June, 2011

NEXTERA ENERGY CANADA, ULC SUMMERHAVEN WIND ENERGY CENTRE APPLICATION FOR A RENEWABLE ENERGY APPROVAL

Wind Turbine Specifications Report

Submitted to:
Director, Ministry of Environment
2 St. Clair West, Floor 12A
Toronto, Ontario
M4V 1L5

REPORT

Report Number: 10-1151-0035

Distribution:

Ministry of Environment - 3 copies
NextEra Energy Canada, ULC - 3 copies
Air Energy TCI Inc. - 2 copies
Golder Associates Ltd. - 2 copies

Table of Contents

1.0 INTRODUCTION

This Wind Turbine Specifications Report (the Report) has been prepared to provide information to the public, Aboriginal communities, municipalities and local authorities regarding the proposed Summerhaven Wind Energy Centre (the Project). The Report is a required component of an Application for a Renewable Energy Approval (REA Application) under Ontario Regulation (O. Reg.) 359/09[1] made under the *Environmental Protection Act* (EPA).

This Report has been prepared in accordance with O. Reg. 359/09. Table 1 summarizes information to be included in the Report based on Table 1 of O. Reg. 359/09 and directs readers to the associated section(s) of this document.

Table 1: Wind Turbine Specifications Report requirements under O. Reg. 359/09

Requirement as per O. Reg. 359/09	Report section where information can be found
Make and model	Section 2, Table 2
Name plate capacity	Section 2, Table 2
Hub height above grade	Section 2, Table 2
Rotational speeds	Section 2, Table 2
Acoustic emission data (including sound power level and frequency spectrum, in terms of octave-band sound power levels)	Section 2.1, Appendix A

Additional information about the Project can be found in the Construction Plan Report (Golder, 2011a), Design and Operations Report (Golder, 2011b), Decommissioning Plan Report (Golder, 2011c), and Project Description Report (Golder, 2011d). A description of the Site Plan design is provided in the Design and Operations Report. As it is broadly applicable to all of the REA Reports, and to avoid redundancy, the Site Plan diagram has been provided as a stand-alone document (the Site Plan Report).

Technical studies associated with the REA Application requirements were initiated in 2007 and extended into 2010. Additional information about the Project and results of technical studies and assessments of negative environmental effects are available in the following reports:

- Wind Turbine Specifications Report (this Report);
- Natural Heritage Assessment Report (Golder, 2011e);
- Stage 1 Archaeological Assessment Report (Golder, 2010a);
- Heritage Assessment Report (Golder, 2011j);
- Noise Study Report (Golder, 2011f);
- Water Assessment Report (Golder, 2011g);
- Site Plan Report (Golder, 2011h); and

[1] As amended by O. Reg. 521/10 which came into force on January 1, 2011.

- Consultation Report (Golder, 2011i)

Stage 2, Stage 3 and Stage 4 Archaeological Assessment Reports are not required as part of the REA Application for this Project (Ministry of Energy and Infrastructure, 2010) and are typically not publically available documents due to the confidential nature of the content. Stage 2, Stage 3 and Stage 4 Archaeological Assessment Reports will however be made available to the Ministry of Tourism and Culture (MTC) for review and their issuance of a Comment Letter in advance of construction and hard copies of this information will be provided to Aboriginal communities with an interest in the Project, as identified by the Director, and as agreed to by individual Aboriginal communities.

1.1 Project Summary

The Project consists of the site preparation, construction, operation, and decommissioning of 59 turbine wind generating facility with a total installed nameplate capacity of 131.04 MW. The Project will be owned and operated by NextEra Energy Canada, ULC (NextEra Energy Canada) and will be located in the vicinity of Nanticoke, Haldimand County, Ontario (Figure 1, end of Report). The Project lifespan from obtaining the REA Approval to the end of Decommissioning is estimated to be 27 years.

