmaq with regards to traditional use of the Study Area, the project team undertakes a number of steps in order to properly consider the MEKS data. This involves three main components: Type of Use, Availability, and Importance.

Type of Use

The first component of analysis is the “Type of Use” of the resource which involves the categorization of the resource. All resources are placed into various general categories regarding the Type of Use**.** The category headings are Medicinal/Ceremonial, Food/Sustenance, and Tool/Art. These general headings are used so as to ensure further confidentiality with respect to the resources and the area where they are harvested. As well, the total number of instances where a resource harvest has been documented by the study is quantified here as well.

Availability

After the data is considered by the Type of Use, it is considered in accordance with its availability. This involves considering whether the resource is abundant in the Study Area or whether it is rare or scarce. Based on the information that is provided to the team from the ecological knowledge holders and/or written literature sources, the availability of the resource is then measured in regard to other water or land areas that are outside of the Study Area. This measuring is primarily done in the context of the areas adjacent to the Study Area, and if required, other areas throughout the province. By proceeding in this manner, the study can provide an opinion on whether that resource may be **Rare, Scarce** or **Abundant**.

The data is classified in accordance with following:

Rare – only known to be found in a minimum of areas, may also be on the species at risk or endangered plants list;
Common – known to be available in a number of areas; and
Abundant – easily found throughout the Study Area or in other areas in the vicinity.
This allows the study team to identify the potential impact of a resource being destroyed, by the proposed project activities, will affect the traditional use activity being undertaken.

Importance

The final factor the MEKS team considers when attempting to identify the significance of a resource to Mi'kmaq use is whether the resource is of major importance to Mi'kmaq traditional use activities. This can be a somewhat subjective process, as any traditional resource use will be of importance to the individual who is acquiring it, regardless of whether its use is for food or art, and regardless if the resource is scarce or abundant. However, to further identify the importance, the MEKS team also considers the frequency of its use by the Mi'kmaq; whether the resource is commonly used by more than one individual, the perceived importance to the Mi'kmaq in the area, and finally the actual use itself. These factors support the broad analysis of many issues in formulating an opinion on significance and supports identifying whether the loss of a resource will be a significant issue to future Mi'kmaq traditional use, if it is impacted by the project activities.

4.6 Mi'kmaq Significance Species Findings

This MEKS identified resource and land/water use areas within the Project Site and Study Area that continue to be utilized by the Mi'kmaq people, to varying degrees.

Type of Use

The study identified the following in the Study Area:

TYPE OF USE	NUMBER OF AREAS	NUMBER OF SPECIES
Food/Sustenance	59	14
Medicinal/Ceremonial	0	0
Tools/Art	2	2

Table 5. Resource Use within Study Area

Availability

During the information gathering for the Study Area, interviewees had mentioned the fishing for salmon. The Atlantic Salmon is considered an endangered species in Canada. *(47)*

Striped bass has no status with the Nova Scotia species registry, the federal species at risk registry consider the Gulf of St. Lawrence population of Striped Bass to be of special concern (*47*)

Importance

While stated above, it is worth noting again that assigning an importance designation for any activity done by Mi'kmaq can be a subjective process, and that all activities are considered ways of preserving the Mi'kmaq way of life, in some shape or form. Scarcity and abundance of a species in an area can both increase the importance of a species.

As noted previously, Atlantic Salmon and Striped Bass are considered an endangered, threatened, or species of special concern in Canada and the Mi'kmaq still rely on these species for sustenance and for cultural ceremonies and activities. Any disturbances to their habitats could have an impact on Mi'kmaq use.

Based upon the high frequency of activities reported by the interviewees, trout, salmon, and eel fishing along with deer, partridge and rabbit hunting can be considered to be the favored activity for Mi'kmaq in this particular area.

5.0 CONCLUSIONS

This Mi'kmaq Ecological Knowledge Study has gathered, documented and analyzed the traditional use activities that have been occurring in the Project Site and the Study Area by undertaking interviews with individuals who practice traditional use, or know of traditional use activities within these areas and reside in the nearby Mi'kmaq communities.

