HARDWOOD LANDS

COMMUNITY WIND PROJECT

ENVIRONMENTAL ASSESSMENT REGISTRATION DOCUMENT

Proponent
Scotian WindFields Inc.
and
Scotian Wind Inc.
and
SWEB Development Inc.
and
WEB Wind Energy North America Inc.

Document Prepared By:
Strum Consulting

August 2015

EXECUTIVE SUMMARY

Scotian WindFields Inc., Scotian Wind Inc., SWEB Development Inc. (SWEB), and WEB Wind Energy North America Inc. have proposed to develop a 6.0 megawatt three turbine wind project in the community of Hardwood Lands, Nova Scotia. The proposed Study area is approximately 6.8 km northeast of the community of Nine Mile River, Nova Scotia in the Municipality of the District of East Hants and is centered at 45º5'29.46"N, 63º31'23.50"W, on privately owned land.

The Hardwood Lands Community Wind Project has been developed in support of Nova Scotia's "Renewable Electricity Plan: A Path to Good Jobs, Stable Prices and a Cleaner Environment" , which is a strategic plan designed to decrease the province's dependence on carbon-based energy sources (fossil fuels) and move towards greener, more affordable and more reliable sources of electricity. The Project is proposed under the province of Nova Scotia's recently developed Community Feed-In-Tariff program.

The Project is considered a Class 1 undertaking under the Nova Scotia Environmental Assessment Regulations and as such, requires a registered Environmental Assessment as identified under Schedule A of the Regulations. The Environmental Assessment and the registration document have been completed according to the methodologies and requirements outlined in the document "A Proponent's Guide to Wind Power Projects: Guide for Preparing an Environmental Assessment Registration Document", as well as accepted best practices for conducting environmental assessments. As the Project consists of three turbines, it is considered a small project. Based on the known existence of four bird species listed under the Nova Scotia *Endangered Species Act* (NS *ESA*); and the presence of a bat hibernaculum less than 25 km from the Study area, the Project is classified as having a 'Very High' potential sensitivity. Overall, the Project has therefore been determined to be a Category 4.

A number of environmental components were evaluated for this assessment. Based on field data and associated research, mitigation strategies and best management practices were identified to avoid or mitigate potential effects of the Project for the majority of the components. Following the preliminary assessment, the components identified for further assessment were: avifauna, bats, and species of conservation interest. The effects assessment for these components determined that residual effects are expected to be not significant. Cumulative effects were also considered to be not significant.

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ACCDC	Atlantic Canada Conservation Data Centre
ARIA	Archaeological Resource Impact Assessment
ATV	All-terrain Vehicle
AQHI	Air Quality Health Index
BFL	Boreal Felt Lichen
BMP	Best Management Practice
CanWEA	Canadian Wind Energy Association
CCH	NS Department of Communities, Culture, and Heritage
CEAA	*Canadian Environmental Assessment Act*
CEDIF	Community Economic Development Investment Funds
CLC	Community Liaison Committee
COMFIT	Community Feed-In-Tariff
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CWS	Canadian Wildlife Service
dBA	Decibel
DFO	Fisheries and Oceans Canada
DND	Department of National Defense
EA	Environmental Assessment
EC	Environment Canada
EMF	Electromagnetic Field
EMI	Electromagnetic Interference
EPP	Environmental Protection Plan
GHG	Greenhouse Gas
GIS	Geographical Information System
IBAs	Important Bird Areas
IBoF	Inner Bay of Fundy
IPCC	Intergovernmental Panel on Climate Change
KMKNO	Kwilmu'kw Maw-klusuaqn Negotiation Office
LWT	Large Scale Wind Turbine
MBBA	Maritime Breeding Bird Atlas
MBCA	Migratory Birds Convention Act
MEKS	Mi'kmaq Ecological Knowledge Study
MORI	Market & Opinion Research International
MTO	Ministry of Transportation of Ontario
MTRI	Mersey Tobeatic Research Institute
MW	Megawatt

NRCan	Natural Resources Canada
NSDE	Nova Scotia Department of Energy
NSDNR	Nova Scotia Department of Natural Resources
NSE	Nova Scotia Environment
NSEA	Nova Scotia Environment Act
NSESA	Nova Scotia Endangered Species Act
NSPI	Nova Scotia Power Inc.
NSTIR	Nova Scotia Department of Transportation and Infrastructure Renewal
NSTPW	Nova Scotia Department of Transportation and Public Works
NTLA	Non Turbine Land Agreement
OMNR	Ontario Ministry of Natural Resources
PID	Property Identification Number
RABC	Radio Advisory Board of Canada
RCMP	Royal Canadian Mounted Police
SARA	Species at Risk Act
SOCI	Species of Conservation Interest
SWFI	Scotian WindFields Inc.
SWI	Scotian Wind Inc.
TDGA	Transportation of Dangerous Goods Act
UTM	Universal Transverse Mercator
VEC	Valued Ecosystem Component
WAM	Wet Areas Mapping
WEB AG	WEB Windenergie AG
WEB N.A.	WEB Wind Energy North America Inc.
WHMIS	Workplace Hazardous Materials Information System

1.0 PROJECT INFORMATION

1.1 Project Introduction

Scotian WindFields Inc. (SWFI), Scotian Wind Inc. (SWI), SWEB Development Inc. (SWEB), and WEB Wind Energy North America Inc. (WEB N.A.) have proposed to construct and operate a three turbine, 6.0 megawatt (MW) wind project (the Project) at a site in the community of Hardwood Lands, Nova Scotia. The proposed Study area is approximately 6.8 km northeast of the community of Nine Mile River, Nova Scotia in the Municipality of the District of East Hants (45° 5'29"N, 63°31'23"W), and is located on privately owned land.

The Project has been developed in support of Nova Scotia's "Renewable Electricity Plan: A Path to Good Jobs, Stable Prices and a Cleaner Environment" (Renewable Electricity Plan) (NSDE 2010). This is a strategic plan designed to decrease the province's dependence on carbon-based energy sources (fossil fuels) and move the province towards greener, more affordable, and more reliable sources of electricity. Nova Scotia recognizes the numerous benefits of supporting the development of renewable energy within the province, as currently 82% of the province's energy comes from non-renewable sources (NSPI 2013), mostly sourced from outside of the province. 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 (NSDE 2010). Negative impacts to human health, particularly in developing countries, and the environment, mainly in the form of climate change, are among the widely cited problems associated with fossil fuel consumption around the world.

In its most recent assessment report, "Climate Change 2007 - Impacts, Adaptation and Vulnerability", the United Nations Intergovernmental Panel on Climate Change (IPCC) provided a detailed synopsis of the impacts associated with climate change on both global and regional scales. Evidence from all continents indicates that many biological systems and habitats are currently being affected by regional climate change. Ecological changes include: changes to the thermal dynamics and quality of aquatic habitats; shifts in migratory timing and ranges of fauna and flora; changes in fish abundance; and increased risk of extinction and loss of forest habitat (IPCC 2007).

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 2009), wind energy is a critical component of Canada's renewable energy strategy. Wind energy is emission-free; with every MW of wind energy generated reducing greenhouse gas (GHG) emissions by as much as 2,500 tons per year, and improving air quality (NSDE 2009). Numerous benefits can be expected from the transition to renewable energy, and may include:

- 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; and
- Educational opportunities for youth and the broader community about renewable energy technology, its benefits, and the role played in Nova Scotia's energy future.

As part of this overall strategy, the Hardwood Lands Community Wind Project will contribute to meeting Nova Scotia's renewable energy goals by producing enough green energy to provide 1,728 NS homes with stable, locally-produced renewable energy.

The Project is committed to sharing economic opportunities with the local community, throughout the development and life-span of the Project via job creation, tax revenue, and the creation of a community dividend. No public funding is required for this Project.

1.2 Project Summary

This section of the Environmental Assessment (EA) report provides a summary of the Project, description of the proponent, and regulatory requirements. The structure of the overall document and the investigators and authors involved are also provided.

Table 1.1: Project Summary

Project Name	Hardwood Lands Community Wind Project
Proponent Name	SWFI, SWI, SWEB, and WEB N.A.
Proponent Contact Information	SWFI, SWI David Angot 108F Trider Crescent Dartmouth, NS B3B 1R6 Phone: 902.468.3132 Fax: 902.468.3002 Email: dangot@scotianwindfields.ca SWEB Dan Roscoe 108F Trider Crescent Dartmouth, NS B3B 1R6 Phone: 902.468.3132 Fax: 902.468.3002 Email: dan.roscoe@swebdevelopments.ca WEB N.A. Stuart Lawrie 480 University Ave, Suite 1500 Toronto, ON M5G 1V2 Phone: 416.986.9607 Email: sl@webwindenergy.com
Project Location	• The Study area is located near the community of Hardwood Lands, approximately 6.8 km northeast of Nine Mile River,

	Nova Scotia (Drawing 1.1); • The Study area is located within the Municipality of the District of East Hants, Nova Scotia; • The approximate center of the Hardwood Lands Study area is located at 45º5'29.46"N, 63º31'23.50"W; • The Hardwood Lands Project site includes Property Identification Numbers (PIDs) 45101136, 45289675, 45101128, 45366648, 45119344, 45366630, 45188810, and 45271939. • The Hardwood Lands Study area includes PIDs 45366648 and 45101128.
Landowner(s)	Atlantic Star Forestry Ltd (PIDs 45366648*, 45119344, 45366630, 45188810) Elmsdale Lumber (PID 45101128)* Downey Thompson (PID 45101136) Brian Leahy (PID 45289675) Everett Clarke (PID 45271939)
Closest distance from a turbine to a seasonal or permanent residence	1565 m from turbine 3
Expected rated capacity of proposed project in MW	6.0 MW
Project Website	http://www.scotianwindfields.ca/wind/projects/hardwood-lands-community-wind-project

*Land contains project infrastructure.

1.3 Proponent Description

SWFI is a Nova Scotia based, owned, and operated company whose primary mandate is to develop investment opportunities in renewable energy from funds raised within Nova Scotia. Approximately 36% of the shares in SWFI are held by community Wind Fields, community-owned investment funds covering the entire geographical region of the province. These Community Economic Development Investment Funds (CEDIF) provide the opportunity for Nova Scotia citizens to invest in and provide renewable energy to the province.

WEB N.A. is a wholly owned subsidiary of WEB Windenergie AG (WEB AG). WEB AG is a publicly traded Austrian-based renewable energy company with experience in complete life cycle wind energy development and operation. The company has been involved in planning, developing, financing, constructing, and operating renewable energy projects in Austria, Germany, France, Italy, Czech Republic, and Canada. WEB AG operates, and has 100% ownership, of over 153 wind energy plants, some of which have been in operation for 17 years. Comprising a total capacity of more than 260 MW, WEB AG is seeking to grow its core business within Europe and North America. WEB AG adds significant value to the Project team through their exceptional experience in the wind energy industry, as well as their financial capabilities with their group of more than 3,300 shareholders and access to financing.

SWI was formed to be the Community Feed-in Tariff (COMFIT) eligible entity, to raise local investment in community-based wind energy projects, and to assist in the community engagement part of the development process. SWI will obtain CEDIF status as part of this process. SWI is

N

King Meadows

Hants County

Indian Brook 14

Shubenacadie
Native Reserve 14

Sandy Desert

Stewiacke

Shubenacadie River

Highway 215

Highway 2

Highway 224

St. Andrews River Meadow

Shubenacadie
Provincial Game
Sanctuary

Colchester County
Halifax County

Nieforths Hill

Annand Bog

Highway 277

Highway 224

Highway 214

Highway 102

Highway 102

Highway 2

Highway 14

Cooks
Lake

Lake
Egmont

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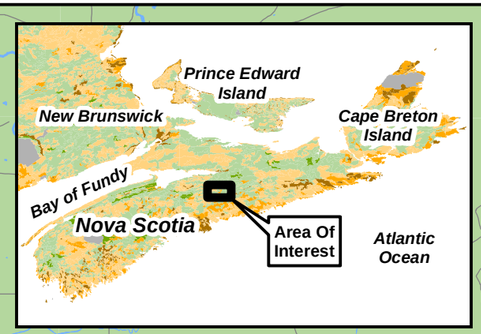
Metres



Notes:

1. Reference: Digitial Topographic Mapping By Nova Scotia Geomatics Centre.
2. Projection: NAD83(CSRS), UTM Zone 20 North.

Legend:

- Study Area
- County Boundary
- Native Reserve
- Public Roads
- Major Roads and Highways
- Water Bodies

Hardwood Lands Community Wind Project - Site Location

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Date: August 2015	Project #: 14-5169
Scale: 1:80,000	Drawing #: **1.1**
Drawn By: H. Serhan	
Checked By: M. Henley	

currently owned by a broadly distributed group of locally based shareholders, which includes four other CEDIF entities.

1.4 Regulatory Framework.

1.4.1 Federal

A federal EA is not required for the Project as it is not located on federal land or listed as a physical activity that constitutes a "designated project" as listed under the Regulations Designating Physical Activities of the *Canadian Environmental Assessment Act (CEAA) (*2012*).*

Additional federal requirements are identified in Section 11.2 and 16.0.

1.4.2 Provincial

The Project is subject to a Class I EA as defined by the Environmental Assessment Regulations under the Nova Scotia *Environment Act (*NS*EA)*. As such, the proponents are required to register the Project with Nova Scotia Environment (NSE) and subsequently comply with the Class I registration process as defined by the document “A Proponent’s Guide to Environmental Assessment” (NSE 2009a).

The use of provincial roads during the construction, operation, and decommissioning phases of the Project will be in compliance with the “Nova Scotia Temporary Workplace Traffic Control Manual” (NSTIR 2009).

Additional provincial permits will be required as outlined in Section 16.

1.4.3 Municipal

Land use by-laws exist in the Municipality of the District of East Hants, which require approval for wind power projects. This Project will require submission of a Large Scale Wind Turbine (LWT) development application. The Municipality of East Hants Land Use By-law outlines application requirements, as well as several setbacks and guidelines (Appendix A).

All required municipal permits (Section 16) and approvals will be obtained prior to construction.

1.5 Structure of Document

Table 1.2 outlines the content of each section of this EA report.

Table 1.2: EA Report Structure

Section	Content
Section 1	Project Information
Section 2	Project Description including an overview of Project location and activities
Section 3	Project Schedule
Section 4	General Environmental Mitigation/Best Practices

Section	Content
Section 5	Environmental Management
Section 6	Project Scope
Section 7	EA Methodology
Section 8	Biophysical Environment
Section 9	Socio-Economic Environment
Section 10	Cultural and Heritage Resources
Section 11	Other Considerations
Section 12	Consultation and Engagement
Section 13	Effects Assessment
Section 14	Effects of the Environment on the Project
Section 15	Cumulative Effects Assessment
Section 16	Other approvals
Section 17	Conclusions
Section 18	References

1.6 Author of the Environmental Assessment

This EA was completed by Strum Consulting, an independent, multi-disciplinary team of consultants with extensive experience in undertaking EAs across Atlantic Canada and internationally. This report was prepared and reviewed by:

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2.0 PROJECT DESCRIPTION

2.1 Turbine Specifications

The Project will be powered by three wind turbines, each rated at 2.0 MW, for a nominal capacity of 6.0 MW in total. Under normal conditions the turbines will operate 24 hours per day, 7 days per week. The Vestas V110 has been selected as the turbine model for the Project. Specifications are provided in Table 2.1.

Drawing 2.1 provides the turbine and access road layout.

Table 2.1: Turbine Technical Specifications Vestas V110

Turbine Component	Vestas V110 Specifications
Rated capacity	2 MW
Cut – in wind speed	11 km/h
Cut – out wind speed	72 km/h
Maximum Output	45 km/h
Number of blades	3
Diameter	110.0 m
Swept area	9,503 m^2
Tower (hub) height	95 m
Control system	Vestas

2.2 Project Phases

The proposed Project will include three phases: site preparation and construction; operations and maintenance; and decommissioning. Activities and requirements associated with each phase are discussed in the following sections. Standard environmental mitigations that have been incorporated into the Project design are presented in Section 4.0.