Turbine towers will be constructed on a concrete foundation. Underground and overhead cables will interconnect individual turbines and eventually connect to the substation (see Site Plan Report). The operation of the wind turbines will be monitored remotely from a Project operations building located near the substation. Once tested and commissioned, the turbines will require scheduled visits for maintenance during the Operations Phase. Maintenance will include complete inspection of the turbines' components and the tower, functionality testing, replacement of worn parts, bolt tightening and lubrication of moving parts. Routine preventative maintenance activities will be completed as per manufacturer requirements.

The Project Area (Figure 1) encompasses approximately 22,583 ha of privately owned land parcels. Land use is predominantly cash-crop agriculture (i.e., farming for corn, soybeans, wheat), although some areas are pasture (predominantly for cattle) and several wooded areas are present. Selkirk Provincial Park and Haldimand Conservation Area are located along the shore of Lake Erie south of the Project Area. The Grand River runs northeast of the Project Area and an Imperial Oil refinery is directly southwest.

The location of the Project was predicated by interest expressed by local landowners. Haldimand County is also attractive for wind development due to its proximity to Lake Erie, which results in favourable wind conditions for power production.

2.0 TECHNICAL SPECIFICATIONS

The Project will consist of 59 wind turbines. To generate the nameplate capacity of 131.04 MW, the Project will utilize a combination of two wind turbine models, which include the Siemens SWT-2.221-101 Low Noise wind turbine (Section 2.1) and the Siemens SWT-2.221-93 Low Noise wind turbine (Section 2.2).

2.1 Siemens SWT-2.221-101 Low Noise Wind Turbine

The Siemens SWT-2.221-101 Low Noise wind turbine is especially suited to areas with low to medium wind speeds and offers support for grid connections in all major markets. A summary of the technical specifications for this wind turbine is presented in Table 2 with additional information provided by the manufacturer in Section 2.1.2.

Table 2: Summary of Technical Specifications for the Siemens SWT-2.221-101 Low Noise Wind Turbine

Specification	Turbine
Make and model	Siemens SWT-2.221-101 Low Noise
Nominal power	2.221 MW
Hub height (above grade)	80 m
Rotor diameter	101 m
Number of blades	3-bladed, horizontal axis
Blade length	49 m
Swept area	8,000 m^2
Cut-in wind speed	4 m/s
Cut-out wind speed	25 m/s
Rated wind speed	12-13 m/s

Source: Modified from Siemens, 2010c

As shown on Plate 1, the Siemens SWT-2.221-101 Low Noise wind turbine is made up of four main components: the foundation, tower, nacelle (i.e., hub, or generator housing) and blades. The nacelle will be mounted on an 80 m high tubular steel tower fitted with internal personnel hoists and lifts. A prefabricated power module is located at the bottom of the tower and provides the platform for the power converter, the turbine transformer and the medium-voltage switchgear (Siemens, 2010a).