The information gathered was then considered in regard to species, location, use, availability and frequency of use to further understand the traditional use relationship that the Mi'kmaq maintain within the Project Site and Study Area.

Historic Review Summary

The Project Site(s) and Study Area centered on Long Lake, west of Goose Harbour Lake Reservoir and within both ***Epekwitk aqq Piktuk*** District (Territory) and ***Eskikewa'kik*** District (Territory).

There are very few known archaeological finds/sites found within the vicinity of the Study Area due to little development. Development can be building and road construction including agricultural land use that accidentally finds precontact and early Mi'kmaq archaeological sites, features or artifacts.

There sparse potential natural resources within the Study Area concerning stone of suitable properties for tools and weapons for early peoples. There are no reported sources of Black Ash within the Study Area nor that part of the Province. Black Ash was and is a valuable resource for tool handles and craft-basket making to early peoples then and to the Mi'kmaq today.

Much of the local history of the area was centered around Canso and Guysborough areas. Canso has a recorded history as early as the 1500's and was an important fishing station for European fishing fleets and Mi'kmaq trading until the British established fortifications at Canso.

Paqtnkek Mi'kmaw Nation is the nearest Mi'kmaq community located approximately 19km west of the center of the Project Site and Study Area. Paqtnkek Mi'kmaw Nation is on Paqtnkek-Niktuek No. 23, consisting of 204.8 hectares (506 acres). Other Paqtnkek lands today include 43.4 hectares (107 acres) at Welnek No. 38, located 18km east of Antigonish.

A review of Specific Claims shows no current and active First Nation Claims within the Project Site Study Area. Paqtnkek Mi'kmaw Nation has one "Invited to Negotiate" and "Active" Specific Claim concerning loss of land in 1827 with the Crown Grant to Peter McChesney without surrender.

Traditional Use - Project Site Summary

Based on the data documented and analyzed, it was concluded that there is reported Mi'kmaq use reported on the Project Site.

Activities in the Project Site include trout and salmon fishing happening along with deer, partridge and rabbit hunting.

Overall, the majority of activities took place as Recent Past and Historical Past categories. There were no active usage areas reported.

Traditional Use - Study Area Summary

Trout and Salmon fishing, along with deer, partridge and rabbit hunting were also the activities reported by interviewees in the highest frequency. There was other fishing, hunting, and gathering activities reported as well.

Overall, the activities took place primarily in the Recent Past (82%) and Historic Past (18%).