2.2.1 Site Preparation and Construction

Services required prior to and during construction include, but are not limited to:

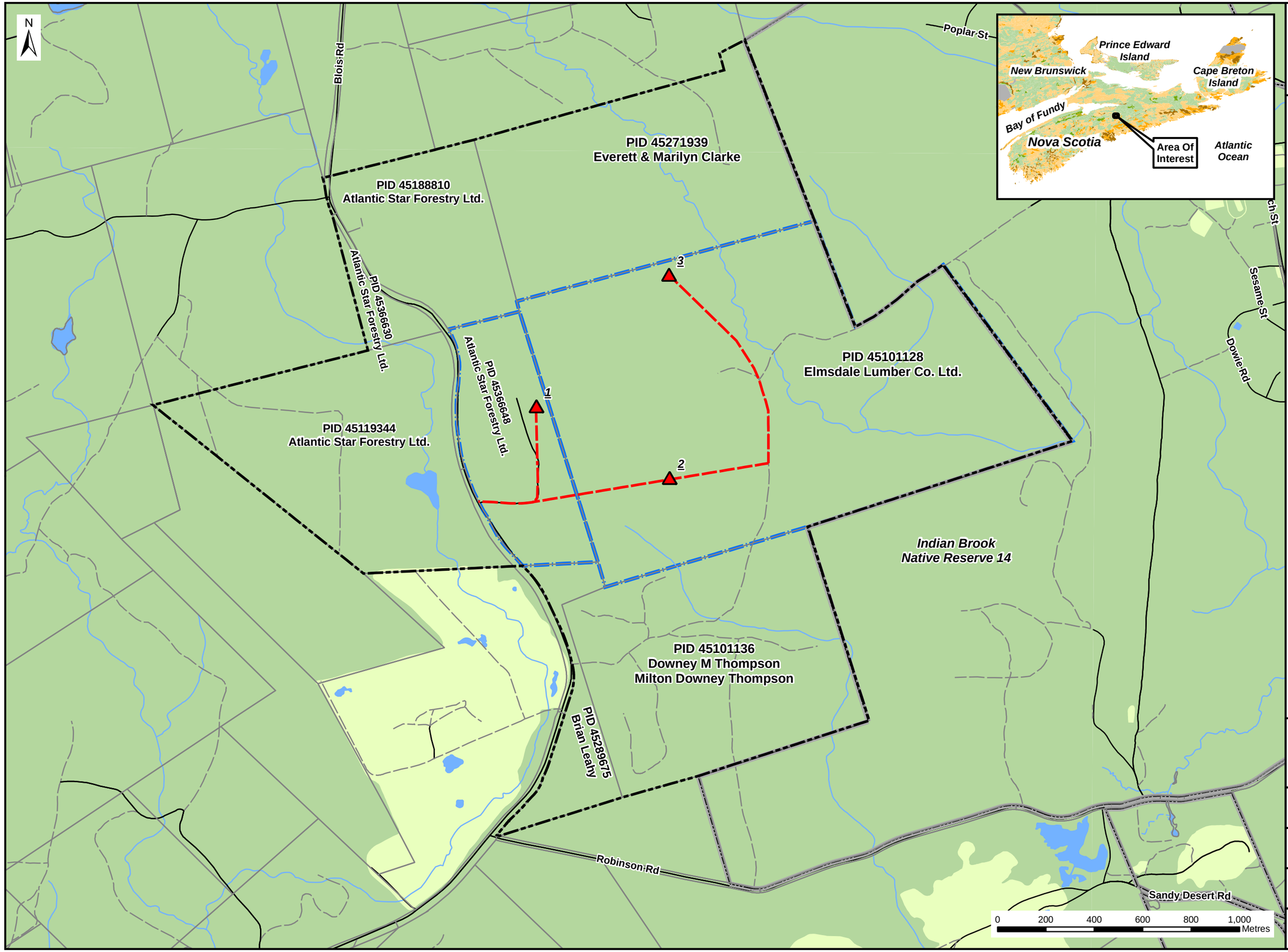
- Staging and storage facilities;
- Temporary offices;
- Laydown areas for construction and maintenance equipment;
- Temporary sanitary facilities;
- Water and rinsing facilities;
- Utilities and communications; and
- Garbage collection and off-site disposal.

Site preparation activities include:

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

General construction activities include:

- Access road upgrading and construction;
- Laydown area and turbine pad construction;
- Transportation of turbine components;



Notes:

1. Reference: Digital Topographic Mapping & Property Management Unit MU0904 by Nova Scotia Geomatics Centre.
2. Projection: NAD83(CSRS), UTM Zone 20 North.

Legend:

- Proposed Turbine
- Proposed Access Road
- Study Area
- Project Site
- Property Boundary
- Native Reserve
- Public Roads
- Access Roads / Trails
- Mapped Stream
- Mapped Indefinite Stream
- Water Bodies

Hardwood Lands Community Wind Project - Turbine & Road Layout

Strum Consulting

Date: August 2015	Project #: 14-5169
Scale: 1:6,000	Drawing #: **2.1**
Drawn By: H. Serhan	
Checked By: M. Henley	

- Turbine assembly;
- Grid connection;
- Removal of temporary works and site restoration; and
- Commissioning.

Weather constraints may affect the proposed schedule and weather dependent activities (*e.g.,* turbine delivery construction) which have been scheduled to occur during optimal time frames to minimize delay. For example, the delivery of the turbine pieces will occur outside of the spring weight restrictions, which are pursuant to Subsection 20(1) of Chapter 371 of the Revised Status of Nova Scotia, *The Public Highways Act (*1989*).*

Equipment needs will likely include:

- Light trucks;
- Drilling rigs;
- Backhoes; and
- Feller Buncher (and similar harvesting equipment).

Access Road Construction
Access will be provided from existing logging roads extending off of Blois Road, west of the proposed site. Approximately 745 m of existing road and 1790 m of new road construction will be required to provide direct access to the turbines. The detail design phase of the Project will determine which portions of the existing road will require upgrades or modification. The new access road is expected to be constructed to a standard carriageway width of 6 m; plus shoulders sloped at a ratio of 2:1. There will be areas where the road width could increase to 10 to 12 m to accommodate cut and fill areas and/or wide turns. Conversely, areas of flat straightaways can allow for a road surface as narrow as 4.5 m.

During the construction phase, the Project roads will be maintained with additional stone 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 accompanied 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; and
- Light trucks.

Laydown Area and Turbine Pad Construction
General activities during the creation of the laydown and turbine pad 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);
- Pouring and curing of concrete pads (complete with reinforcing steel);
- Placement of competent soils to bring area to grade;
- Compaction of soils; and
- Excavation for electrical conduits and fibre optic communication trenches.

The tower foundations will be approximately 15 m diameter (typical for a 2-3 MW wind turbine) and extend to a depth of 3 m below grade.

Each turbine pad and laydown area is expected to be approximately 100 m x 100 m. 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 construction of a typical turbine pad (from clearing to final preparation for erecting of the turbine) can take between 1 to 4 months, depending on weather, soil, and construction vehicle access. The following equipment may be used for the laydown area and turbine pad construction:

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

Transportation of Turbine Components
A detailed transportation study will be completed by the turbine supplier as part of the design phase to determine appropriate routes and means for equipment and materials to be delivered to Study Area. It is anticipated that as many resources and components as possible will be purchased from local suppliers and manufacturers. Upon completion, the study will be provided to NSTIR for review and comment.

The following commitments are expected to be required:

- Work Within Highway Right of Way Permit: required if removing access signs and guard rails.
- Overweight Special Moves Permit from Service NS and Municipal Relations: 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.
- Road weight restrictions, especially Spring Weight Restrictions, for heavier equipment and materials that will be transported to the Study area.
- Access points will be designed with proper height and width to accommodate large trucks and will adhere to commercial stopping sight distances.

The transportation route is expected to require a few slight road modifications, mostly involving the removal of signage and guardrails. To mitigate any negative effects on motorists where modification is required, a notice will be placed in public areas to inform local residents of signage removal or road infrastructure alterations. Removed signage and guardrails will be immediately replaced and appropriate temporary signage will be provided as necessary to ensure travelling public safety. Upgrades will also be made to roads and overhead wires, branches, and signs if conflicts arise. For areas requiring modifications, these will be completed to relevant specifications and any areas requiring reinstatement will also be completed as requested.

To the extent possible, transportation through Halifax will avoid high traffic times (*e.g.*, 7-9 am and 3-6 pm; Monday to Friday). All travel will be conducted using safe work practices for transporting oversized loads.

Transport of equipment will be via a minimum number of vehicles to minimize impacts to road-way flow and impacts on air quality due to exhaust.

During the Project's construction phase, trucks and other vehicles will be frequently visiting the Study area resulting in increased vehicular sound. To mitigate this effect, vehicles will only be visiting and working on-site during normal daytime hours of operation, where possible, and will avoid high-traffic times of day to reduce local traffic congestion.

Turbine Assembly

The wind turbine assembly includes tower sections, the nacelle, the hub, and three-blade rotors (*i.e.,* a total of eight major components). All sections will be delivered by several flatbed trucks and the pieces will require a crane for removal from the vehicle at each of the prepared turbine pads.

The tower sections will be erected in sequence on the turbine foundation, followed by the nacelle, hub, and rotors. 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 lightening conditions. Typical assembly duration should be between 2 to 5 days.

The following equipment is expected to be used for turbine assembly:

- Main crane unit (up to 400' high in some cases);
- Assembly cranes; and
- Manufacturer's support vehicles.

Collection System, Substation, and Grid Connection
Electricity produced by this Project will connect to the 25 kV distribution circuit of the Elmsdale substation via a voltage regulator in the base of the turbine. The existing power lines will be extended from the Shaw gravel plant on Robinson Road to Blois Road and onto the site.

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

- Excavator and/or back hoe;
- Bucket trucks;
- Light cranes; and
- Light trucks.

Removal of Temporary Works and Site Restoration
Once construction has been completed, all temporary works will be removed and the site will be appropriately graded.

The following equipment is expected to be used this process:

- Excavator and/or back hoe;
- Grader;
- Hydroseeder; and
- Light trucks.

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

Commissioning will require coordination with Nova Scotia Power Inc. (NSPI) as electrical energy will need to be managed both within the substations and on the transmission line. These performance tests will be completed by qualified wind power technicians and NSPI employees.

Additional testing may also be required for transformers, power lines, and substation components, all of which will be performed by qualified engineers and technical personnel.

2.2.2 Operations and Maintenance

Maintenance will conform to manufacturer equipment specifications, industry best management practices (BMPs), and standard operating procedures.

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

Vegetation management will be implemented as detailed in the project Environmental Protection Plan (EPP) to ensure that access roads and turbine locations remain clear of vegetation. 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 during the life of the Project.

Scheduled maintenance work will be carried out on a periodic basis. Maintenance work may require the use of a variety of cranes for brief periods of time for replacement of blades or other turbine components. The most common vehicle during maintenance work will be light/medium pickup trucks.

2.2.3 Decommissioning

As noted above, the operational life of the Project is estimated to be a minimum of 20 years. Prior to year 20, NSE will be either provided with decommissioning plans or a copy of the new power purchase agreement.

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

- Dismantling and removal of the turbines from the Study area.
- Removal of the turbine foundations to below grade and reinstatement with top soil to ensure stabilization of the land.
- Removal, recycling (where possible), and disposal of collection system, conductor, and poles with NSPI's permission/cooperation.
- Removal of all other equipment and reinstatement and stabilization of land.

3.0 PROJECT SCHEDULE

Table 3.1 presents the Project schedule from EA approval to Project decommissioning.

Table 3.1: Project Schedule

Project Activity	Timeline
EA Registration	August 2015
Geotechnical Assessment	December 2015
Engineering Design	Civil and Electrical Design: August 2015 Foundation Design: September 2015
Power Purchase Agreement	October 2015
Clearing	October 2015
Construction	June 2016
Commissioning	June 2016
Operation	July 2016
Follow-up Environmental Studies	2016/2017
Decommissioning	TBD

4.0 GENERAL ENVIRONMENTAL MITIGATION/BEST PRACTICES

The following general environmental mitigation is considered to be standard practice and will be implemented as part of the Project design. Specific mitigation, monitoring, and follow-up that may be required to address residual environmental effects are discussed in Section 13.

4.1 Clearing and Grubbing

- Environmentally sensitive features will be identified and clearly marked where feasible (e.g., watercourses, wetlands, areas of high archaeological potential).
- All watercourses will be kept free of chips and debris resulting from clearing activities.
- Appropriate erosion and sedimentation controls will be implemented to stabilize the slopes/banks on either side of watercourses and prevent sediment run-off.

4.2 Blasting (if necessary)

- Blasting will be conducted in accordance with provincial legislation and subject to terms and conditions of applicable permits.
- All blasts will be conducted and monitored by certified professionals.
- Once the location of any required blasting is confirmed and the geotechnical investigation is completed, the need to implement mitigation measures or monitoring programs will be evaluated.
- If required, all protective measures will be outlined in the EPP and approved by NSE in advance of blasting activities.
- Landowners will be notified of any blasting activities

- Where blasting is planned within 500 m of residences, activities will comply with the requirements of any applicable existing by-laws.
- Following any blasting or disturbance of soils or bedrock, exposed soils or bedrock will be recovered with soil and re-vegetated as required to minimize any exposure.
- Blasting near watercourses will only occur in consultation with Fisheries and Oceans Canada (DFO), and will follow the requirements of the *Fisheries Act* (1985) as well as the requirement of the DFO Factsheet: "Blasting – Fish and Fish Habitat Protection" (DFO 2010a); and/or the DFO "Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters" (Wright and Hopky 1998), as applicable.
- If sulphide bearing materials are identified through pre-construction geotechnical surveys, these areas will be referenced in the EPP.
- Rock removal in known areas of elevated potential will conform to relevant legislation (*e.g.,* the Sulphide Bearing Material Disposal Regulations of the NS*EA*), and in consultation with relevant regulatory departments).

4.3 Transportation

- A notice will be placed in public areas along Blois Road to inform local residents of signage removal or road infrastructure alterations. Removed signage and guardrails will be immediately replaced and appropriate temporary signage will be provided as necessary to ensure public safety.
- To the extent possible, transportation of materials through Halifax will avoid high traffic times (7-9 am and 3-6 pm; Monday to Friday). All travel will be conducted using safe work practices for transporting oversized loads. Consideration will be given to transporting turbine blades and other oversized loads at night to avoid high traffic periods and allow lane closures, as necessary, to navigate turns along the route.
- Equipment transport will utilize a minimum number of vehicles to minimize effects to road-way flow and effects to air quality from exhaust.
- Upgrades will be made to roads and overhead wires, branches, and signs if conflicts arise. Modifications and subsequent reinstatement will be completed to NSTIR specifications.

4.4 Avifauna

- Tree clearing activities will be executed in a manner that complies with the *Migratory Bird Convention Act* (*MBCA*) and the *Species at Risk Act* (*SARA*), specifically to avoid incidental take.
- Primary mitigation for avifauna will be attained through Project planning and scheduling of clearing activities, on a best-efforts basis, to avoid key migratory bird nesting periods.
- Should vegetation clearing be required during nesting periods, searches for migratory bird nests should be undertaken within the area to be disturbed, in consultation with Canadian Wildlife Service (CWS), and all identified nests should be flagged.

4.5 Dust and Noise

- Where required, dust will be controlled by using water or a suitable, approved dust suppressant.
- Construction equipment will be maintained in good working order and properly muffled.

- Noise control measures (*e.g.,* sound barriers, shrouds, enclosures) will be used where warranted.
- Noise-generating construction activities will comply with the requirements of existing by-laws (where applicable)[*e.g.*, A By-Law Relating to the Prevention of Excessive Noise in the Municipality of East Hants (1995)].
- Engine idling will be restricted.