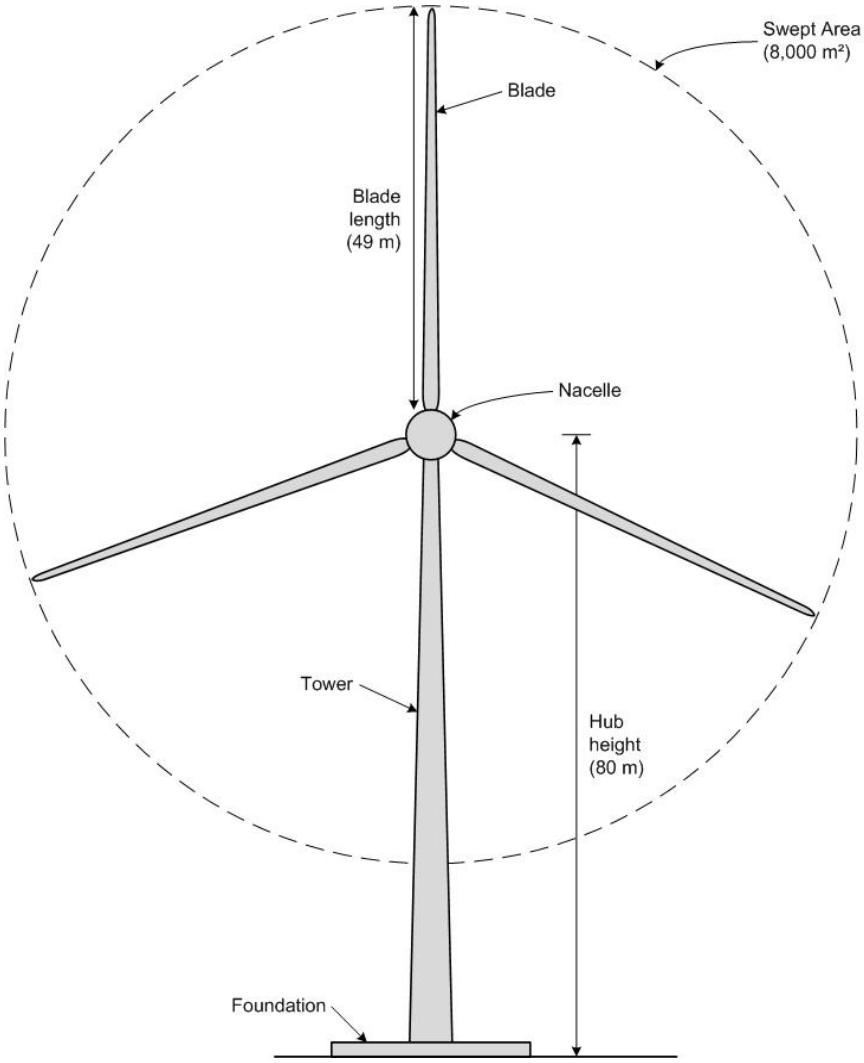
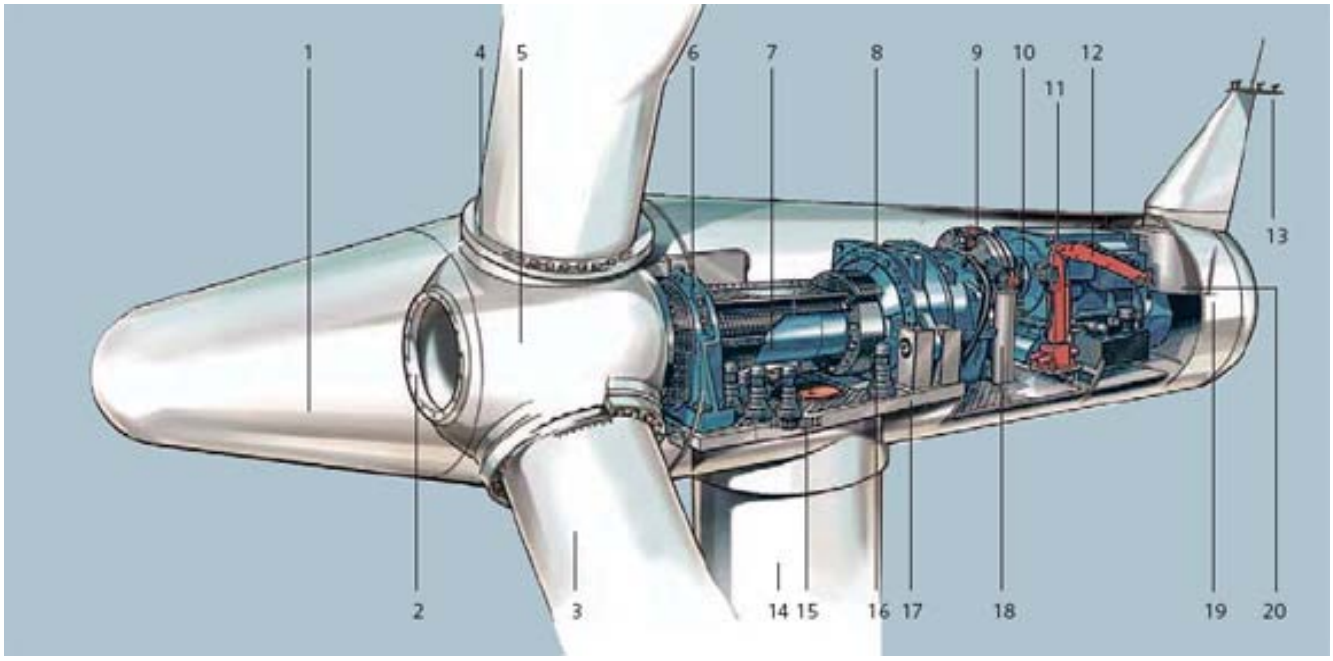