Sources

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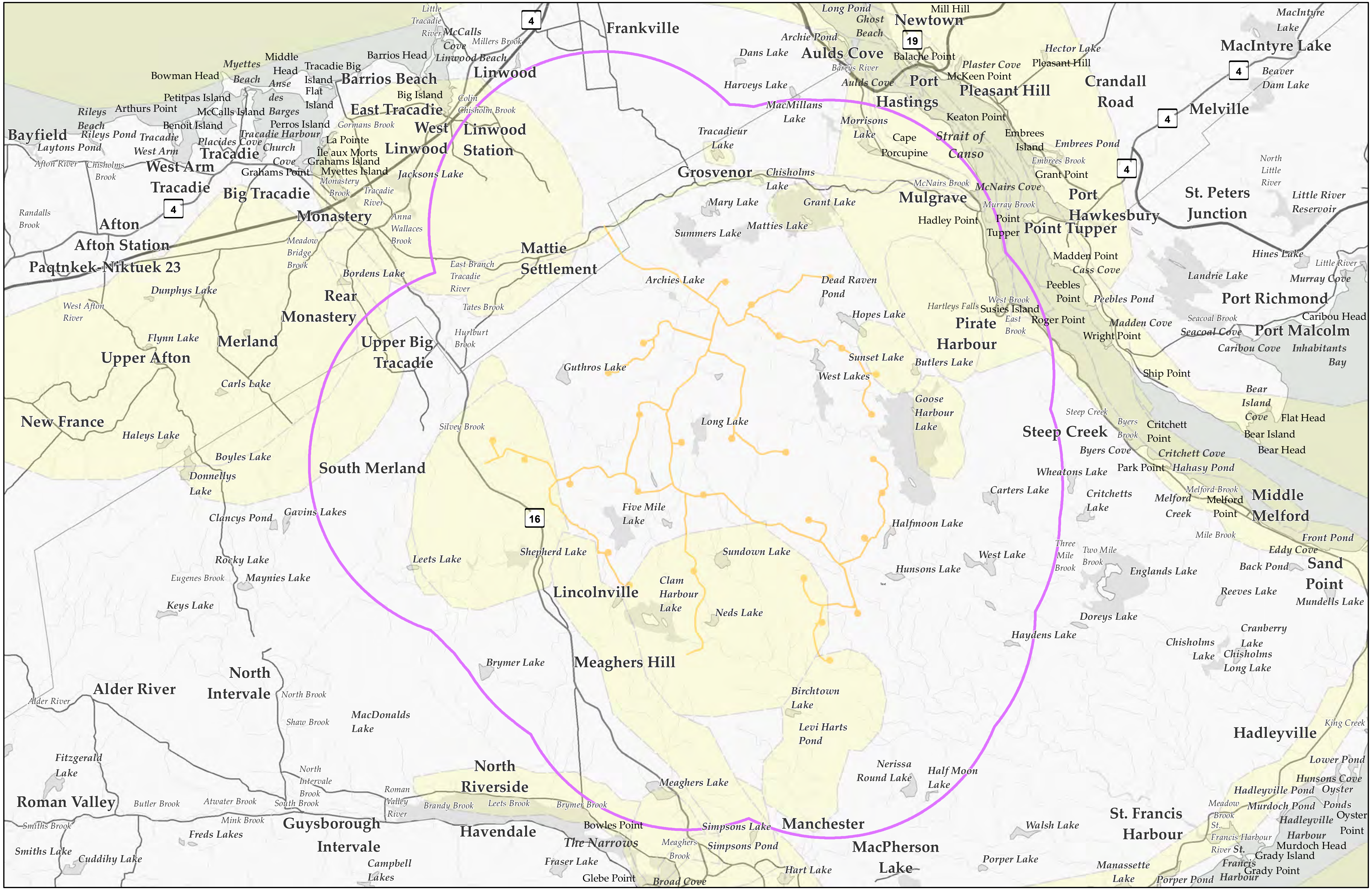


Goose Harbour Lake - Wind Farm Project
MEKS
Guysborough Co., NS

Traditional & Current Use:
All Usage

Legend

- Study Area
- Proposed Project Area
- All Usage Areas

Disclaimer

This map was developed for a poposal and is a graphical representation of the project site and study to be used within a Mi'kmaq ecological knowledge study, and should not be used for navigation purposes.