4.6 Erosion and Sedimentation Control

Contractors will use the erosion and sedimentation control measures listed below at all sites where soil or sub-soil has been exposed and there is potential for erosion:

- A site specific erosion and sedimentation control plan will be developed during the design phase of the Project.
- The area of exposed soil will be limited, and the length of time soil is exposed without mitigation (*e.g.,* mulching, seeding, rock cover) will be minimized through scheduled work progression.
- Both temporary and permanent control measures for erosion and sedimentation will be implemented in an appropriate time frame.
- Erosion and sedimentation control structures will be maintained and inspected regularly with particular emphasis before and after forecasted heavy rain events, and with consideration of the timing and types of activities involved.
- Existing roads and access routes will be used to the extent feasible.
- With the exception of temporary water crossing locations, travel through wetlands and within watercourse buffers with machinery will be avoided, when feasible. If travel through a wetland is required, the appropriate mitigation measures will be employed, (*e.g.,* geotextile matting, work timed to occur during frozen ground conditions, and travel routed through drier portions of the wetland).
- Care will be taken to ensure that the potential for surface run-off containing suspended materials or other harmful substances is minimized.
- Where necessary, erosion and sedimentation control measures will remain in place after work is completed, areas have stabilized, and natural re-vegetation occurs. All temporary erosion and sedimentation control materials will eventually be removed from the construction site.
- Permits/approvals related to site construction will be kept on-site.

4.7 Watercourse Crossings

- Any watercourse crossings required will comply with existing regulatory requirements.
- Crossing of watercourses will not result in permanent diversion, restriction, or blockage of natural flow.
- Crossings will be restricted to a single location on a watercourse and occur at right angles to the watercourse.
- Crossings should be located in areas which exhibit a stable soil type and where grades approaching the crossings will not be too steep.

- The approaches to watercourse crossings will be stabilized with brush mats, where necessary. Stream banks prone to erosion may require additional stabilization. Material used to stabilize/repair stream banks will be clean, non-erodible, and will not come from the stream bank or bed.
- Any wash water from the cleaning of construction vehicles will be disposed of on-site, using standard industry practices and following environmental regulations/guidelines for the protection of watercourses.

4.8 Wetlands

- Wetlands will be avoided to the extent possible. Where unavoidable, wetland crossings/alteration will be completed in accordance with the Nova Scotia Wetland Conservation Policy and the wetland alteration application process during the permitting stage of the Project.
- Crossing of wetlands will not result in permanent diversion, restriction, or blockage of natural flow, such that hydrologic function of wetlands will be maintained.
- Run-off from construction activities will be directed away from wetlands.
- Any wash water from the cleaning of construction vehicles will be disposed of on-site, using standard industry practices and following environmental regulations/guidelines for the protection of wetlands.
- Work vehicles and/or heavy equipment will be cleaned and inspected prior to use to prevent the introduction of weed/invasive/non-native species to sensitive habitats such as wetlands.

4.9 Dangerous Goods Management

- All fuels and lubricants used during construction will be stored according to containment methods in designated areas, located a minimum 30 m from surface waters and wetlands.
- Where possible, refueling in the field will not occur within 30 m of watercourses, water bodies or wetlands.
- Storage of all hazardous materials will comply with Workplace Hazardous Materials Information System (WHMIS) requirements. Appropriate material safety data sheets will be located at the storage site.
- Transportation of dangerous goods will comply with the *Transportation of Dangerous Goods Act (TDGA)* (1992).
- Equipment will be kept in good working order, will be inspected regularly, and any observed leaks will be repaired.

4.10 Waste

- Solid wastes, including waste construction material, will be disposed of in approved facilities.
- Temporary storage of waste materials on-site will be located at least 30 m from known watercourses, wetlands, and water bodies.
- Waste materials will be removed from the site by a qualified waste hauler and disposed/recycled in accordance with provincial waste regulations. All applicable materials will be stored as per WHMIS requirements and transported as per requirements of the *TDGA* (1992).

4.11 Excavation and Site Reinstatement

- All soils removed during the excavation phase will be stored according to provincial regulations and best practice guidelines.
- Any soil needed for backfilling, after foundations have been poured, will be stored temporarily adjacent to the excavations until needed. Any remaining excavated material will be used on-site or removed and sent to an approved facility.
- Prior to excavation activities, erosion and sedimentation control measures will be deployed and assessed on a regular basis.
- Once backfilled material has stabilized, temporary erosion and sedimentation controls will be removed. Attention will be paid during site reinstatement to ensure areas will promote wildlife return to the area, to the extent possible.

5.0 ENVIRONMENTAL MANAGEMENT

5.1 Environmental Protection Plan

An EPP will be developed following EA approval of the Project. The EPP will be approved by NSE prior to start of construction of the Project and will detail best practices and mitigative measures to be employed during construction to minimize potential environmental impacts. The EPP document 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 a plan 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; and
- environmental commitments made as part of the EA.

A suggested Table of Contents for the EPP is provided in Appendix B.

6.0 PROJECT SCOPE

As a Class 1 EA, this registration document and supporting studies have been developed to meet all requirements under Section 9(1A) of the N*SEA.*

In addition, the document has been prepared using the following provincial guidelines:

- "A Proponent's Guide to Wind Power Projects: Guide for preparing an Environmental Assessment" (NSE 2012a); and
- "A Proponent's Guide to Environmental Assessment", published by the Environmental Assessment Branch of NSE and revised in 2009 (NSE 2009a).

The following regulatory bodies have been contacted by the Project team to provide input into the Project planning process and advice regarding the EA scope:

- Canadian Wildlife Service (CWS);
- Nova Scotia Department of Communities, Culture, and Heritage;
- NSE; and
- Nova Scotia Department of Natural Resources (NSDNR).

During the EA review process, additional consultation may be required with these and other agencies.

6.1 Site Sensitivity

Potential wind farms are assigned a category level, according to a matrix provided in "A Proponent's Guide to Wind Power Projects" (NSE 2012a). This matrix considers the overall Project size and the sensitivity of the Study area to determine the category level. The category level then outlines guidance with respect to the collection of baseline data for the EA, as well as post-construction monitoring requirements.

As the Project consists of three turbines, it is considered a small project. Based on the known existence of four bird species listed under the Nova Scotia *Endangered Species Act* (NS *ESA*); and the presence of a bat hibernaculum less than 25 km from the Study area, the Project is classified as having a 'Very High' potential sensitivity. Overall, the Project has therefore been determined to be a Category 4.

6.2 Assessment Scope

EA is a planning tool used to predict the environmental effects of a proposed project, identify measures to mitigate adverse environmental effects, and predict whether there will be significant adverse environmental effect after mitigation is implemented.

The EA focuses on specific environmental components called valued environmental components (VECs). VECs are specific components of the biophysical and human environments that, if altered by the Project, may be of concern to regulatory agencies, Aboriginal peoples, stakeholders, resource managers, scientists, and/or the general public. VECs incorporate biological systems as well as human, social, and economic conditions that are affected by changes in the biological environment. As such, VECs can relate to ecological, social, cultural, or economic systems that comprise the environment as a whole.

The scope of the assessment for this Project includes: selection and preliminary assessment of potential interactions; identification of VECs; identification of environmental effects; and identification of the standards or thresholds that are used to determine the significance of residual environmental effects. This scoping relies upon direction from regulatory authorities; consideration of input from stakeholders; and the professional judgment of the Project team.

6.3 Spatial and Temporal Boundaries of the Assessment

For this Project, the Project site consists of all parcels of land included under land agreements which include PIDs 45101136, 45289675, 45101128, 45366648, 45119344, 45366630, 45188810, and 45271939, comprising a total area of approximately 518 ha (Drawing 2.1).

The Study area includes all parcels of land that contain the turbines and associated infrastructure, which include PIDs 45366648 and 45101128 for an approximate area of 240 ha. Unless otherwise identified, the assessment of effects was undertaken for the area identified as the Study area (Drawing 2.1).

For the purpose of data collection and the socio-economic environment, the Municipality of the District of East Hants was considered. In addition, residences located within a 2 km buffer of the Study area were assessed as potential receptors for the purposes of evaluating potential impacts from sound and shadow flicker.

The temporal scope of this assessment covers the construction, operation, and decommissioning phases of the Project, and associated activities, as described in Sections 2.2.1, 2.2.2, and 2.2.3. Accidents, malfunctions, and unplanned events are addressed separately.

6.4 Site Optimization

As part of the Project planning process, a detailed constraints analysis was conducted to ensure that potential effects to the environment and neighboring residents are minimized. This analysis was continually updated and refined based on the results of Project specific desktop studies, modeling, and field assessments. As a result, several layout iterations were reviewed to reflect a growing knowledge of the Study area and surrounding community. Specifically, layout modifications were incorporated into the planning process in consideration of the following:

- Sighting within an optimal wind regime;
- Avoidance of interference with telecommunication and radar systems;
- Maintenance of a minimum 30 m (from the tip of blade) 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 (from tip of blade) buffer between turbine locations and field identified wetlands (NSE standard). NSDNR requests that larger buffer distances (*i.e.*, 80 - 100 m from the tip of blade) are incorporated into 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 Aboriginal resources;
- Maintenance of a minimum 550 m setback (NSE standard) between turbines and occupied dwellings, cottages, camps, daycares, hospitals, and schools;

- Predictive sound modeling results to meet NSE standards (*i.e.,* 40 dBA for dwellings, daycares, hospitals, and schools);
- Predictive shadow flicker modeling results to meet NSE standards (*i.e.,* no more than 30 minutes of shadow flicker per day and no more than 30 hours of shadow flicker per year); and
- Maintenance of the municipal setback from adjoining property (lot) lines, which indicates the turbine shall be located not less than 4 times the height of the turbine, measured from the height of the tower plus the distance from the top of the tower to the highest extended tip of the rotor blades.

In addition to the general planning "constraints" and minimum setbacks mentioned above, the Study 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. These include:

- Accommodation of a large residential setback of almost 1565 m, well in excess of the NSE Standard;
- The use of a site that has been previously disturbed by forestry activities (i.e., tree clearing and logging trails/roads throughout the Study area);
- Incorporation of 745 m of existing roads into the Project design, minimizing the overall new road disturbance impacts and clearing requirements;
- No wetland or watercourse alterations required at turbine locations; and
- Accommodation of a buffer distance between turbines and the field identified watercourse in excess of 236 m.

This siting exercise, using the above noted constraints and setbacks, resulted in the current turbine locations that this EA was based on. Through this process, these locations were selected to provide a minimal disturbance to surrounding land uses, local residents, and environmental features.

7.0 ENVIRONMENTAL ASSESSMENT METHODOLOGY

The methodological framework used in this EA has been developed to meet the requirements of the N*SEA*. This framework is based on a structured approach that:

- focuses on issues of greatest concern;
- considers Aboriginal concerns as well as concerns raised by the public and other stakeholders; and
- integrates mitigative measures into Project design.

The methodology provides an overview of the baseline conditions and an assessment of VECs that reflect key issues of concern. Within the specified spatial and temporal boundaries, the potential for interaction between individual VECs and Project activities are determined. Where there is potential for Project-related environmental effects, each effect is assessed using the results of preliminary

investigations, guidance from regulators, and the collective knowledge and expertise of the Project team. The residual Project-related environmental effects, (*i.e.*, after mitigation has been applied), are characterized using specific criteria (direction, magnitude, geographic extent, duration, frequency, and reversibility) that are applied to each VEC. The significance of these residual effects is then determined based on pre-defined and VEC-specific thresholds.

Project-related environmental effects are assessed and include potential interactions; mitigation and environmental protection measures proposed to reduce or eliminate adverse environmental effects; and the characterization of the residual environmental effects of the Project. The ultimate focus of the assessment is on residual environmental effects that remain after planned mitigation has been applied.

7.1 Preliminary VEC Selection

A preliminary assessment of potential interactions between selected environmental components and the Project was undertaken to identify VECs. This preliminary assessment is summarized in Table 7.1. For some of the identified environmental components, additional information has been provided in the report. Many of the interactions can be addressed using industry BMPs and adhering to existing regulations to mitigate potential effects. Where environmental BMPs and regulations are considered to be insufficient to fully mitigate potential effects, or where additional information is required, the components are identified as VECs and are therefore subject to further assessment in Section 13.0. Specific environmental requirements and mitigation practices are identified in the effects assessment and will be refined in subsequent environmental regulatory permitting processes.

Table 7.1: VEC Selection Table

Environmental Component	Description	Assessed further?	Applicable Section in the Report
Atmospheric Environment	Atmospheric environment includes consideration of air quality and climate conditions. Concerns include: - Dust generation from construction and operation activities. - Interaction with air quality due to exhaust emissions, including greenhouse gas emissions from Project equipment and vehicles during construction and operation. Only minimal amounts of dust and air emissions are expected. Mitigation for these potential effects is provided in Section 4. Project-related emissions are anticipated to be temporary, localized, and minor in nature. Measurable changes to the atmospheric environment are not expected.	No	Section 8.1

Environmental Component	Description	Assessed further?	Applicable Section in the Report
Geophysical Environment	Geophysical components include consideration of hydrogeology, groundwater, and bedrock and surficial geology. Concerns include: - Damage from blasting to domestic water sources. - Localized disturbances to surface soils and shallow bedrock. - Potential for karst topography (sinkholes) at the site. Once the location of any required blasting is confirmed and the geotechnical investigation is completed, the need to implement mitigation measures or monitoring programs will be evaluated. The presence of karst topography will be assessed as part of the geotechnical investigation. Impacts from karst topography, if any, are expected to be manageable through avoidance and mitigation. Project-related effects on the geophysical environment are anticipated to be temporary, localized, and minor in nature. Measurable changes to the geophysical environment are not expected.	No	Section 8.2
Freshwater Environment	Freshwater environments involve consideration of fish and fish habitat and water quality which may be impacted by watercourse crossings, erosion and sedimentation etc. Concerns include: - Loss or damage to fish habitat. - Decreased water quality. - Mortality of aquatic species. Based on the proposed Project layout, four watercourse alterations may be required to accommodate new road construction and upgrades which will be confirmed when the final engineering design is complete (refer to Section 8.3.1). All construction activities near watercourses will comply with the applicable regulations and guidelines. Any potential impacts to watercourses should be easily addressed through the provincial permitting process. Additional mitigation is described in Section 4.	No	Section 8.3

Environmental Component	Description	Assessed further?	Applicable Section in the Report
	Project-related effects on the freshwater environment are anticipated to be temporary, localized, and minor in nature. Measurable changes to the freshwater environment are not expected.		
Terrestrial Habitat, Flora and Fauna (including wetlands)	Terrestrial habitat involves consideration of general and specialized terrestrial habitats, such as wetlands, as well as terrestrial flora and fauna *(Note: Birds and rare species have been considered separately)*. Concerns include: - Habitat fragmentation. - Introduction of invasive species. - Damage to wetland ecosystems. - Sensory disturbance to fauna species. - Mortality of some smaller faunal species due to clearing activities. - Loss of vegetation and effects to fauna and flora species due to herbicide application (vegetation management). Habitat fragmentation is considered to be minimal due to the small-scale clearing required. Environmental protection practices will be incorporated into clearing and grubbing activities as described in Section 4. Mitigation to control and prevent the introduction of invasive species is provided in Section 4 and will be included as part of the Project Vegetation Management Plan. Avoidance of wetland habitat has been taken into consideration in Project planning and design including access roads and placement of turbines. Additional mitigative measures provided in Section 4 will be employed to protect wetland habitat. Based on the proposed Project layout, alteration of two wetlands maybe required to accommodate new road construction and upgrades which will be confirmed when the final engineering design is complete (refer to Section 8.4.1). It is expected that temporary sensory disturbance related to the site preparation and construction phases of the Project will not persist in the long-term. Sensory disturbance related to turbine operations will be negligible.	No	Section 8.4, 8.5, and 8.6