Plate 1: Basic Wind Turbine Specifications

Three 50 m rotor blades made of fibreglass-reinforced epoxy are mounted to the rotor hub (Siemens, 2010a). The Siemens SWT-2.221-101 Low Noise wind turbine will generate electricity between the wind speeds of 4 m/s (i.e., the cut-in wind speed) and 25 m/s (i.e., the cut-out wind speed) and will reach its nameplate capacity of 2.221 MW when wind speeds reach approximately 12 m/s (Siemens, 2009).

As shown on Plate 2, most of the equipment used to convert wind energy into electricity is contained in the nacelle of the turbine, which will also act as a sound enclosure to reduce noise emissions. The rotor is specifically designed to optimize the energy returns under various wind conditions. In order to maximize production of electricity, the wind turbine is designed to automatically rotate (yaw) into the wind and adjust the pitch of the blades. In low and medium wind speeds, the blade pitch setting is slowly adjusted to provide maximum power output at any given wind speed. When the rated wind speed is reached, the pitch angle is adjusted to maintain the power level. Limitation of the power output in high winds is necessary on all wind turbines in order to prevent the generator from overloading.



1 Spinner	6 Main bearing	11 Generator	16 Yaw gear
2 Spinner bracket	7 Main shaft	12 Service crane	17 Nacelle bedplate
3 Blade	8 Gearbox	13 Meteorological sensors	18 Oil filter
4 Pitch bearing	9 Brake disc	14 Tower	19 Canopy
5 Rotor hub	10 Coupling	15 Yaw ring	20 Generator fan

Plate 2: Nacelle Arrangement (Siemens, 2009)

The nacelle includes major components such as the main shaft and bearing, gearbox, brake disc and generator. The nacelle is climate controlled and is constructed from steel and fibreglass to protect against the elements (e.g., lightning). The wind turbine is equipped with lightning protection to protect from the effects of direct and nearby strikes. The overall design basis refers to the international standard IEC 61400-24 Lightning Protection Level I, and includes (Siemens, 2010b):

- Protection of the blades with a dedicated lightning termination pad system. A flexible down conductor located inside the blade provides a dedicated conductor path to the main shaft;
- Protection of the main shaft by a 5-mm steel plate, acting as a Faraday cage for the nacelle. The meteorological instruments are protected by a separate lightning protection system. All main components are effectively grounded;
- Protection of the turbine controller by surge protection devices installed with mechanical overload protection; and
- Conduction from the nacelle to the earth via the tower and heavy bounding of the foundation.

2.1.1 Acoustic Emissions Data

The operation of the wind turbines will generate noise. The SWT-2.221-101 Low Noise wind turbine has a maximum overall sound power rating of 105.0 dBA. Additional information on the acoustic data, including typical octave band spectra are included in Appendix A. As this information is considered confidential (proprietary knowledge), this Appendix is provided under separate cover to MOE.

2.1.2 Manufacturer Technical Data

The manufacturer's technical specifications for the SWT-2.221-101 Low Noise wind turbine are summarized in Table 3.