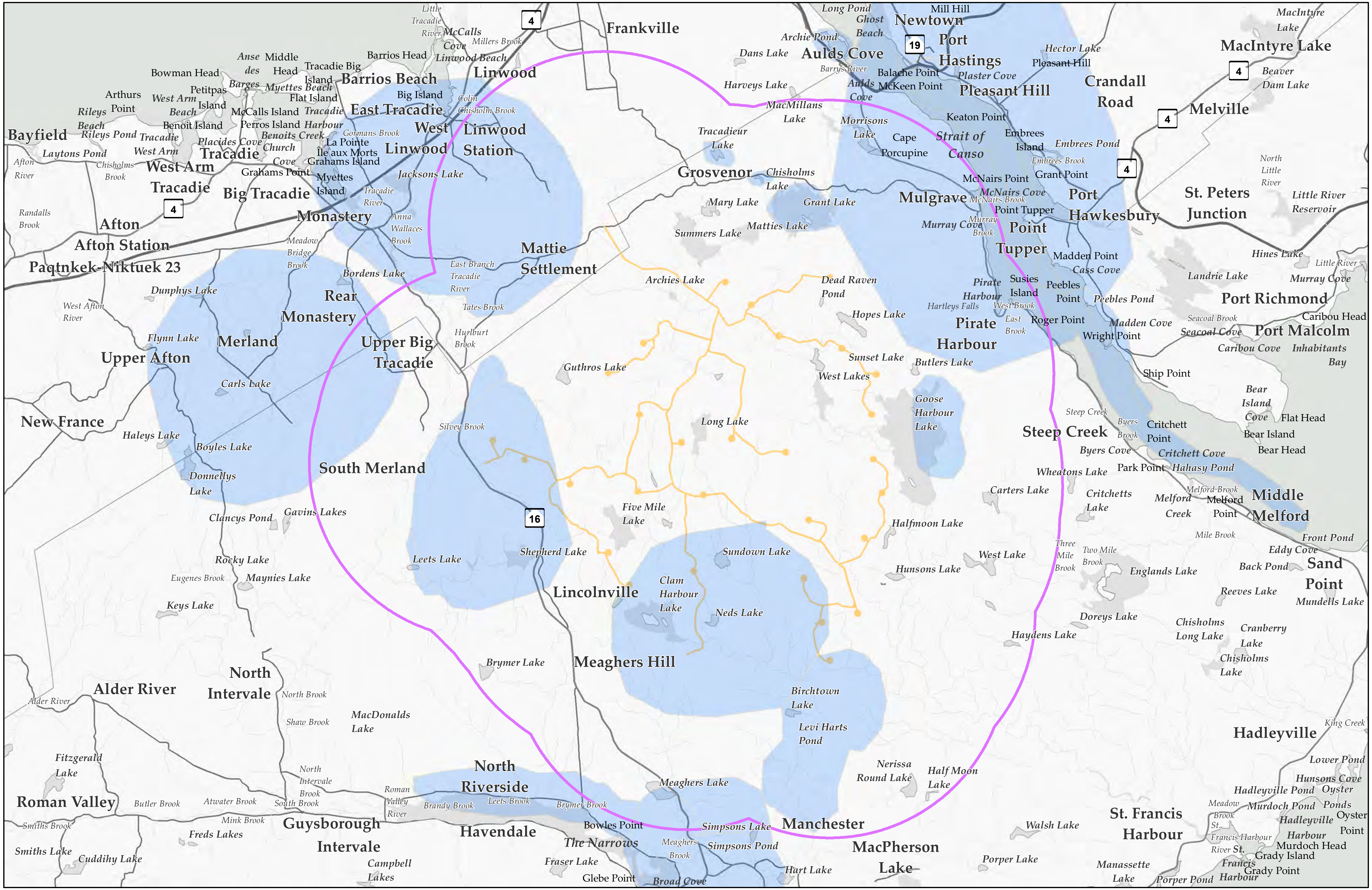
Features presented may not accurately represent actual topographical or proposed features.