Environmental Component	Description	Assessed further?	Applicable Section in the Report
	Mortality of fauna will be minimal due to the utilization of existing access roads, small scale clearing requirements and attention to seasonal mitigation. Project-related effects on the terrestrial environment are anticipated to be temporary, localized, and minor in nature. Measurable changes to the terrestrial habitat and flora and fauna are not expected.		
Species of Conservation Interest (SOCI)	SOCI are those species assessed as being at risk or sensitive to some degree. For the purposes of this EA, SOCI include those species listed as: • "Endangered", "Threatened", or "Special Concern" under *SARA;* and • "Endangered", "Threatened "or "Vulnerable" under the NS *ESA*. Consideration is also given to species: • Ranked as "1 – At Risk", "2 – May Be At Risk", "3 - Sensitive" or "5 - Undetermined" under the NSDNR General Status Ranks of Wild Species in Nova Scotia; • Listed "Endangered", "Threatened", or "Special Concern" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC); and • Ranked as "S1", "S2" or "S3" under the ACCDC provincial conservation status rank. Based on the above criteria, three fish SOCI and three terrestrial fauna SOCI have potential to occur at the Study area. Concerns include: - Sensory disturbance. - Direct and indirect adverse environmental effects to habitat (loss or alteration). - Effects to fish passage/migration. - Direct mortality of individuals. Loss of terrestrial fauna and aquatic SOCI is considered minimal due to the utilization of existing access roads, small	Yes	Sections 8.3, 8.5, 8.6 and 13.2.1

Environmental Component	Description	Assessed further?	Applicable Section in the Report
	scale clearing requirements, and attention to seasonal mitigation. However, due to special status under federal and provincial federal legislation/guidance, aquatic and terrestrial fauna SOCI are considered further in the assessment as a VEC.		
Avifauna	The effects of wind turbines on avifauna are variable and depend on factors such as the development design, topography of the area, habitats affected, and the bird community in the wind farm area. Concerns include: - Mortality resulting from direct collision. - Habitat alteration. - Sensory disturbance. The requirements as set out in the *MBCA* will be adhered to for clearing activities (Section 4). Due to the potential effects of wind turbines on avifauna, this component is considered for further assessment.	Yes	Sections 8.7 and 13.2.2
Bats	The installation of wind turbines has the potential to impact bats both directly and indirectly. Concerns include: - Mortality resulting from direct collision and/or barotrauma. - Habitat alteration. - Sensory disturbance. The significance of these impacts at the population level depends on a number of biotic and abiotic variables, including the number of individuals affected and the stability of the population, season, physiologic condition of the individuals affected, and weather factors. Due to the potential effects of wind turbines on bat populations, this component is considered for further assessment.	Yes	Sections 8.8 and 13.2.3
Local Economy/Land Use/Recreation and Tourism	Socio-economic aspects such as economy, land use/value, and recreation and tourism may be affected by the Project; however these effects may be positive and/or negative. The Project will likely create more local jobs, increase municipal tax revenues, and provide a community dividend, thereby	No	Section 9.0

Environmental Component	Description	Assessed further?	Applicable Section in the Report
	resulting in a positive change for community. Impacts to land use are not expected in the area since the Project is located on privately owned land. 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. The Project represents a small footprint on privately owned land. Therefore, impacts to the broad recreational/tourism community are not expected. Effects on the socio-economic environment are expected to be positive in nature, or temporary, localized, and minor in nature. Measurable changes to the local economy, recreation and tourism are not expected.		
Human Health	The public is often concerned about the potential for impacts to human health from wind turbines. Concerns include: - Sound (addressed as a separate section). - Shadow flicker (addressed as a separate section). - Infrasound. - Electromagnetic fields (EMF). - Effects to air quality from dust and air emissions. - Risk of ice throw. A literature review regarding the potential for impacts to human health from wind turbines was completed (Appendix C). The main findings from this review are as follows: • There is no evidence that the levels of infrasound produced by the turbines present a risk to human health. • There is no discernible evidence that there are health risks associated with electric magnetic fields (EMFs). • Effects to air quality are expected to be temporary, minor, and localized in nature (refer also to Section 4.4 and to 'Atmospheric Environment', above). • Setbacks and safety awareness measures minimize any potential risk from ice throw.	No	Section 11, Appendix C

Environmental Component	Description	Assessed further?	Applicable Section in the Report
	Effects to human health are considered minimal or non-existent due to the size and location of the wind farm, mitigation, and setback distances.		
Cultural and Heritage Resources	If present, cultural and heritage resources may be affected by ground disturbance during construction and decommissioning activities. An Archeological Resource Impact Assessment (ARIA) indicated that the proposed turbine locations exhibit high potential for encountering Precontact and/or early historic Native archaeological resources. Additional studies (including a sub-surface survey in areas of high potential and commissioning of a MEKS study) to confirm conditions, will be completed. Should discovery of archeological resources be confirmed, disturbance within these areas will be avoided. Procedures related to potential discovery of archaeological items or sites during construction will be described in the EPP.	No	Section 10
Shadow Flicker	Shadow flicker can occur when rotating blades cast flickering shadows during times of direct sunlight. Modeling results indicate that all residential receptors are predicted to comply with the industry standard of no more than 30 hours of shadow flicker per year and no more than 30 minutes of shadow flicker on the worst day. Shadow flicker, therefore, is not expected to be an issue at any existing residence/dwelling in the vicinity of the Project.	No	Section 11.1
Electromagnetic Interference (EMI)	The rotating blades and support structures of wind turbines can interfere with various types of electromagnetic signals emitted from telecommunication and radar systems. An EMI study completed for this Project indicated that there were no objections regarding EMI effects associated with the Project provided to date.	No	Section 11.2
Visual Landscape	Wind farms produce visual effects to the local landscape. A visual assessment was completed for the Project. Predicted view planes generated by the assessment are presented in Section 11.3.	No	Section 11.3

Environmental Component	Description	Assessed further?	Applicable Section in the Report
	Effects to the visual landscape are considered minimal to non-existent due to the size and location of the wind farm and setback distances.		
Sound	Sound is generated during all phases of the wind farm. Concerns include: - Noise during construction and decommissioning phases. - Annoyance and unpleasantness, for local residents in close vicinity, from turbine blades during operation. Construction and decommissioning phases will be short-term. Effects of noise created during these phases are expected to be temporary, minor, and localized in nature. Modeling results for wind farm operation indicate that all residential receptors are predicted to comply with the NSE standard of 40 dBA (exterior of the residence). Effects from sound during operation are therefore considered minimal due to the size and location of the wind farm and setback distances. Post-construction monitoring will be completed during operation, as required.	No	Section 11.4

Based on the preliminary assessment of potential interactions summarized in Table 7.1, the VECs addressed in this EA are as follows:

- SOCI;
- Avifauna; and
- Bats.

8.0 BIOPHYSICAL ENVIRONMENT

8.1 Atmospheric Environment

8.1.1 Weather and Climate

Nova Scotia's climate is quite varied and is largely governed by coastal influences and elevation (Davis and Browne 1996). The Study area (centered at 45º5'29.46"N, 63º31'23.50"W) lies within the Central Lowlands Ecodistrict of Nova Scotia, which encompasses mush of Hants and Colchester Counties (Neily et al. 2003). The climate is conducive to farming and the area has been extensively used for dairy and beef production and the growing of forage and cereal crops, including corn. The typical growing season in the area of the Project is 198 days (Webb and Marshall 1999).

Local temperature and precipitation data were obtained from the Halifax Stanfield International Airport meteorological station (44°53'00N, 63°31'00.00W) located approximately 22 km south of the Study area. For the period from 1981-2010, the mean annual temperature was 6.6°C, with a mean daily high of 11.3°C and a mean daily low of 1.9°C (EC 2014a). January and February were the coldest months (-5.9 °C and -5.2°C, respectively), while the warmest months were July and August (18.8 °C and 18.7°C, respectively) (EC 2014a).

From 1981-2010, mean annual snowfall was 221 cm and rainfall was 1,196.1 mm (EC 2014a). Most snowfall is received in January (58 cm), while the rainiest months are October and November (124.6 mm and 139.1 mm, respectively) (EC 2014a).

Environment Canada (EC) measures wind conditions in Nova Scotia at those meteorological stations that are under long term observation. The closest such station to the Study area is the Halifax Stanfield International Airport, mentioned above. The Canadian Climate Normals (1981-2010) for this station indicate an annual wind speed of 16.5 km/h, most commonly out of the south (EC 2014a). The maximum hourly wind speed for this station was 93 km/h, recorded on November 4, 2007, with the highest single wind gust measuring at 132 km/h on December 26, 1976 (EC 2014a). According to the NS Wind Atlas (NSDE 2007), average wind speeds at 30 m and 50 m above the ground at the Study area range from 16.24 – 18.0 km/h, and range from 18.03 – 19.8 km/h at 80 m above the ground.

8.1.2 Air Quality

Currently in Nova Scotia, 42% of total GHG emissions come from electricity use and 89% of electricity comes from fossil fuels (NSDE 2009). Because of this heavy reliance on coal and other fossil fuels for electricity, every MW of wind power installed reduces GHG emissions by as much as 2,500 tonnes per year (NSDE 2011). By reducing Nova Scotia's reliance on fossil fuels, wind energy will therefore contribute to improving local air quality (NSDE 2011).

Nova Scotia monitors air quality at six stations throughout the province. Measured parameters include ground-level ozone (O_3), particulate matter (PM2.5), and nitrogen dioxide (NO_2), and these values are used to calculate a score on the Air Quality Health Index (AQHI) (EC 2014b). 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+). The AQHI monitoring station closest to the Study area is located in Halifax, approximately 49 km south of the Study area. The AQHI at this site is usually low at all times of the year (EC 2014b).

Mitigation measures for potential effects to the atmospheric environment are provided in Section 4.

8.2 Geophysical Environment

8.2.1 Physiography and Topography

The Project lies within the Central Lowlands Ecodistrict of the Valley and Central Lowlands Ecoregion (Neily *et al*. 2003). Most of the ecodistrict is fairly level with hummocky to undulating

topography, and elevations which seldom exceed 90 m above sea level. Well drained, fine textured soil on hummocky terrains, underlain by Carboniferous shale, limestone, sandstone, and gypsum, dominate the Central Lowlands Ecodistrict. Karst topography (sink holes) is common on areas underlain by gypsum (Neily *et al*. 2003). The Study area is located on a hummocky terrain with elevations ranging from 72 m to 86 m above sea level.

8.2.2 Surficial Geology

Based on surficial geology mapping, surficial soils in the vicinity of the Study area consist of a silty till plain consisting of silty, compact, material derived from both local and distant sources (Stea *et al.,* 1992) (Drawing 8.1). Organic deposits are mapped at the western extent of the Study area in the form of bogs, fens, and swamps containing sphagnum moss, peat, gyttja, and clay deposits. Till thickness ranges from 3 – 30 m, with organic deposits reaching thicknesses of 1 - 5 m (Stea *et al.* 1992).

8.2.3 Bedrock Geology

Bedrock geology on the northern portion of the Study area consist of early Carboniferous aged Upper Windsor Group designated as the Murphy Road, Pesaquid and Green Oaks Formations (Keppie 2000) (Drawing 8.2). These formations are typically composed of siltstone, minor gypsum, and limestone.

Rocks of the Windsor Group typically have alternating layers of carbonates (limestone), evaporites (gypsum, rock salt, and potash), and 'redbeds' (shales, sandstones, and conglomerates). Soluble rocks such as evaporites and limestones have the potential to form solution/collapse features, resulting in karst landscapes in some areas. The occurrence of karst landscapes such as sinkholes is a potential geological hazard, particularly where structures rest on or near the surface. The effects of karst topography, if any, are expected to be manageable through further study, avoidance routing, and mitigation.

The southern portion of the Study area is underlain by the Early – Late Carboniferous Mabou Group designated as the Watering Brook Formation (Keppie 2000) (Drawing 8.2). This formation consists of siltstone, minor sandstone, gypsum, and anhydrite.

According to the NSE Well Log Database (NSE 2013), there are six drilled wells and one dug well within 2 km of the site, ranging in depths from 7.1 m to 91.3 m. The majority of wells were drilled through a combination of shale, siltstone and limestone. Surficial material consisted of clay, boulders, and gravel ranging from 28.9 m to 42.6 m in thickness.

8.2.4 Hydrogeology and Groundwater

Groundwater Quantity

Water supplies near the Study area are generally derived from individually drilled or dug wells. A summary of the pertinent (within 2 km of the Study area) well properties included in NSE Well Log Database (NSE 2013) is presented in Table 8.1.

N

Blois Rd

Poplar St

PID 45271939
Everett & Marilyn Clarke

PID 45188810
Atlantic Star Forestry Ltd.

Atlantic Star Forestry Ltd.
PID 45366630

Atlantic Star Forestry Ltd.
PID 45366648

PID 45101128
Elmsdale Lumber Co. Ltd.

PID 45119344
Atlantic Star Forestry Ltd.

1

2

3

Indian Brook
Native Reserve 14

PID 45101136
Downey M Thompson
Milton Downey Thompson

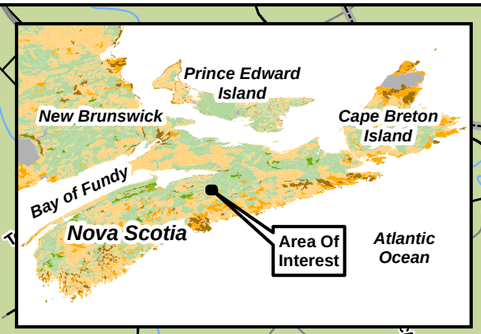
PID 45289675
Brian Leahy

Robinson Rd

Sandy Desert Rd

Dowie Rd

Sesame St



0 200 400 600 800 1,000 Metres

Notes:

1. Reference: Digital Topographic Mapping & Property Management Unit MU0904 by Nova Scotia Geomatics Centre. DP ME 36, Version 2, 2006, Digital Version of Nova Scotia Department of Natural Resources Map ME 1992-3, Surficial Geology Map of the Province of Nova Scotia, scale 1:500 000, by R. R. Stea, H. Conley and Y. Brown, 1992.
2. Projection: NAD83(CSRS), UTM Zone 20 North.

Legend:

- Proposed Turbine
- Proposed Access Road
- Study Area
- Project Site
- Property Boundary
- Native Reserve
- Public Roads
- Access Roads / Trails
- Mapped Stream
- Mapped Indefinite Stream
- Water Bodies

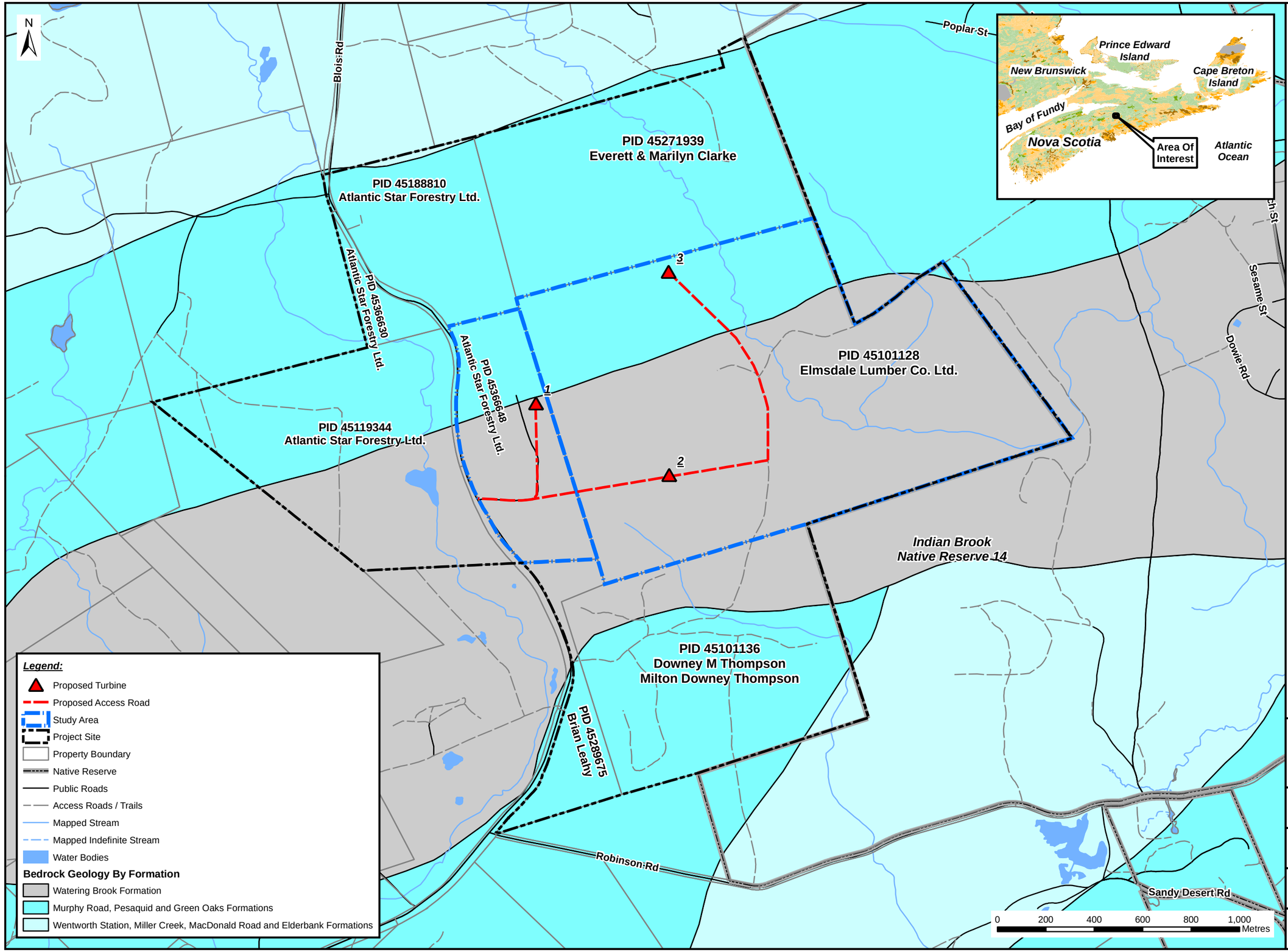
Surficial Geology By Unit

- Glaciolacustrine Deposits
- Kame Fields and Esker Systems
- Organic Deposits
- Silty Till Plain

Hardwood Lands Community Wind Project - Surficial Geology

Strum CONSULTING

Date: August 2015	Project #: 14-5169
Scale: 1:15,000	Drawing #: **8.1**
Drawn By: H. Serhan	
Checked By: M. Henley	



Notes:

1. Reference: Digital Topographic Mapping & Property Management Unit MU0904 by Nova Scotia Geomatics Centre.
   DP ME 43, Version 2, 2006, Digital Version of Nova Scotia Department of Natural Resources Map ME 2000-1, Geological Map of the Province of Nova Scotia, scale 1:500 000, Compiled by J. D. Keppie, 2000.
2. Projection: NAD83(CSRS), UTM Zone 20 North.