Table 3: Technical Specifications for the Siemens SWT-2.221-101 Low Noise Wind Turbine

Component	Element	Specification
Rotor	Type	3-bladed, horizontal
	Position	Upwind
	Diameter	101 m
	Swept area	8,000 m²
	Rotor speed	6-16 rpm
	Power regulation	Pitch regulation
	Rotor tilt	6 degrees
Blades	Type	Self-supporting
	Length	49 m
	Root chord	3.40 m
	Aerodynamic profile	NACA 63.xxx, FFAxxx, SWPxxx
	Material	GRE
	Surface gloss	Semi-matt, <30 / ISO2813
	Surface colour	Light grey, RAL 7035
Aerodynamic brake	Type	Full-span pitching
	Activation	Active, hydraulic
Load supporting parts	Hub	Nodular cast iron
	Main bearings	Spherical roller bearing
	Transmission shaft	Alloy steel
	Nacelle bedplate	Steel
Transmission system	Coupling hub – shaft	Flange
	Coupling shaft – gearbox	Shrink disc
	Gearbox type	3-stage planetary-helical
	Gearbox ratio	1:91
	Gearbox lubrication	Splash / forced lubrication
	Gearbox oil filtering	Inline and offline
	Oil volume	Approximately 400 L
	Gearbox cooling	Separate oil cooler

Component	Element	Specification
	Gearbox designation	PEAB 4456 or EH851
	Gearbox manufacturer	Winergy AG or Hansen Transmissions
	Coupling gear – generator	Double flexible coupling
Mechanical brake	Type	Hydraulic disc brake
	Position	High-speed shaft
	Number of callipers	2
Generator	Type	Asynchronous
	Nominal power	2,221 kW
	Synchronous speed	1,500 rpm
	Voltage	690 V
	Frequency	60 Hz
	Protection	IP54
	Cooling	Integrated heat exchanger
	Insulation class	F
	Generator designation	AMA 500L4 BAYH
Canopy	Type	Totally enclosed
	Material	Steel
Yaw system	Type	Active
	Yaw bearing	Externally geared slew ring
	Yaw drive	Eight electrical gear motors with frequency converter
	Yaw brake	Passive friction brake
Controller	Type	Microprocessor
	SCADA system	WPS via modem
	Controller designation	KK WTC 3.0
Tower	Type	Cylindrical and/or tapered tubular steel tower
	Hub height	80 m or site-specific
	Corrosion protection	Painted
	Surface gloss	Semi-gloss 80-50 ISO 2813
	Surface colour	Light grey, RAL 7035
Operational data	Cut-in wind speed	4 m/s
	Nominal power	12-13 m/s
	Cut-out wind speed	25 m/s
	Maximum 2 s gust	55 m/s (standard version) 59.5 m/s (IEC version)
Weights	Rotor	62 tons
	Nacelle excl. rotor	82 tons
	Tower (80 m)	162 tons

Source: Modified from Siemens 2010c

2.2 Siemens SWT-2.221-93 Low Noise Wind Turbine

The Siemens SWT-2.221-93 Low Noise wind turbine (nominal power 2.221 MW) is especially suited to areas with moderate average wind speeds and includes a generator that is designed for high efficiency at partial loads (Siemens, 2010d). The majority of the Siemens SWT-2.221-93 Low Noise wind turbine technical specifications are the same as the SWT-2.221-101 Low Noise wind turbine, however a summary of the technical specifications that are different for the Siemens SWT-2.221-93 Low Noise wind turbine are provided in Table 4 below.

Table 4: Siemens SWT-2.221-93 Low Noise Wind Turbine Technical Specifications

Component	Element	Specification
Rotor	Diameter	93 m
	Swept area	6,800 m²
Blades	Length	45 m
	Tip Chord	0.8 m
	Root chord	3.50 m
	Aerodynamic profile	NACA 63.xxx, FFAxxx
Transmission system	Gearbox designation	PEAB 4456
	Gearbox manufacturer	Winergy AG
Yaw system	Yaw drive	Eight electrical gear motors
Operational data	Nominal power	13-14 m/s
	Maximum 2 s gust	55 m/s (standard version) 59.5 m/s (special version)
Weights	Rotor	60 tons

Source: Modified from Siemens, 2010d

2.2.1 Acoustic Emissions Data

The Siemens SWT-2.221-93 Low Noise turbine has a maximum overall sound power rating of 104.4 dBA. Additional information on the acoustic data, including typical octave band spectra are included in Appendix A. As this information is considered confidential (proprietary knowledge), this Appendix is provided under separate cover to MOE.