0 0.5 1 2
Kilometers

Datum: UTM NAD83
Zone 20
Scale: 1:105,000

Version: Report
December 2022

Membertou
GEOMATICS SOLUTIONS



Goose Harbour Lake - Wind Farm Project
MEKS
Guysborough Co., NS

Traditional & Current Use: Fishing

Legend

- Study Area
- Fishing Areas
- Proposed Project Area

Disclaimer

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Kilometers

Datum: UTM NAD83
Zone 20
Scale: 1:105,000

Version: Report
December 2022

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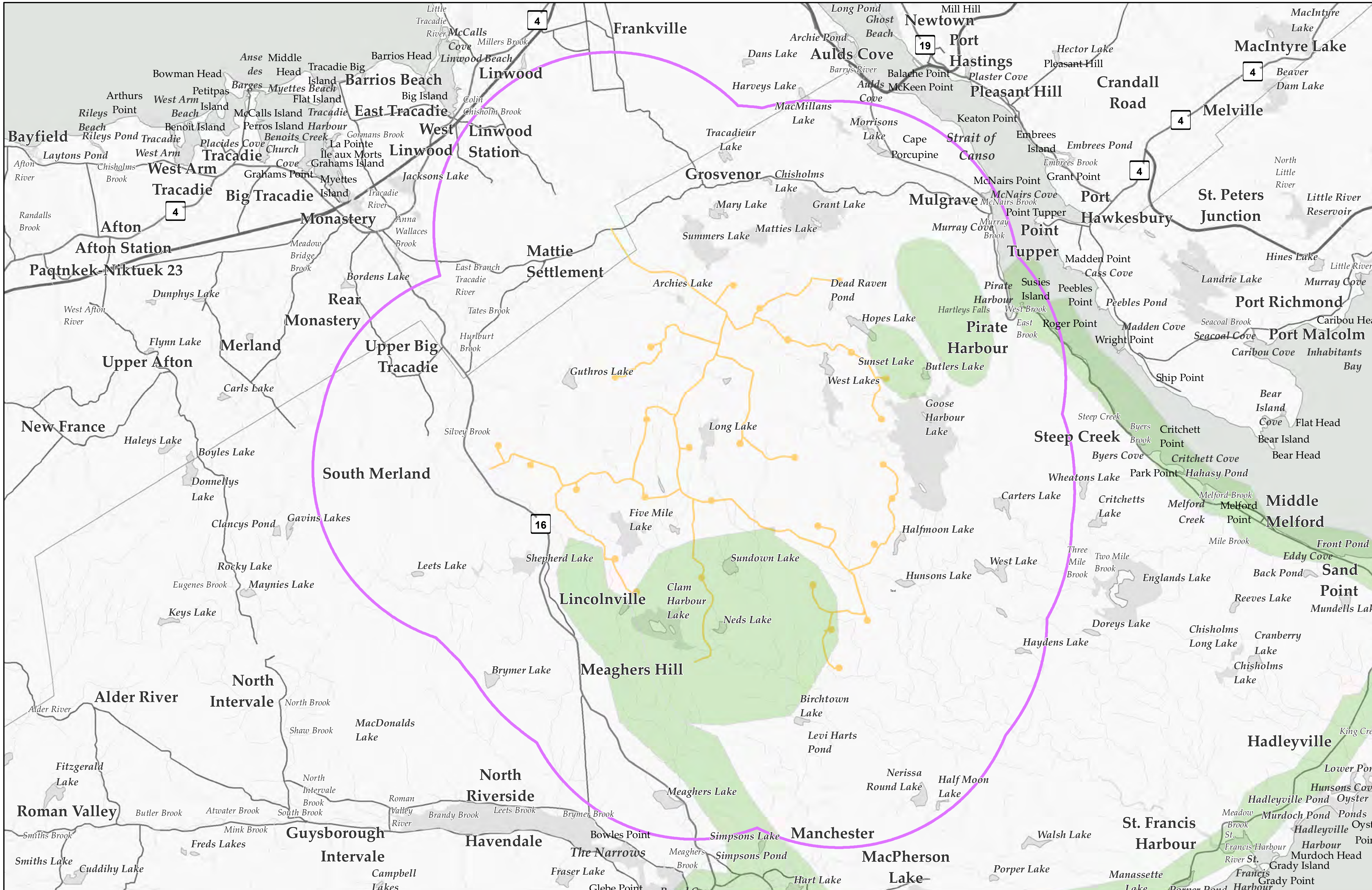
Goose Harbour Lake - Wind Farm Project MEKS Guysborough Co., NS