Hardwood Lands Community Wind Project - Bedrock Geology

Strum Consulting

Date: August 2015	Project #: 14-5169
Scale: 1:15,000	Drawing #: 8.2
Drawn By: H. Serhan	
Checked By: M. Henley	

Table 8.1: Summary of Well Records

Well Number	Drilled Date (yr)	Type	Well Depth (m)	Casing Length (m)	Estimated Yield (Lpm)	Water Level (m)	Overburden Thickness (m)	Water Bearing Fractures (m)
2429	2000	Drilled	61.5	29.8	181.6	23.1	28.9	8.5, 10.7, 24.4
20288	2002	Drilled	54.8	45.6	68.1	21.3	42.6	n/a
20289	2002	Drilled	25.2	25.2	36.3	15.2	-	9.5, 9.8
80380	2008	Dug	7.1	-	-	2.1	-	28, 38.1
440048	1944	Drilled	91.3	-	-	-	-	0.6, 1.8
790557	1979	Drilled	-	16.7	-	-	-	n.a
962315	1996	Drilled	18.2	18.2	68.1	4.2	-	

Source: NSE 2013

Based on short term driller's estimates for the wells in Table 8.1, the average yield is approximately 88.5 Lpm (23.4 gpm) and average well depth is approximately 43.0 m (141.2 ft). These measurements represent very short term yields estimated by the driller at the completion of well construction. Fracture depths ranged from 0.6 m (1.9 ft) to 38.1 m (124.9 ft). The closest drilled well to the proposed turbines is located along Blois Road (1.2 km southwest of Turbine 3).

The NSDNR Pump Test Database (NSDNR 2013) provides longer term yields for select wells throughout the province. One regional well, drilled through Windsor Group bedrock located within 6 km of the Study area, indicates a long term safe yield (Q_{20}) of 290 Lpm (76.6 gpm) and an apparent transmissivity of 64 m^2/day.

NSE maintains the Nova Scotia Groundwater Observation Well Network (NSE 2012b). The nearest observation well to the Study area is located approximately 30 km south, in Fall River. This well was drilled to a depth of 61 m through slate bedrock of the Halifax Formation. This well has been monitored since 2008 and water levels appear to have remained relatively consistent.

The Project is not expected to have any impact on groundwater quantity.

Groundwater Quality

The Windsor Group is generally of very poor quality, due to the occurrence of evaporate deposits contributing to excessive amounts of sulphates, hardness, and total dissolved solids (Lay et al.1979). These waters are generally classed as calcium bicarbonate or calcium sulphate waters.

Groundwater quality from Mabou Group bedrock can be expected to be of good chemical quality with a tendency toward hardness. Iron and manganese concentrations in excess of relative aesthetic guidelines are found in approximately half of all wells located in Mabou Group bedrock (Gibb and McMullin 1980).

The Project is not expected to have any impact on groundwater quality.

Mitigation measures for potential effects to the geophysical environment are provided in Section 4.

8.3 Freshwater Environment

The Project lies within the Central Lowlands Ecodistrict, which is part of the Valley and Central Lowlands Ecoregion (Neily *et al.* 2003). A defining feature of this Ecodistrict is the extent to which it is drained by large rivers that empty into the Bay of Fundy, including the Stewiacke and the Shubenacadie Rivers (Neily *et al.* 2003). There are few freshwater lakes within the ecodistrict (Webb and Marshall 1999) which, combined with rivers and streams, account for just 1.5% of the ecodistrict's area (Neily *et al.* 2003).

The Study area lies within the Shubenacadie/Stewiacke Watershed (1DG). This watershed, commonly referred to as the Shubenacadie River Watershed, occupies most of north-central Nova Scotia and discharges into the Minas Basin. The Shubenacadie is a tidal river which originates from Shubenacadie (Grand) Lake, located about 13.6 km southwest of the Study area, and flows to the northeast, emptying into Cobequid Bay near Maitland.

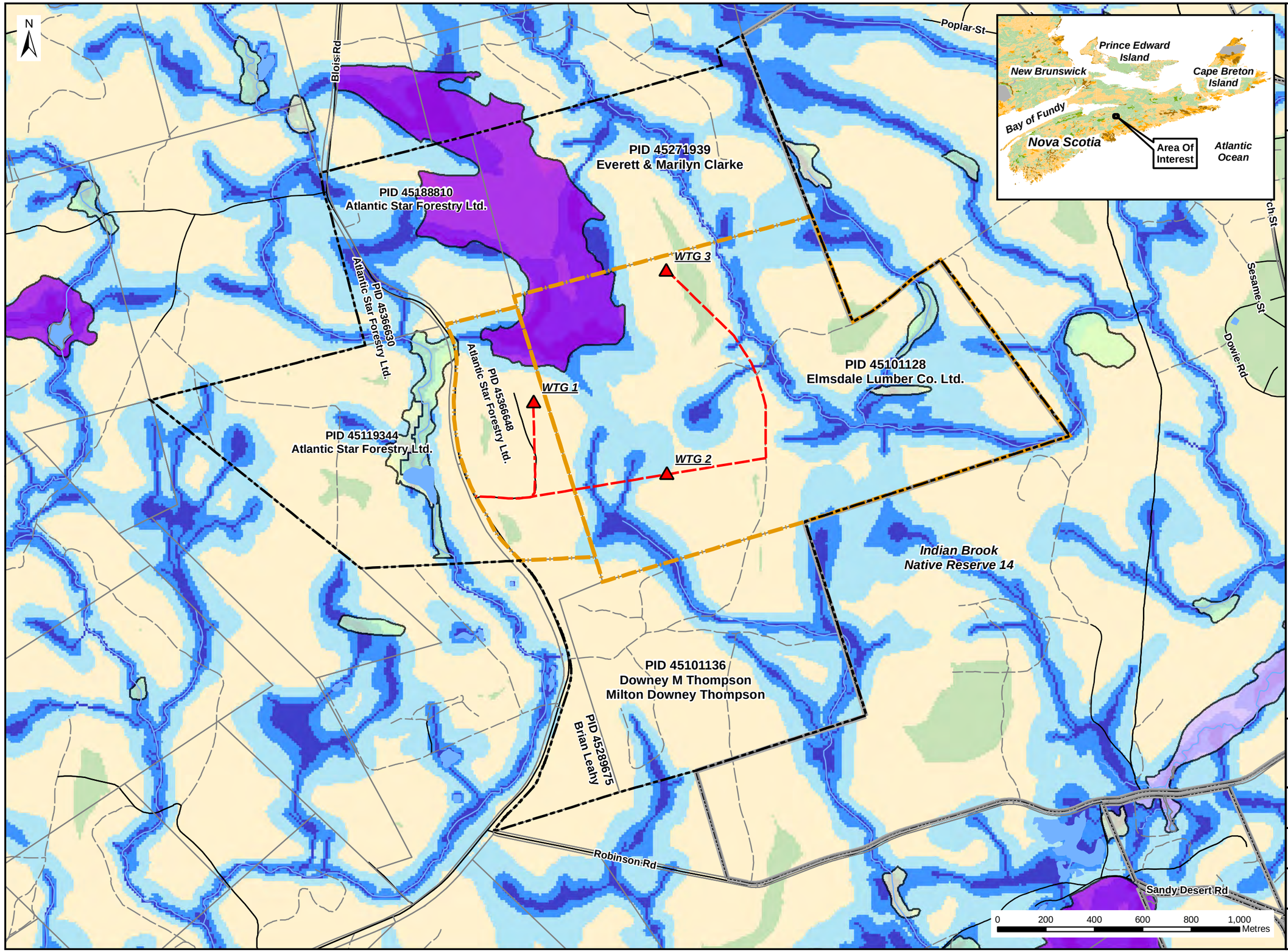
Prominent water bodies in the Shubenacadie/Stewiacke Watershed include Grand Lake, Shortts Lake, and Kinsac Lake. The closest named water body to the Study area is Brazil Lake, located approximately 2.5 km northwest.

Twelve lakes within Hants County are included in the Nova Scotia Lake Inventory Program (NSE 2012c), which determines the baseline biophysical attributes of lakes throughout the province. The closest lake to the Study area for which data is available is Grand Lake, which is located approximately 13.6 km southwest of the Study area. However, temperature and dissolved oxygen data are from sampling events completed in 1974 and therefore, are considered outdated.

No lakes or water bodies are present within the Study area boundaries (Drawing 8.3). The closest mapped water body to the site is Brazil Lake situated approximately 2.5 km to the northwest.

Two mapped streams are located within the Study area (Drawing 8.3) (NSDNR 2014a). One stream located to the south of turbine 2 flowing southeast. The second stream is mapped in the northeastern portion of the site flowing to the southeast, approximately 100 m east of the proposed access road between turbine 2 and turbine 3.

Four watercourses were observed along the proposed access road (Drawing 8.4). General characteristics of the watercourses at the location of the proposed road are presented in Table 8.2.



Notes:

1. Reference: Digital Topographic Mapping & Property Management Unit MU0904 by Nova Scotia Geomatics Centre. Wetland Inventory & Wet Area Mapping by Nova Scotia Department of Natural Resources (NS DNR).
2. Projection: NAD83(CSRS), UTM Zone 20 North.

Legend:

- Proposed Turbine
- Proposed Access Road
- Study Area
- Project Site
- Property Boundary
- Native Reserve
- Public Roads
- Access Roads / Trails
- Mapped Stream
- Mapped Indefinite Stream
- Water Bodies

NS DNR Wetland Inventory

Wetland Type

- Bog or Fen
- Fen
- Marsh
- Salt Marsh
- Swamp

Depth to Water Table (m)

- 0 - 0.10 m
- 0.11 - 0.50 m
- 0.51 - 2 m
- 2.01 - 10 m
- > 10 m

Hardwood Lands Community Wind Project - Desktop Review Results

Strum Consulting

Date: August 2015	Project #: 14-5169
Scale: 1:15,000	Drawing #: **8.3**
Drawn By: H. Serhan	
Checked By: M. Henley	

N

PID 45271939
Everett & Marilyn Clarke

PID 45188810
Atlantic Star Forestry Ltd.

PID 45366648
Atlantic Star Forestry Ltd.

WTG 3

Watercourse 4

WTG 1

PID 45101128
Elmsdale Lumber Co. Ltd.

Watercourse 3

WTG 2

Watercourse 1

Watercourse 2

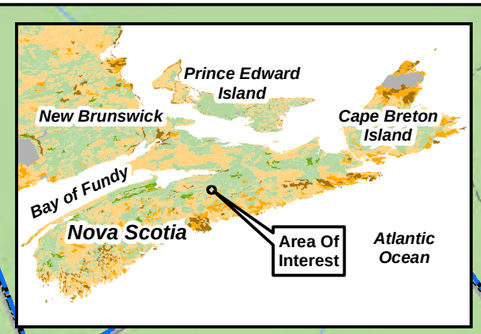
Blois Rd

PID 45119344
Atlantic Star Forestry Ltd.

PID 45289675
Brian Leahy

PID 45101136
Downey M Thompson
Milton Downey Thompson

Shubenacadie
Native Reserve 14
(Indian Brook)



0 100 200 300 400 500 Metres

Notes:

1. Reference: Digital Topographic Mapping & Property Management Unit MU0904 by Nova Scotia Geomatics Centre.
2. Projection: NAD83(CSRS), UTM Zone 20 North.
3. GPS Data Collected is Typically to +/-5m Accuracy.

Legend:

- Proposed Turbine
- Proposed Access Road

Field Identified Watercourses (Type)

- Drainage Channel
- Watercourse

Field Identified Wetland Bounaries (Type)

- Confirmed WL Bdy
- Approximate WL Bdy
- Wetland Habitat
- Wetland: Clear Cut
- Wetland: Treed Swamp
- Project Site Boundary
- Property Boundary
- Study Area
- 100m Turbine Buffer
- Native Reserve
- Public Roads
- Access Roads / Trails
- Mapped Stream
- Mapped Indefinite Stream
- Water Bodies
- Cleared Area

Hardwood Lands Community Wind Project - Survey Results

Strum CONSULTING

Date: August 2015	Project #: 14-5169
Scale: 1:6,500	Drawing #: **8.4**
Drawn By: H. Serhan	
Checked By: A. Walter	

Table 8.2 Watercourse Characteristics

Feature ID	Feature Type	Bankfull Width (m)	Water Depth (cm)		Substrate	Drainage Direction
			Bank Full	Wetted		
Watercourse 1	Ephemeral Stream	0.3-1	10-30	15	Sand, gravel and silt	Northwest to southeast
Watercourse 2	Ephemeral Stream	0.4-1	10-20	5-10	Gravel and silt	North to south
Watercourse 3	Ephemeral Stream	1-2	40-50	10-15	Sand, gravel and silt	West to east
Watercourse 4	Ephemeral Stream	1-2	100	8	Rock, boulders	Southwest to northeast

8.3.1 Watercourse Alterations

Based on the proposed Project layout, one culvert replacement (Watercourse 3), and three new culverts will be required along the proposed access road. No watercourse alterations are expected in association with turbine pads as there are no watercourses within 236 m of the turbine locations. The detailed design phase of the Project will determine where road upgrade and modifications, as well as associated culverts, are required. As noted in Table 8.2, all of the identified watercourses are small in size (i.e., none exceeded a bankfull width of 2 m). Any potential impacts should be easily addressed through the provincial permitting process.

8.3.2 Fish and Fish Habitat

In the absence of specific studies to determine the presence of fish, no statement can be made regarding the presence of fish in the watercourse in the Study area. Fish habitat potential of watercourses which interact with Project infrastructure will be more closely evaluated during the water crossing permitting stage prior to construction. Crossing structure will be designed accordingly.