3.0 REFERENCES

Golder Associates Ltd. 2010a. Stage 1 Archaeological Assessment Report. Prepared for: Ministry of Tourism and Culture and Ministry of the Environment.

Golder Associates Ltd. 2011a. Construction Plan Report. Prepared for: Ministry of the Environment.

Golder Associates Ltd. 2011b. Design and Operations Report. Prepared for: Ministry of the Environment.

Golder Associates Ltd. 2011c. Decommissioning Plan Report. Prepared for: Ministry of the Environment.

Golder Associates Ltd. 2011d. Project Description Report. Prepared for: Ministry of the Environment.

Golder Associates Ltd. 2011e. Natural Heritage Assessment Report. Prepared for: Ministry of Natural Resources and Ministry of the Environment.

Golder Associates Ltd. 2011f. Noise Study Report. Prepared for: Ministry of the Environment.

Golder Associates Ltd. 2011g. Water Assessment Report. Prepared for: Ministry of the Environment.

Golder Associates Ltd. 2011h. Site Plan Report. Prepared for: Ministry of the Environment.

Golder Associates Ltd. 2011i. Consultation Report. Prepared for: Ministry of the Environment.

Golder Associates Ltd. 2011j. Heritage Assessment Report. Prepared for: Ministry of Tourism and Culture and Ministry of the Environment.

Haldimand County. 2006. Official Plan. URL: http://www.haldimandcounty.on.ca/uploadedFiles/Our_County/About_Haldimand_County/Countys_Official_Plan/Official%20Plan.pdf. Accessed July 2010.

Ministry of Energy and Infrastructure. 2010. Letter to Justin W. Rangooni, Ontario Policy Manager & Legal Counsel, CanWEA. Exemption from having completed the Stage 2 Archaeology Assessment prior to submission of the REA Application. June 14, 2010.

Siemens. 2009. The new standard for moderate wind conditions, Siemens Wind Turbine SWT-2.3-101. Siemens AG Energy Sector. URL: http://www.energy.siemens.com/hq/pool/hq/power-generation/wind-power/E50001-W310-A121-X-4A00_WS_SWT-2.3-101_US_1009.pdf. Published 2009. Erlangen, Germany.

Siemens. 2010a. Success on solid ground, Reliable performance and innovation in onshore wind power. Siemens AG Energy Sector. URL: http://www.energy.siemens.com/hq/pool/hq/power-generation/wind-power/E50001-W310-A152-X-4A00_WS_Wind%20Onshore_US.pdf. Published 2010. Erlangen, Germany.

Siemens. 2010b. Wind Turbines - Siemens. Product SWT-2-3-101. URL: http://www.energy.siemens.com/hq/en/power-generation/renewables/wind-power/wind-turbines/. Accessed: September 2010.

Siemens. 2010c. SWT-2-3-101 – Siemens. URL: http://www.energy.siemens.com/hq/en/power-generation/renewables/wind-power/wind-turbines/swt-2-3-101.htm. Accessed: September 2010.

Siemens. 2010d. SWT-2-3-93 – Siemens. URL: http://www.energy.siemens.com/hq/en/power-generation/renewables/wind-power/wind-turbines/swt-2-3-93.htm. Accessed: September 2010.

Report Signature Page

GOLDER ASSOCIATES LTD.