Traditional & Current Use: Gathering



Legend

- Study Area
- Gathering Areas
- Proposed Project Area

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0 0.5 1 2
Kilometers

Datum: UTM NAD83
Zone 20
Scale: 1:105,000

Version: Report
December 2022

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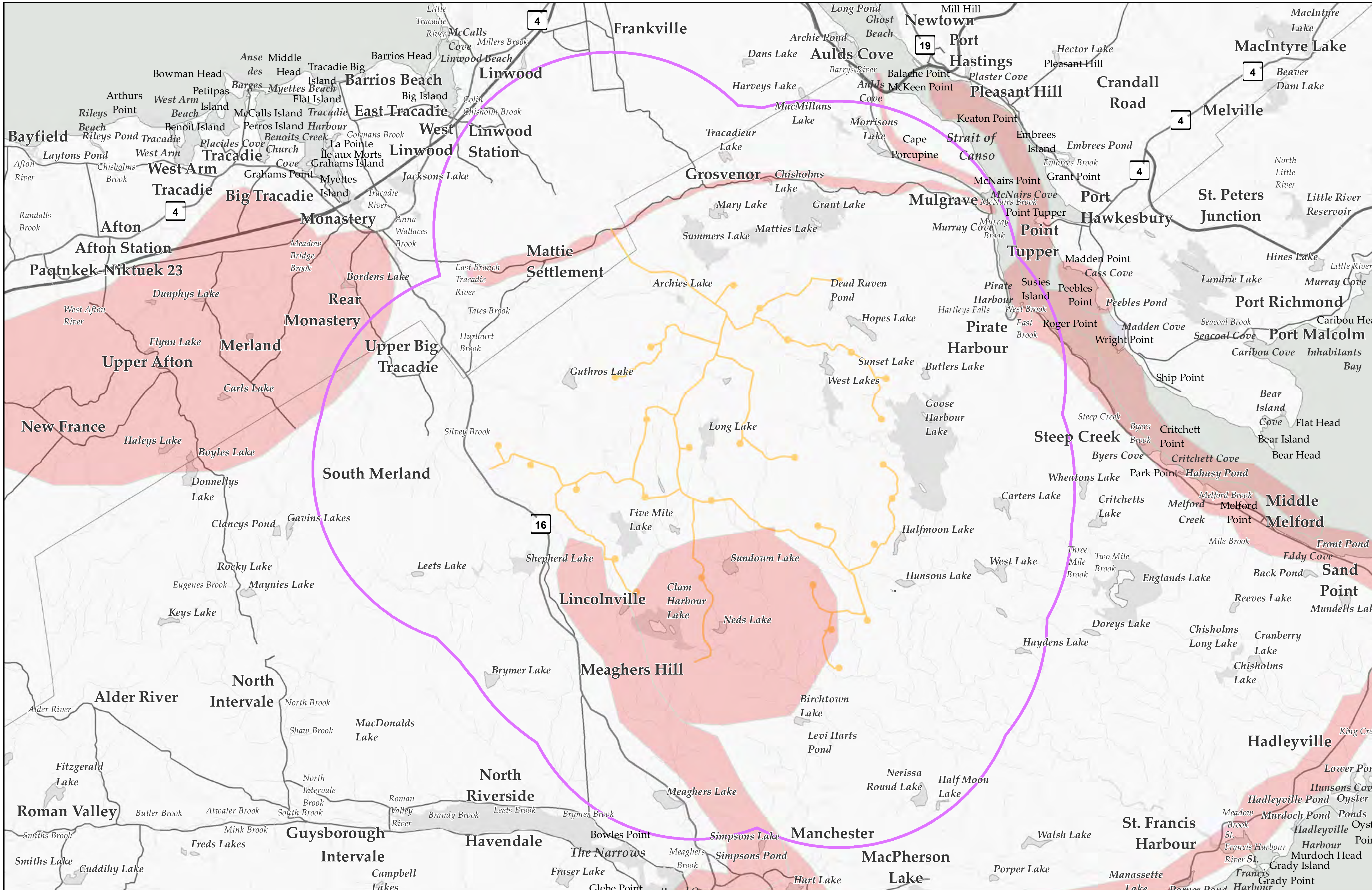
Sources: Esri, Garmin, USGS, NRCAN, GeoNOVA, OpenStreetMap contributors, and the GIS User Community.

Goose Harbour Lake - Wind Farm Project MEKS Guysborough Co., NS

Traditional & Current Use: Hunting



Sources: Esri, Garmin, USGS, NRCAN, GeoNOVA, OpenStreetMap contributors, and the GIS User Community.

Legend

- Study Area
- Hunting Areas
- Proposed Project Area

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0 0.5 1 2
Kilometers

Datum: UTM NAD83
Zone 20
Scale: 1:105,000

Version: Report
December 2022

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