The on-site watercourse flows southwest to the Nine Mile River, a tributary to the Shubenacadie River which originates from Shubenacadie (Grand) Lake. Shubenacadie (Grand) Lake, is a large, deep lake which drains 59 named lakes and numerous streams, popular among recreational fishers, thus fish species present in the lake have been well-documented. Species known to inhabit Grand Lake include striped bass (*Morone saxatilis*), Atlantic salmon (*Salmo salar*) (landlocked population), brook trout (*Salvelinus fontinalis*), chain pickerel (*Esox niger*), white perch (*Morone Americana*), yellow perch (*Perca flavescens*), brown bullhead (*Ameiurus nebulosus*), American eel (*Anguilla rostrata*), rainbow smelt (*Osmerus mordax*), alewife (*Alosa pseudolarengus*) and American shad (*Alosa sapidissima*), banded killifish (*Fundulus diaphanous*), and stickleback (species unspecified).

A review of the Atlantic Canada Conservation Data Center (ACCDC) database for fish species recorded within a 100 km radius of the Study area was completed. All species, including status rankings, are provided in Table 8.3.

Table 8.3: Fish Species Recorded within a 100 km radius of the Study Area

Common Name	Scientific Name	*SARA* Status[1]	NS *ESA* Status[2]	COSEWIC Status[3]	NSDNR Status[4]	NS S-Rank[5]
American eel	*Anguilla rostrate*	Not Listed	Not Listed	Threatened	1 - Secure	S5
Atlantic salmon	*Salmo salar*	Not Listed	Not Listed	Endangered	2 – May Be At Risk	S2
Atlantic salmon - Inner Bay of Fundy population (IBoF)	*Salmo salar* pop.1	Endangered	Not Listed	Endangered	2 – May Be At Risk	S2
Atlantic sturgeon	*Acipenser Oxyrhynchus*	Not Listed	Not Listed	Threatened	2 – May Be At Risk	S1?
Striped bass – Bay of Fundy population	*Morone saxatilis*	Not Listed	Not Listed	Endangered	2 – May Be At Risk	S1

Source: ACCDC 2015

[1] Government of Canada 2012; [2] NS *ESA* 2013; [3] COSEWIC 2012a; [4]NSDNR 2010; [5]ACCDC 2015

Fish species recorded within a 100 km radius of the Study area were screened against the criteria outlined in the document "Guide to Addressing Wildlife Species and Habitat in an EA Registration Document" (NSE 2009b) to develop a list of priority species (*i.e.*, SOCI), which are assessed further as a VEC.

In the context of this EA, SOCI include those that are:

- Listed under *SARA* as "Endangered", "Threatened", or "Special Concern";
- Listed under the NS *ESA* as "Endangered", "Threatened", or "Vulnerable";
- Assessed by COSEWIC as "Endangered", "Threatened", or "Special Concern";
- Assessed by NSDNR as "1 – At Risk", "2 – May Be At Risk", "3 - Sensitive", or "5 - Undetermined"; or
- Ranked by ACCDC as "S1", "S2", or "S3".

Priority fish species include:

- American eel – "Threatened" (COSEWIC);
- Atlantic salmon – "Endangered" (COSEWIC), "2 – May Be At Risk" (NSDNR), "S2" (ACCDC);
- Atlantic salmon (IBoF population) – "Endangered" (*SARA*), "Endangered" (COSEWIC), "2 - May Be At Risk" (NSDNR), "S2" (ACCDC);
- Atlantic sturgeon – "Threatened" (COSEWIC), "2 – May Be At Risk" (NSDNR), "S1?" (ACCDC);

- Striped bass (Bay of Fundy population) – "Endangered" (COSEWIC), "2 – May Be At Risk" (NSDNR), "S1" (ACCDC).

American Eel

The distribution of the American eel ranges from South America to Greenland in accessible freshwater systems that are connected to the Atlantic Ocean. This species spawns in salt water, and juveniles drift in ocean currents, eventually migrating inland through freshwater rivers and their tributaries. In later life stages, American eel persist in a variety of freshwater and estuarine habitats (COSEWIC 2012b). The American eel is common in Nova Scotia and has been documented in lakes and watercourses in the vicinity of the Study area (Halfyard 2008).

Potential effects of the Project on this species, as well as proposed mitigation measures, are discussed in more detail in Section 13.2.1.

Atlantic Salmon

Atlantic salmon are an anadromous species native to the North Atlantic Ocean and coastal rivers, which undertakes long feeding migrations to the ocean as older juveniles and adults, and return to freshwater streams to reproduce. The species requires rivers that are clear, cool and well oxygenated, with pools and shallow riffles and gravel, rubble, rock or boulder bottoms for reproduction (NS Fisheries and Aquaculture 2007; COSEWIC 2010a). All watercourses identified at the Study area form part of the Shubenacadie/Stewiacke River watershed, therefore any Atlantic salmon present would form part of the IBoF population or the landlocked population which inhabits Grand Lake (Halfyard 2008; COSEWIC 2010a).

IBoF salmon spawn in those rivers of Nova Scotia and New Brunswick that drain into the Minas Basin and Chignecto Bay (COSEWIC 2010a). Although IBoF Atlantic salmon have been recorded in 32 rivers in recent years, the population is estimated to have declined by 94% in the past decade (DFO 2008). However, the species is still known to be present in both the Shubenacadie and Stewiacke rivers (DFO 2008; Atlantic Salmon Federation 2012)

The recovery strategy for the species includes a live gene-banking program which has been developed to prevent the imminent extinction of the species (DFO 2010b), and several key populations are maintained in DFO Biodiversity Centres in New Brunswick and Nova Scotia. These stocks will be used to restore self-sustaining populations in select Inner Bay of Fundy rivers. The recovery strategy sets a goal of conserving the genetic characteristics of the few remaining anadromous IBoF Atlantic salmon populations to re-establish self-sustaining populations of the species. Nineteen rivers are identified as being critical to the success of this strategy, including the Shubenacadie and Stewiacke rivers (DFO 2010b).

The majority of field identified watercourses on the Project site are seasonal or ephemeral streams characterized by gravelly, silty substrate, intermittent surface flow, and do not provide suitable spawning or rearing habitat for Atlantic salmon. However, the watercourses may be used during feeding, migration, and other life stages, and therefore Atlantic salmon may be present at the Project

site. The on-site watercourses drain into the Shubenacadie River, which then drains to the Minas Basin. It is possible, therefore, that Atlantic salmon may be encountered at the Study area.

Potential effects of the Project on this species, as well as proposed mitigation measures, are discussed in more detail in Section 13.2.1.

Atlantic Sturgeon

Little is known about the habitat requirements for Atlantic sturgeon at the northern extent of its range, though important freshwater habitats for the species appear to be rivers with access to the sea, preferably with deep channels. Research suggests that the species spawns in freshwater over hard-bottom substrates at depths of 1-3 m in areas of strong currents, under waterfalls, and in deep pools just above the marine-freshwater demarcation (COSEWIC 2011). Juveniles remain in freshwater for the first summer before migrating to estuaries in winter. Juveniles remain in the freshwater-estuary system for 3 to 5 years before migrating to the near-shore marine environment as adults (NOAA 2006).

Occurring in rivers and estuaries near North Atlantic shore environments, the Atlantic sturgeon has been reported in the Annapolis, Avon, Shubenacadie, St. Croix, and LaHave River systems, as well as the Minas Basin (Colligan *et al.* 1998; COSEWIC 2011). In Canada, the species is known to spawn only in two areas, the St. John River and middle St. Lawrence. Historically, the St. Croix River in New Brunswick was also a known spawning area, although the current status of this population is unknown.

Although the watercourses within the Study area drain into the Shubenacadie River, they are not conducive to the spawning habitat requirements of Atlantic sturgeon, therefore it is unlikely that they would be found within the Study area.

The Project is therefore not expected to have any impact on Atlantic sturgeon and no further consideration of effects and mitigation specific to this species has been undertaken.

Striped Bass

The striped bass is an anadromous species typically associated with estuaries and coastal waters, which spawns and over-winters in fresh and occasionally brackish water.

In Nova Scotia, the Annapolis River and the Shubenacadie–Stewiacke River system in the Bay of Fundy historically supported spawning populations (Rulifson and Dadswell 1995, as cited in COSEWIC 2004). Today, the species is known to spawn only in two river systems in eastern Canada: the Miramichi and the Shubenacadie-Stewiacke systems. Catches have been recorded throughout the province, including in the Annapolis River, River Phillip, Grand Lake, and the Minas Basin.

The Shubenacadie River population ascends the river to over-winter in Grand Lake, then returns downstream to spawn in the Stewiacke River (a tributary of the Shubenacadie). Spawning occurs in

the portion of the river affected by a tidal bore (COSEWIC 2004). Due to the close proximity to known striped bass habitat, striped bass cannot be ruled out at the Study area.

Potential effects of the Project on this species, as well as proposed mitigation measures, are discussed in more detail in Section 13.2.1.

8.4 Terrestrial Habitats

The Study area is situated within the Central Lowlands Ecodistrict, part of the Valley and Central Lowlands Ecoregion (Neily et al. 2003). Fine textured soils restrict drainage in much of the ecodistrict, leading to the formation of large, peat-based wetlands. In such poorly drained areas, softwood stands dominate the forest. Upland hardwoods such as yellow birch (*Betula alleghaniensis*), sugar maple (*Acer saccharum*), and American beech (*Fagus grandifolia*) occur on well-drained hills. Much of the area has been utilized for agricultural operations as well as silviculture, resulting in disturbance to native forest species composition and the introduction of invasive species. Minimally disturbed areas, particularly those in well drained slopes, can support mature and even old growth sugar maple and hemlock (*Tsuga canadensis*) stands.

Habitat mapping (NSDNR 2014b) suggests that the vast majority of the Study area is forested, with softwood and mixed wood stands being the dominant habitat features (Table 8.5; Drawing 8.5A).

Table 8.4: Habitat Types within the Study Area

Habitat Type	Area (ha)	Percent Cover
Softwood	101.2	41.9%
Mixed wood	48.6	20.1%
Hardwood	33.8	14.0%
Treed Bog	18.5	7.7%
Windthrow	13.8	5.7%
Clear-cut	11.3	4.7%
Alders	7.9	3.3%
General Wetland	6.4	2.6%
Plantation	0.04	0.02%
Total	**241.5**	**100%**

Source: NSDNR 2014b

A habitat cover map was developed based on field observations in combination with aerial imagery, and the forest inventory database (8.5B). Based on 8.5B, land surrounding the infrastructure predominantly consists of clear cut, regenerating softwood stand, mixedwood forest, and mature hardwood forest.

Intact forest stands at the Study area are varied in their composition and successional stage. Mixedwood stands consist of red maple (*Acer rubrum*), red spruce (*Picea rubrum*), balsam fir (*Abies balsamea*), and white birch (*Betula papyrifera*). Tolerant hardwood stands consist largely of sugar

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WTG 3

WTG 1

WTG 2

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Indian Brook
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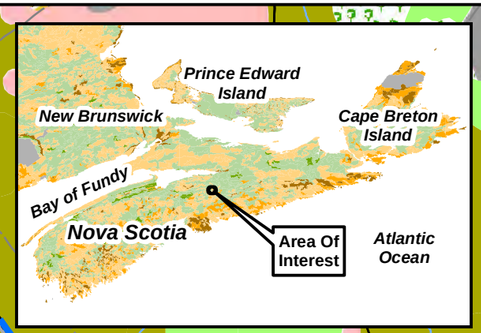
Robinson Rd

0 100 200 300 400 500
Metres



Notes:

1. Reference: Digital Topographic Mapping & Property Management Unit MU0904 by Nova Scotia Geomatics Centre. Forestry Inventory by Nova Scotia Department of Natural Resources (NS DNR).
2. Projection: NAD83(CSRS), UTM Zone 20 North.

Legend:

- Proposed Turbine
- Proposed Access Road
- Study Area
- Project Site Boundary
- Property Boundary
- Native Reserve
- Public Roads
- Access Roads / Trails
- Mapped Stream
- Mapped Indefinite Stream

Forested Land (Type)

- Softwood
- Mixedwood
- Hardwood

Non-Forested Land (Type)

- Wind Throw
- Plantation
- Alders <75% Cover
- Alders >75% Cover
- Clear Cut
- Partial Depletion (Verified)
- Partial Depletion (Unverified)
- General Wetlands
- Treed Bogs
- Water Body
- Barren
- Urban and Miscellanious

Hardwood Lands Community Wind Project - Habitat Cover: Desktop Review

Strum CONSULTING

Date: August 2015	Project #: 14-5169
Scale: 1:10,000	Drawing #: **8.5A**
Drawn By: H. Serhan	
Checked By: M. Henley	

maple (*Acer saccharum*) with yellow birch (*Betula alleghaniensis*) and hay-scented fern (*Dennstaedtia punctilobula*). Softwood forests are largely dense regenerating balsam fir with underlying clear cut slash, and some areas of mature softwood stands consisting of balsam fir and red spruce.

Wetlands present at the site are mostly swamps consisting of mountain holly (*Ilex mucronatum*) and occasionally speckled alder (*Alnus incana*) and Canada holly (*Ilex verticillata*), growing under a canopy of black spruce (Picea mariana) and red maple. Wetlands also occur in clear cut areas where vegetation has been disturbed by forestry activities. These wetlands are often covered by a dense layer of opportunistic herbs such as woolgrass (*Scirpus cyperinus*), fringed sedge (*Carex crinita*), and soft rush (*Juncus effusus*).

It is expected that an area of approximately 1 ha will be disturbed around each turbine location. Two of the proposed turbines (turbines 1 and 2) are located within previously cutover areas, one of which is dominated by regenerating softwood (turbine 1), whereas habitat within turbine 3 disturbance footprint consists of intermixed mature hardwood and regenerating softwood. Excluding turbines located in cutovers and regenerating softwood, the additional disturbance area associated with turbine 3 (mature hardwood) and turbine 1 (mature softwood) represents approximately 1.05% of the Study area.

8.4.1 Wetlands

A desktop identification of the location and extent of potential wetlands across the Study area was completed by reviewing the following information sources:

- Satellite and aerial photography;
- Nova Scotia Wet Areas Mapping database (WAM) (NSDNR 2012a);
- Nova Scotia Geomatics Centre; and
- NS Significant Species and Habitats database (NSDNR 2014a).

The NS Significant Species and Habitat Database identifies four areas of wetland habitat within the Study area boundaries (Drawing 8.3). A 59.4 ha treed bog or fen lies in the northern portion of the Study area, approximately 156 m north of turbine 1. The northeastern boundary of a 6.7 ha tall shrub swamp is situated along the northwestern boundary of the Study area, approximately 350 m northwest of turbine 1. A 0.8 ha low shrub marsh and 1.7 ha tall shrub swamp are situated at the eastern extent of the site, approximately 260 m east of turbine 2 and 1 km southeast of turbine 3, respectively.

WAM indicates the potential for wetland habitat and/or watercourses in several areas throughout the Study area. However, the proposed turbine locations are in areas with low potential for wetland habitat and/or watercourses. Satellite imagery does not indicate any open areas that may represent open bog, marsh, or fen type wetlands in areas near the proposed turbine locations. Potential wet areas are mapped crossing the proposed access road in four locations. Two wet areas extending from the mapped stream in the northeastern portion of the site cross the proposed access road,

approximately 400 m and 500 m south of turbine 3. Two additional wet areas are mapped in association with the mapped stream extending through the southern Study area boundary, crossing the proposed access road, approximately 170 m and 300 m west of turbine 2.

As part of the planning process, wetland field assessments were completed during 2014 and 2015 in land adjacent to the Project footprint, to determine suitable infrastructure placement locations. Multiple areas of wetland habitat were identified during the assessment (Drawing 8.4). The majority of the wetlands identified exist as linear throughflow former treed swamps, currently located within clear cut areas. There are also some intact treed swamp habitats. Water flow is generally sourced from the NS Significant Species and Habitat Database identified treed bog/fen in northern portions of the Study area, and outflow via the linear wetland network to the east and south. One wetland located to the south of turbine 1 acts as a collector of run-off from surrounding higher land, and drains to a robust riparian wetland habitat to the south of turbine 2. The wetlands which drain east all culminate in small ephemeral watercourses which act as an outflow of water connecting to the mapped watercourse in the eastern third of the Study area.