Jeff Wright, R.P. Bio., A.Sc.T.
Project Manager

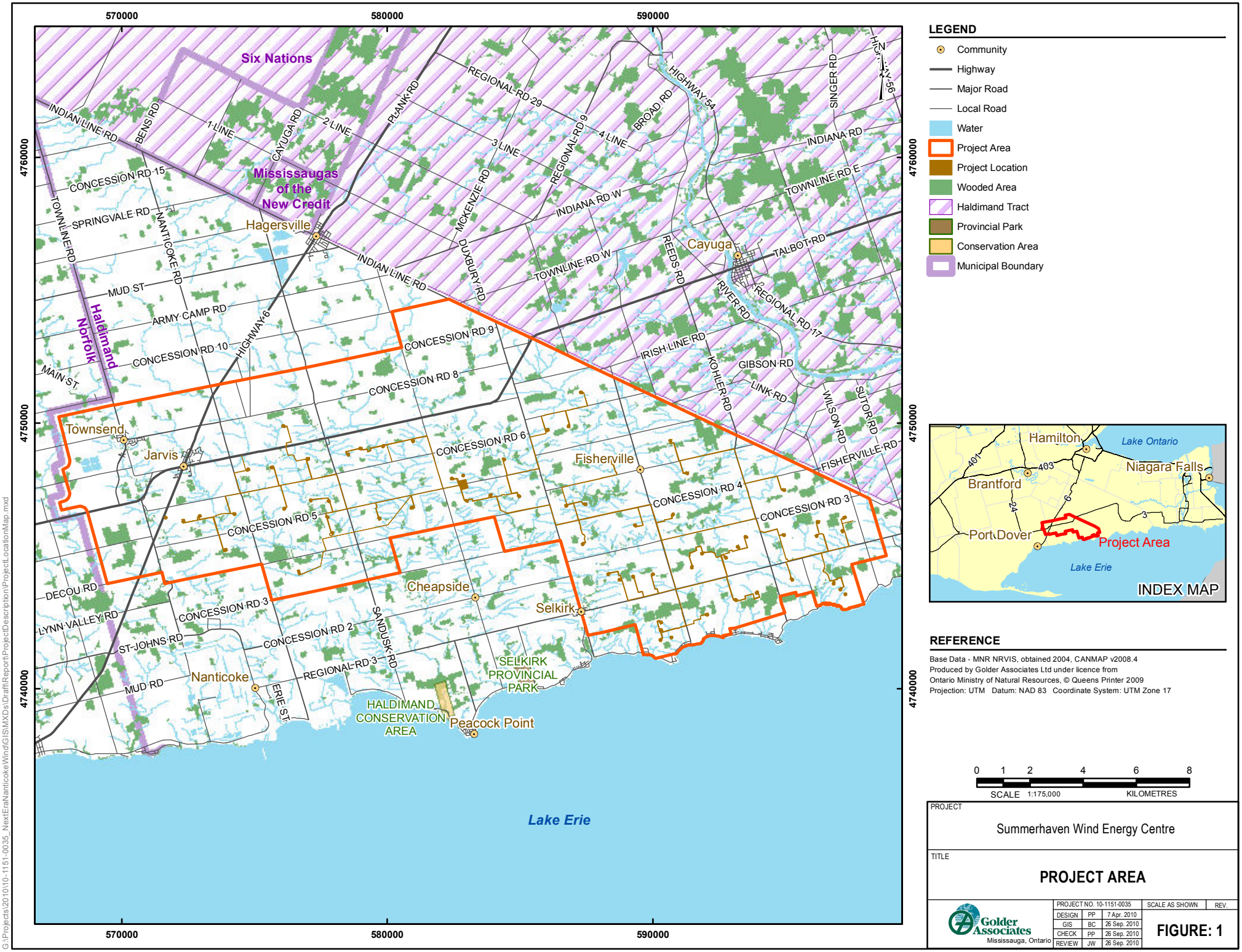
Anthony Ciccone, Ph.D., P.Eng.
Project Director

JR/JW/am

\\mis1-s-filesrv1\data\active\2010\1151\10-1151-0035 nextera - wind farm rea - nanticoke\4 - working rea reports\5 - wind turbine specs report\version 3\2011-06-02 wind turbine specifications report.docx

FIGURE 1

Project Area



LEGEND

- Community
- Highway
- Major Road
- Local Road
- Water
- Project Area
- Project Location
- Wooded Area
- Haldimand Tract
- Provincial Park
- Conservation Area
- Municipal Boundary