Generally conditions within the treed swamps and former treed swamps (currently clear cut) are very consistent. Surface conditions throughout all wetland areas are saturated, however ground disturbance within clear cut areas has precipitated standing, and on occasion, draining water within tire ruts and at the roots of felled trees. Wetland soils are dominated by organic histosol's throughout, although some areas of clear cut wetland exhibit thin organic soils upon depleted mineral soils. No areas of ponded or open water exist.

Clear cut wetlands are dominated by wool grass, spikerush *(Eleocharis spp),* wild lily of the valley *(Maianthemum canadense)* and small balsam fir seedling herbs. Regenerating shrubs and saplings typically consist of balsam fir, grey birch, and red maple. The treed swamp habitat is dominated at all locations with cinnamon fern *(Osmunda cinnamomea)*, three-seeded sedge *(Carex trisperma)*, bunchberry *(Cornus canadensis)*, balsam fir seedlings and starflower *(Coptis trifolia)* herbs. Often in dense congregations, mountain holly, speckled alder and balsam fir dominate the shrub stratum, although red maple and grey birch also intermix. Black spruce, balsam fir, and red maple dominate the treed community.

No wetland alterations will be required in association with turbine pad locations, and turbines have been setback a minimum of 100 m from the tip of turbine blade, to the closest area of wetland habitat. Based on the current layout, it is expected that two minor wetland alterations will be required. One location is associated with an upgrade and/or modification to the existing access road in western portions of the Study area, and the second is the intersection of a narrow portion of clear cut wetland by the proposed access road in southern portions. Detailed design will determine the exact impacts to individual wetlands along the road which are expected to be very limited. Where alterations are required, hydrological function and connectivity of all wetlands will be maintained.

A provincial wetland alteration permit will be sought for the alteration location as required by the Nova Scotia Wetland Alteration Application process. This will be completed during the permitting

stage of the Project and will include a characterization of wetland function affected by the development footprint. Detailed mitigation measures and BMPs to reduce adverse effects on the altered wetland, as well as the adjacent, non-altered wetlands will be outlined as part of this process. Compensation for direct impacts to the wetland will be provided in accordance with NSE requirements.

8.5 Terrestrial Vegetation

ACCDC records indicate that 285 vascular and 48 nonvascular plant species have been identified within 100 km of the Study area (ACCDC 2015). Of the 333 species identified by ACCDC, 282 vascular and 48 nonvascular plant SOCI were identified within 100 km of the Study area. This preliminary list was used to develop a short list of plant SOCI that might be present at the Study area. The short list of plant SOCI is provided as Table D1 in Appendix D.

A plant survey was completed in July 2015 within the Study area, with emphasis on areas that are expected to be disturbed as part of construction activities. No vascular plant SOCI were observed in the clearing area during the plant surveys.

A complete list of plant species identified during the survey is provided as Table D2 in Appendix D.

8.5.1 Boreal Felt Lichen

Boreal Felt Lichen (BFL) is an epiphytic cyanolichen that only exists in Nova Scotia, Newfoundland, and Scandinavia and has been designated as "Endangered" under the *Nova Scotia Endangered Species Act* (*1998*, *c.11, s. 1*, amended *2010, c. 2, s. 99*) since 2003 due to its scarcity in the province and the multitude of threats to its habitat (*e.g*., forestry, development, and air pollution). BFL grows predominantly on mature, balsam fir trees located within 25 km of the Atlantic coast and occurs in proximity to peat-based wetland habitat (MTRI n.d.). These narrow habitat requirements have led to the development of a Geographic Information System (GIS) model of predicted BFL habitat in the province (Cameron and Neily 2008).

Although once known from just a handful of locations in Nova Scotia (COSEWIC 2002), targeted surveys completed in locations identified by the GIS model have identified multiple additional locations within the province (Cameron and Neily 2008).

A desktop review of the predicted BFL habitat GIS layer revealed no predicted BFL habitat existing within the Study area. The closest area of predicted habitat is located over 9 km to the southeast of the Study area boundary.

Site observations made during the 2015 plant survey by a qualified lichen specialist confirmed that suitable BFL habitat does not exist within the Study area, nor was it observed within the Project footprint.

General mitigation measures for Project-related effects to terrestrial vegetation are provided in Section 4.

8.6 Terrestrial Fauna

Information regarding terrestrial fauna for the Study area, including any SOCI, was obtained through a combination of desktop review and field studies.

The desktop component included a review of the NS Significant Species and Habitat Database (NSDNR 2014a) and ACCDC data (ACCDC 2015) for species recorded within a 100 km radius of the Study area. A comparison of habitat mapping data to known habitat requirements for species expected to occur within the area, and for all SOCI, was also completed.

8.6.1 Mammals

The Nova Scotia Significant Species and Habitat Database (NSDNR 2014a) contains 44 unique species and/or habitat records pertaining to terrestrial mammals within a 100 km radius of the Study area. These records include:

- Thirty-nine records that are classified as "Deer Wintering", which relate to known over-wintering habitat for White-tailed deer (*Odocoileus virginianus*);
- Two records classified as "Species of Concern", which relate to Fisher (*Martes pennanti*) and Long-tailed Shrew (*Sorex dispar*);
- Two records classified in the database as "Other Habitat", relating to American Beaver (*Castor canadensis*) and American Black Bear (*Ursus americanus*); and
- One record classified as 'Species of Risk", relating to Southern flying squirrel (*Glaucomys volans*).

There are no records relating to significant terrestrial mammal habitat within 10 km of the Study area.

The ACCDC database (2015) indicates that five species of terrestrial mammals have been recorded within a 100 km radius of the Study area (Table 8.5).

Table 8.5: Mammal Species Recorded within a 100 km radius of the Study Area

Common Name	Scientific Name	*SARA* Status[1]	NS *ESA* Status[2]	COSEWIC Status[3]	NSDNR Status[4]	NS S-Rank[5]
Cougar - Eastern pop.	*Puma concolor*	Not Listed	Not Listed	Not Listed	5	SH
Fisher	*Martes pennanti*	Not Listed	Not Listed	Not Listed	3	S2
Long-tailed shrew	*Sorex dispar*	Not Listed	Not Listed	Not Listed	3	S1
Moose-Mainland NS pop.	*Alces alces*	Not Listed	Endangered	Not Listed	1	S1
Southern flying squirrel	*Glaucomys volans*	Not Listed	Not Listed	Not at Risk	3	S2S3

Source: ACCDC 2015

[1]Government of Canada 2012; [2]NS ESA 2013; [3]COSEWIC 2012a; [4]NSDNR 2010; [5]ACCDC 2015

Of note is that sightings of many of the most common species are unreported to ACCDC, and are therefore under-represented or absent from the database. Consequently, a review of the ACCDC data reveals predominantly rare or noteworthy species despite the fact that these species certainly represent a small fraction of the existing mammal community in any area.

Field surveys (between September 2014 and July 2015) of mammalian fauna at the Study area consisted of direct observations of individuals, as well as the indirect identification of species by sound and/or sign (e.g., scat, tracks, scent, dens, lodges).

Two pellet group surveys and one snow-tracking survey, targeting Mainland moose, but also encompassing all other wildlife species, were conducted in December 2014, January 2015, and May 2015. A detailed methodology for snow-tracking and pellet group surveys is provided in Appendix E.

Table 8.6 lists the mammal species observed/identified at or near the Study area during all field surveys.

Table 8.6: Mammal Species Observed/Identified during Field Surveys

Common Name	Scientific Name	*SARA* Status[1]	NS *ESA* Status[2]	COSEWIC Status[3]	NSDNR Status[4]	NS S-Rank[5]
American Black bear	*Ursus americanus*	Not Listed	Not Listed	Not Listed	4	S5
American porcupine	*Erethizon dorsatum*	Not Listed	Not Listed	Not Listed	4	S5
Bobcat	*Lynx rufus*	Not Listed	Not Listed	Not Listed	4	S5
Coyote	*Canis latrans*	Not Listed	Not Listed	Not Listed	4	S5
Mouse sp.	*N/A*	N/A	N/A	N/A	N/A	N/A
Red Fox	*Vulpes vulpes*	Not Listed	Not Listed	Not Listed	4	S5
Red squirrel	*Tamiasciurus hudsonicus*	Not Listed	Not Listed	Not Listed	4	S5
Shrew sp.	N/A	N/A	N/A	N/A	N/A	N/A
Snowshoe hare	*Lepus americanus*	Not Listed	Not Listed	Not Listed	4	S5
White-footed Deermouse	*Peromyscus leucopus*	Not Listed	Not Listed	Not Listed	4	S5
White-tailed deer	*Odocoileus virginianus*	Not Listed	Not Listed	Not Listed	4	S5
Woodland Jumping Mouse	*Napaeozapus insignis*	Not Listed	Not Listed	Not Listed	4	S5

[1]Government of Canada 2012; [2]NS ESA 2013; [3]COSEWIC 2012a; [4]NSDNR 2010; [5]ACCDC 2015

Priority mammal species include:

- Cougar (Eastern pop.) – “5 - Undetermined” (NSDNR);
- Fisher – “S3” (NSDNR), “S2” (ACCDC);

- Long-tailed shrew – "3 - Sensitive" (NSDNR), "S1" (ACCDC);
- Mainland moose – "Endangered" (NS *ESA*), "S1 – At Risk" (NSDNR), "S1" (ACCDC); and
- Southern flying squirrel – "Special Concern" (*SARA*), "3 - Sensitive" (NSDNR), "S2S3" (ACCDC).

Cougar

Cougars are also known as mountain lions and used to be found from the Yukon to Chile and east to Nova Scotia. The cougar still occurs regularly in British Columbia and the Rocky Mountains of Alberta, though populations have been greatly reduced or even extirpated from central and eastern Canada. A variety of forested habitats are used by this solitary, nocturnal hunter, which feeds mostly on large mammals, including deer, moose, porcupine, beaver, snowshoe hare, mice, and birds.

The cougar is not considered threatened in Canada; however the population of the eastern subspecies (*Felis concolor couguar*) is listed separately as a species-at-risk (NSDNR 2013c). Sightings of eastern cougars are reported on occasion in Nova Scotia, but there has been no tangible evidence to confirm their presence in recent years. All reported sightings are recorded and investigated by wildlife agencies. ACCDC records, meanwhile, indicate that the closest observation of this species to the Study area was 4.1 ± 1 km away. It is considered unlikely that there is a breeding population of eastern cougar in the province. Due to the very low probability of the Project interacting with eastern cougar, no further consideration of effects and mitigation for this species has been undertaken.

Fisher

Fisher prefer dense, mature to old-growth forests with continuous overhead cover (Allen 1983). Generally considered a forest-interior species (OMNR 2000), Fisher require in large tracts of well-connected habitat (Meyer 2007).

Fisher are distributed throughout mainland Nova Scotia, and trapping data suggests population concentrations in Cumberland, Colchester, and Pictou counties (NSDNR 2012b). Approximately 4% of 1,754 Fisher trapped in Nova Scotia between 2000 and 2011 were harvested from Halifax and Hants Counties (NSDNR 2012b). ACCDC data indicate that the closest observation of this species to the Study area was 88.9 ± 5 km away.

Suitable habitat for fisher is present at the Study area in the form of mature forest stands, although stand size is likely a limiting factor preventing permanent territory establishment.

It is therefore unlikely that the Project will impact this species. No further consideration of effects and mitigation for this species has been undertaken.

Long-tailed Shrew

Long-tailed shrew are closely associated with steep, talus slopes, usually close to running water, and the presence of rocks is considered a principal habitat component (Kirkland 1981).

Thought to be found only in the Cobequid Mountains (Scott 1987; Woolaver *et al*. 1998), more recent research has identified an additional population of Long-tailed Shrew near Wolfville at Stewart Mountain, approximately 63 km to the southwest of the Study area (Shafer and Stewart 2006). ACCDC data indicate that the closest observation of Long-tailed shrew to the Study area was 46.1 ± 5 km away.

No indication of Long-tailed shrew was observed during field studies. Suitable habitat in the form of slopes of sufficient grade (≥25%) are not present on the site, therefore it is unlikely that the Project will impact this species. No further consideration of effects and mitigation for this species has been undertaken.

Mainland Moose

Habitat requirements for Mainland moose change throughout the year. Early successional growth, such as that provided by regenerating cutovers, offers quality foraging habitat for moose, and interspersed wetlands provide suitable summer habitat for cows and calves (Parker 2003; Snaith & Beazley 2004). Mature softwood forest is used as escape cover throughout the year, and also provides thermal relief during the summer months (Broders *et al*. 2012) and relief from deep snows in winter (Telfer 1970).

Five significant concentration areas for Mainland moose have been identified in Nova Scotia (NSDNR 2012c). The Study area is located 30 km to the southwest of the closest such area, which encompasses the Cobequid Hills in Cumberland and Colchester Counties. ACCDC records, meanwhile, indicate that the closest observation of this species to the Study area was 54.4 km away.

No evidence of Mainland moose was observed at the Study area, including during pellet group surveys and targeted snow-tracking surveys conducted in December 2014, January 2015, and May 2015. The Study area does consist of key habitat features to support the year-round needs of Mainland moose, namely aquatic sites (wetlands), small areas of softwood forest and extensive foraging habitat (clear cuts). The Study area forms part of a diversified landscape which may support this species, it is therefore possible that Mainland moose occur at the Study area.

Potential effects of the Project on this species, as well as proposed species-specific mitigation measures, are discussed in more detail in Section 13.2.1.

Southern Flying Squirrel

Southern flying squirrel requires mast bearing trees for forage and tree cavities for nesting and in the Atlantic Region, southern flying squirrels select older forest stands (COSEWIC 2006). In Nova Scotia, the species demonstrates a particular affinity to red oak (*Quercus rubra*) which is most commonly found in mixed wood stands as opposed to pure hardwood stands (Lavers 2004).

In Nova Scotia, Southern flying squirrel occur primarily in a region bounded by the South Mountain in the north, Kentville in the east, New Ross in Lunenburg County to the south, and extends to

Kejiimkujik National Park in the west (COSEWIC 2006). ACCDC data indicate that the closest observation of this species to the Study area was 64.3 ± 10 km away.

No indication of Southern flying squirrel was observed during field studies, although the species' nocturnal habits mean it is unlikely to be identified in the absence of targeted surveys. One area of mature hardwood exists in northern portions of the Study area, however, field surveys completed confirm that red oak and other mast bearing trees such as American beech (*Fagus grandifolia*) are very infrequent, and at best a minor component of the stands at the Study area. Given that suitable habitat is scarce, it is unlikely that Southern flying squirrel occurs at the Study area.

The Project is therefore not expected to have any impact on Southern flying squirrel and no further consideration of effects and mitigation for this species has been undertaken

8.6.2 Herpetofauna

The Nova Scotia Significant Species and Habitat Database (NSDNR 2014a) contains 26 unique species and/or habitat records pertaining to reptiles and amphibians within a 100 km radius of the Study area. These records include:

- Twenty-four that are classified in the database as "Species at Risk", all of which relate to the Wood turtle (*Glyptemys insculpta*);
- One record classified as "Species of Concern", which relates to the Painted turtle (*Chrysemys picta*); and
- One record classified as "Other Habitat", which also relates to the Wood turtle.

There are twenty records pertaining to Wood Turtle within a 10 km radius of the Study area. All records are classified as "Species at Risk", with eighteen along Nine Mile River, and two along the Shubenacadie River (Table 8.7).

Table 8.7: Wood Turtle Habitats Recorded within a 10 km Radius of the Study Area

Habitat Location	Habitat Size (ha)	Distance and Orientation from Study Area
Nine Mile River	0.071	9.6 km SW
	0.753	4.6 km SW
	0.224	9.6 km SW
	1.532	5.9 km SW
	0.257	6.0 km SW
	2.006	6.3 km SW
	0.107	6.0 km SW
	0.349	5.3 km SW
	0.877	7.5 km SW
	0.1	7.7 km SW
	0.153	7.6 km SW
	0.25	7.4 km SW

Habitat Location	Habitat Size (ha)	Distance and Orientation from Study Area
	0.201	8 km SW
	0.153	7.8 km SW
	0.789	8.3 km SW
	0.582	5.4 km SW
	2.079	9.6 km SW
	350.104	0.3 km SW
Shubenacadie River	5.39	9.6 km SE
	465.42	8.6 km SE

Source: NSDNR 2014a

The ACCDC database identifies three terrestrial herpetofauna species within a 100 km radius of the Study area (Table 8.8).

Table 8.8: Reptile and Amphibian Species Recorded within a 100 km Radius of the Study Area

Common Name	Scientific Name	*SARA* Status[1]	NS *ESA* Status[2]	COSEWIC Status[3]	NSDNR Status[4]	NS S-Rank[5]
Common snapping turtle	*Chelydra serpentina*	Special Concern	Vulnerable	Special Concern	4	S3
Four-toed Salamander	*Hemidactylium scutatum*	Not Listed	Not Listed	Not at Risk	4	S3
Wood turtle	*Clemmys insculpta*	Threatened	Threatened	Threatened	3	S2

Source: ACCDC 2015

[1]Government of Canada 2012; [2]NS ESA 2013; [3]COSEWIC 2012a; [4]NSDNR 2010; [5]ACCDC 2015

The same data limitations and interpretations as noted for the mammalian fauna (Section 8.6.1) are also applicable to the reptile and amphibian data.

Studies of the amphibian and reptile community at the Study area were conducted in conjunction with other field surveys between September 2014 and July 2015. Species were either identified directly through visual observation, or indirectly using other evidence (e.g., calls, egg masses, tadpoles, etc.). Table 8.9 lists the amphibian and reptile species identified at or near the Study area during field studies.

Table 8.9: Herpetofauna Species Recorded During Field Surveys

Common Name	Scientific Name	*SARA* Status[1]	NS *ESA* Status[2]	COSEWIC Status[3]	NSDNR Status[4]	NS S-Rank[5]
Common Gartersnake	*Thamnophis sirtalis*	Not Listed	Not Listed	Not Listed	4	S5

[1]Government of Canada 2012; [2]NS ESA 2013; [3]COSEWIC 2012a; [4]NSDNR 2010; [5]ACCDC 2015

Priority herpetofauna species include:

- Common snapping turtle – "Special Concern" (*SARA*), "Vulnerable" (NS *ESA*), "Special Concern" (COSEWIC); "S3" (ACCDC);
- Four-toed salamander – "S3" (ACCDC); and
- Wood turtle – "Threatened" (*SARA*), "Threatened" (NS *ESA*), "Threatened" (COSEWIC), "3 - Sensitive" (NSDNR), "S2" (ACCDC).

None of the priority species listed above were observed during field surveys.

Common Snapping Turtle
Common snapping turtle, despite its conservation status, is considered relatively common in mainland Nova Scotia (Davis and Browne 1996). Common snapping turtle habitat is usually associated with slow moving water of moderate depth, with a muddy bottom and dense vegetation. Established populations are typically found in ponds, lakes, and river edges (COSEWIC 2008).

The species has a widespread distribution across Nova Scotia, including the central mainland region within which the Study area is located (COSEWIC 2008). ACCDC records indicate that the closest observation of this species to the Study area was 7 ± 5 km away.

No indication of Common snapping turtle was observed during field studies. While the mapped watercourses to the southern and eastern portions of the Study area (Drawing 8.3 and 8.4) present potential Common snapping turtle habitat, watercourses that intersect Project infrastructure (e.g. access roads) at the Study area are relatively small, are of an ephemeral nature, and of shallow depth. It is therefore unlikely that Common snapping turtle will be impacted by Project activities.

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

No indication of four-toed salamander was observed during field studies. Multiple areas of treed and shrub swamp wetland habitat exists within the Study area, in addition to one sphagnum bog (as defined by the NS Significant Species and Habitat Database) located in the corner of northeastern portions of the Study area (Drawing 8.3). The sphagnum bog will be unaffected by Project infrastructure, therefore, it is unlikely that four-toed salamander will be impacted by Project activities

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

The species is found throughout the province but seems to be most abundant in central Nova Scotia, including the Salmon River and Shubenacadie River watersheds (MacGregor and Elderkin 2003). ACCDC data indicate that the closest observation of this species to the Study area was 6.2 ± 1 km away.

No indication of Wood turtle was observed during field studies. However, suitable watercourse and associated riparian habitat is present at the Study area to support Wood turtles throughout the annual cycle (Drawing 8.4). Given that the species is concentrated in central Nova Scotia, and that suitable habitat is present, it is likely that individual Wood turtle home ranges include part of the Study area.

Potential effects of the Project on this species, as well as proposed species-specific mitigation measures, are discussed in more detail in Section 13.2.1.

8.6.3 Butterflies and *Odonates*

The Nova Scotia Significant Species and Habitats (NSDNR 2014a) database identifies five significant habitat features relating to butterflies and *Odonates* within a 100 km radius of the Study area. These records include:

- Three records classified as 'Species of Concern', relating to Jutta arctic (*Oeneis jutta*) (2) and Little bluet (*Enallagma minusculum*);
- One record classified as "Species at Risk", relating to Ebony boghaunter (*Williamsonia fletcheri*); and
- One record classified as 'Other Habitat' pertaining to Hoary elfin (*Callophrys polios*).

The database contains no records of butterflies or *Odonates* within a 10 km radius of the Study area.

The ACCDC database contains records of 62 unique taxa of butterfly and *Odonates* within a 100 km radius of the Study area (Table 8.10).

Table 8.10: Unique Butterfly and *Odonate* Species Recorded within a 100 km radius of the Study Area

Common Name	Scientific Name	*SARA* Status[1]	NS *ESA* Status[2]	COSEWIC Status[3]	NSDNR Status[4]	NS S-Rank[5]
Acadian Hairstreak	*Satyrium acadica*	Not Listed	Not Listed	Not Listed	5	S1
Aphrodite Fritillary	*Speyeria Aphrodite*	Not Listed	Not Listed	Not Listed	4	S3S4
Arctic Fritillary	*Boloria chariclea*	Not Listed	Not Listed	Not Listed	3	S2
Baltimore Checkerspot	*Euphydryas phaeton*	Not Listed	Not Listed	Not Listed	4	S3
Banded Hairstreak	*Satyrium calanus*	Not Listed	Not Listed	Not Listed	5	S2

Common Name	Scientific Name	*SARA* Status[1]	NS *ESA* Status[2]	COSEWIC Status[3]	NSDNR Status[4]	NS S-Rank[5]
Bog Elfin	*Callophrys lanoraieensis*	Not Listed	Not Listed	Not Listed	2	S1S2
Broadtailed Shadowdragon	*Neurocordulia michaeli*	Not Listed	Not Listed	Not Listed	Not Listed	S1
Bronze Copper	*Lycaena hyllus*	Not Listed	Not Listed	Not Listed	4	S1
Brook Snaketail	*Ophiogomphus asperses*	Not Listed	Not Listed	Not Listed	2	S1
Clamp-Tipped Emerald	*Somatochlora tenebrosa*	Not Listed	Not Listed	Not Listed	4	S3
Common Branded Skipper	*Hesperia comma*	Not Listed	Not Listed	Not Listed	4	S3
Common Roadside-Skipper	*Amblyscirtes vialis*	Not Listed	Not Listed	Not Listed	4	S2
Compton Tortoiseshell	*Nymphalis l-album*	Not Listed	Not Listed	Not Listed	4	S1S2
Delicate Emerald	*Somatochlora franklini*	Not Listed	Not Listed	Not Listed	3	S1
Eastern Comma	*Polygonia comma*	Not Listed	Not Listed	Not Listed	Not Listed	S2
Eastern Pine Elfin	*Callophrys niphon*	Not Listed	Not Listed	Not Listed	4	S2
Eastern Red Damsel	*Amphiagrion saucium*	Not Listed	Not Listed	Not Listed	4	S3
Ebony Boghaunter	*Williamsonia fletcheri*	Not Listed	Not Listed	Not Listed	2	S1
Elfin Skimmer	*Nannothemis bella*	Not Listed	Not Listed	Not Listed	4	S3
Forcipate Emerald	*Somatochlora forcipata*	Not Listed	Not Listed	Not Listed	2	S2
Great Spangled Fritillary	*Speyeria cybele*	Not Listed	Not Listed	Not Listed	4	S3S4
Green Comma	*Polygonia faunus*	Not Listed	Not Listed	Not Listed	4	S3
Greenish Blue	*Plebejus saepiolus*	Not Listed	Not Listed	Not Listed	Not Listed	S1
Grey Comma	*Polygonia progne*	Not Listed	Not Listed	Not Listed	4	S3S4
Grey Hairstreak	*Strymon melinus*	Not Listed	Not Listed	Not Listed	4	S2
Harlequin Darner	*Gomphaeschna furcillata*	Not Listed	Not Listed	Not Listed	3	S3
Harpoon Clubtail	*Gomphus descriptus*	Not Listed	Not Listed	Not Listed	3	S2

Common Name	Scientific Name	*SARA* Status[1]	NS *ESA* Status[2]	COSEWIC Status[3]	NSDNR Status[4]	NS S-Rank[5]
Harvester	*Feniseca tarquinius*	Not Listed	Not Listed	Not Listed	4	S3S4
Henry's Elfin	*Callophrys henrici*	Not Listed	Not Listed	Not Listed	4	S2
Hoary Comma	*Polygonia gracilis*	Not Listed	Not Listed	Not Listed	3	S1
Hoary Elfin	*Callophrys polios*	Not Listed	Not Listed	Not Listed	4	S3S4
Jutta Arctic	*Oeneis jutta*	Not Listed	Not Listed	Not Listed	2	S1
Juvenal's Duskywing	*Erynnis juvenalis*	Not Listed	Not Listed	Not Listed	4	S2S3
Kennedy's Emerald	*Somatochlora kennedyi*	Not Listed	Not Listed	Not Listed	2	S1S2
Lance-Tipped Darner	*Aeshna constricta*	Not Listed	Not Listed	Not Listed	4	S3
Little Wood-satyr	*Megisto cymela*	Not Listed	Not Listed	Not Listed	4	S3S4
Maine Snaketail	*Ophiogomphus mainensis*	Not Listed	Not Listed	Not Listed	2	S1
Milbert's Tortoiseshell	*Aglais milberti*	Not Listed	Not Listed	Not Listed	4	S2
Monarch	*Danaus plexippus*	Special Concern	Not Listed	Special Concern	3	S2B
Mottled Darner	*Aeshna clepsydra*	Not Listed	Not Listed	Not Listed	4	S3
Mustard White	*Pieris oleracea*	Not Listed	Not Listed	Not Listed	3	S2
Northern Cloudywing	*Thorybes pylades*	Not Listed	Not Listed	Not Listed	3	S2
Northern Pearly-Eye	*Lethe anthedon*	Not Listed	Not Listed	Not Listed	4	S3
Northern Pygmy Clubtail	*Lanthus parvulus*	Not Listed	Not Listed	Not Listed	4	S3
Ocellated Darner	*Boyeria grafiana*	Not Listed	Not Listed	Not Listed	3	S3
Orange Bluet	*Enallagma signatum*	Not Listed	Not Listed	Not Listed	2	S1
Pepper and Salt Skipper	*Amblyscirtes hegon*	Not Listed	Not Listed	Not Listed	4	S2
Prince Baskettail	*Epitheca princeps*	Not Listed	Not Listed	Not Listed	3	S2
Quebec Emerald	*Somatochlora brevicincta*	Not Listed	Not Listed	Not Listed	2	S1
Question Mark	*Polygonia interrogationis*	Not Listed	Not Listed	Not Listed	4	S3B
Riffle Snaketail	*Ophiogomphus carolus*	Not Listed	Not Listed	Not Listed	4	S3

Common Name	Scientific Name	*SARA* Status[1]	NS *ESA* Status[2]	COSEWIC Status[3]	NSDNR Status[4]	NS S-Rank[5]
Rusty Snaketail	*Ophiogomphus rupinsulensis*	Not Listed	Not Listed	Not Listed	2	S1S2
Salt Marsh Copper	*Lycaena dospassosi*	Not Listed	Not Listed	Not Listed	Not Listed	S2
Satyr Comma	*Polygonia satyrus*	Not Listed	Not Listed	Not Listed	3	S1
Seaside Dragonlet	*Erythrodiplax Berenice*	Not Listed	Not Listed	Not Listed	3	S3
Skillet Clubtail	*Gomphus ventricosus*	Not Listed	Not Listed	Endangered	2	S1
Spot-Winged Glider	*Pantala hymenaea*	Not Listed	Not Listed	Not Listed	3	S2B
Striped Hairstreak	*Satyrium liparops*	Not Listed	Not Listed	Not Listed	5	S3
Taiga Bluet	*Coenagrion resolutum*	Not Listed	Not Listed	Not Listed	2	S1
Zebra Clubtail	*Stylurus scudderi*	Not Listed	Not Listed	Not Listed	2	S1S2

Source: ACCDC 2015

[1]Government of Canada 2012; [2]NS ESA 2013; [3]COSEWIC 2012a; [4]NSDNR 2010; [5]ACCDC 2015

No observations of butterfly and Odonate species were made during field surveys.

All butterfly and *Odonate* species listed in Table 8.10 are considered priority species, however due to the large number of records; only those which are legally protected under *SARA* and NS*ESA* are further discussed.

Monarch

Only the Monarch has been granted a designated conservation status at either the provincial or federal level. This species 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 2010b), and individuals can be found throughout the province from May to October (Maritime Butterfly Atlas 2012). ACCDC records indicate that the closest observation of this species to the Study area was 9.1 ± 7 km away

No indication of Monarch was observed during field surveys. Open habitat at the Study area is prevalent, particularly in cutovers areas and along roadsides (Drawing 8.5A and 8.5B). Considering the widespread distribution of the species in Atlantic Canada, it is possible that Monarch occurs at the Study area, particularly during the migratory period (late summer/early fall). However, it is

N

Blois Rd

Atlantic Star Forestry Ltd.
PID 45366630

PID 45271939
Everett & Marilyn Clarke

PID 45188810
Atlantic Star Forestry Ltd.

Atlantic Star Forestry Ltd.
PID 45366648

WTG 3

WTG 1

WTG 2

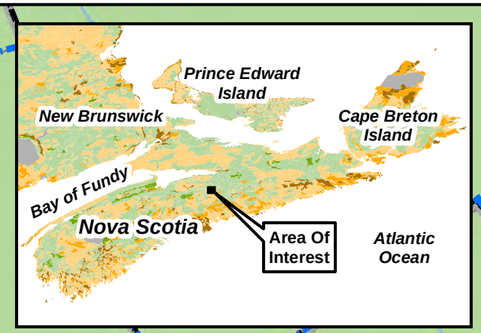
PID 45101128
Elmsdale Lumber Co. Ltd.

PID 45119344
Atlantic Star Forestry Ltd.

PID 45289675
Brian Leahy

PID 45271939
Everett & Marilyn Clarke

Indian Brook
Native Reserve 14



0 100 200 300 400 500 Metres

Notes:

1. Reference: Digital Topographic Mapping & Property Management Unit MU0904 by Nova Scotia Geomatics Centre. Habitat Cover is based on Google & Bing Satellite Imagery Dated 2014.
2. Projection: NAD83(CSRS), UTM Zone 20 North.

Legend:

- Proposed Turbine
- Proposed Access Road
- Project Site Boundary
- Property Boundary
- Study Area
- 100m Turbine Buffer
- Native Reserve
- Public Roads
- Access Roads / Trails
- Mapped Stream
- Mapped Indefinite Stream

Habitat Cover

- Clear Cut
- Mature Hardwood Forest
- Mixedwood Forest
- Regen Softwood Stand
- Softwood Forest

Hardwood Lands Community Wind Project - Habitat Cover: Field Observations

Strum 20 YEARS Taking Charge CONSULTING

Date: August 2015	Project #: 14-5169
Scale: 1:7,000	Drawing #: **8.5B**
Drawn By: H. Serhan	
Checked By: A. Walter	