REFERENCE

Base Data - MNR NRVIS, obtained 2004, CANMAP v2008.4
Produced by Golder Associates Ltd under licence from
Ontario Ministry of Natural Resources, © Queens Printer 2009
Projection: UTM Datum: NAD 83 Coordinate System: UTM Zone 17

0 1 2 4 6 8
SCALE 1:175,000 KILOMETRES

PROJECT
Summerhaven Wind Energy Centre

TITLE
PROJECT AREA

Golder Associates
Mississauga, Ontario

PROJECT NO. 10-1151-0035			SCALE AS SHOWN	REV.
DESIGN	PP	7 Apr. 2010		
GIS	BC	26 Sep. 2010		
CHECK	PP	26 Sep. 2010		
REVIEW	JW	26 Sep. 2010		

FIGURE: 1

G:\Projects\2010\10-1151-0035_NextEraNanticoke\WindGIS\MXDs\DraftReport\ProjectDescription\ProjectLocationMap.mxd

APPENDIX A

Acoustic Emission Data

SWT-2.221-101 Low Noise, Hub Height 80 m Acoustic Emission

Sound Power Levels
The warranted sound power levels are presented with reference to the code IEC 61400-11:2002 with amendment 1 dated 2006-05 based on a hub height of 80 m and a roughness length of 2.133 m as described in the IEC code. The sound power levels (Lwa) presented are valid for the corresponding wind speeds referenced to a height of 10 m above ground level.

Wind speed [m/s]	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Up to cut-out**
Sound Power Level	105.0	105.0	105.0	105.0	105.0	105.0	105.0	105.0	105.0	105.0

Table 1: Noise emission, Lwa [dB(A) re 1 pW]

Typical Octave Band
Typical, not warranted octave band spectra are tabulated below for 6 and 8 m/s referenced to 10 m height.

Octave band, centre frequency [Hz]	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
Sound Power Level	82.6	93.8	97.0	99.5	99.6	97.1	89.3	84.9

Table 2: Typical octave band for 6 m/s

Octave band, centre frequency [Hz]	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
Sound Power Level	82.4	93.0	96.0	99.8	100.1	96.5	89.6	85.7

Table 3: Typical octave band for 8 m/s

SWT-2.221-93 Low Noise, Hub Height 80 m Acoustic Emission

Sound Power Levels

The warranted sound power levels are presented with reference to the code IEC 61400-11:2002 with amendment 1 dated 2006-05 based on a hub height of 80 m and a roughness length of 2.133 m as described in the IEC code. The sound power levels (Lwa) presented are valid for the corresponding wind speeds referenced to a height of 10 m above ground level.

Wind speed [m/s]	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Up to cut-out**
Sound Power Level	103.7	104.4	104.4	104.4	104.4	104.4	104.4	104.4	104.4	104.4

Table 1: Noise emission, Lwa [dB(A) re 1 pW]

Typical Octave Band

Typical, not warranted octave band spectra are tabulated below for 6 and 8 m/s referenced to 10 m height.

Octave band, centre frequency [Hz]	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
Sound Power Level	84.7	95.0	100.6	98.5	94.6	92.8	88.2	81.0

Table 2: Typical octave band for 6 m/s

Octave band, centre frequency [Hz]	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
Sound Power Level	85.5	93.9	99.1	99.2	96.9	93.5	89.0	85.4

Table 3: Typical octave band for 8 m/s

At Golder Associates we strive to be the most respected global group of companies specializing in ground engineering and environmental services. Employee owned since our formation in 1960, we have created a unique culture with pride in ownership, resulting in long-term organizational stability. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees now operating from offices located throughout Africa, Asia, Australasia, Europe, North America and South America.

Africa	+ 27 11 254 4800
Asia	+ 852 2562 3658
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 55 21 3095 9500

solutions@golder.com
www.golder.com

Golder Associates Ltd.
2390 Argentia Road
Mississauga, Ontario, L5N 5Z7
Canada
T: +1 (905) 567 4444

Golder Associates