Noise Impact Assessment

For the

Eigg Mountain Wind Farm Project

Prepared For:

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1.0 Introduction

Renewable Energy Systems (RES) is currently in the process of developing the Eigg Mountain Wind Farm Project. The project will consist of up to 22 wind turbines which will be located in Antigonish County, Nova Scotia, south of the coastal community of Arisaig. The developer is planning to install Nordex N163 6.X 7000 kW turbines which have a hub height of 118 m and a rotor diameter of 163 m.

The following report summarizes the results of sound modeling which will be incorporated into the Nova Scotia Environmental Assessment Registration Document for the project.

2.0 Sound Analysis

2.1 Background

Nortek Resource Solutions Inc. has completed a noise impact assessment for the proposed Eigg Mountain Wind Farm Project. The objective of the analysis was to assess the impact of the the wind turbine sound emissions on surrounding dwellings. Noise modeling is based on sound levels that are adjusted to take into account how humans perceive sound with a lower sensitivity to very low and very high frequencies. The A-weight decibel (dBA) provides a measure of the loudness of sound in human terms.

The Nova Scotia Department of Environment and Climate Change (NSECC) requires that predicted noise levels are not to exceed 40 dBA for permanent and seasonal residential receptors which include homes, daycare facilities, hospitals and schools. The 40 dBA limit also includes a 35 dBA background noise consideration which is included in the modeling.

2.2 Methodology

The sound analysis was completed using WindPro 4.2.285 which provides a comprehensive suite of wind farm design and modeling software. The sound model is based on the *ISO 9613-2 – Attenuation of sound during propagation outdoors, Part 2*. This international standard provides a conservative estimate of sound propagation and subsequent environmental attenuation as a result of ground porosity, atmospheric attenuation and geometric spreading. A conservative modeling approach was utilized for this project by using the General Model with ground attenuation (porosity set at 0.7 to represent a mix of well forested and cleared areas, where 0 is a hard surface (ie. concrete, asphalt, rock, water or ice) and 1 is a soft surface (ie. vegetation, trees or snow). The ISO 9613-2 standard assumes an ambient air temperature of 10^{o} C and 70% relative humidity which are ideal for atmospheric sound transfer. A meteorological coefficient can be assigned to the model to simulate sound damping due to unique meteorological conditions and noise propagation in the upwind direction. To maintain a conservative approach, a meteorological coefficient was not applied for this analysis. Additionally, the modeling assumes that all receptors are downwind of each wind turbine, which

contributes to the conservative nature of the analysis. A wind speed of 8 m/s (at 10 m reference height) was modeled as this represents the highest noise emissions from the various wind turbines.

The Eigg Mountain – James River Wilderness Area is currently consists of 7,600 ha after the last expansion and is dominated with upland forests. The original wilderness area was designated in 2005 and was expanded in 2007, 2015 and 2022. Wilderness areas are provincially-significant protected areas that are designated under Nova Scotia's Wilderness Areas Protection Act. Wilderness areas are used for scientific research, education and recreation. One receptor is located within the wilderness area and was modeled separately due to its unique location. Forest management activities are excluded from wilderness areas and therefor the existing forests within these areas are allowed to develop naturally. This will result in the land within the wilderness area always being covered with some form of natural vegetation, even after a major blow down, insect or wild fire event regardless of the successional stage of the forest. The ISO 9613-2 standard defines porous ground as *ground covered by grass, trees or other vegetation and or all other ground surfaces suitable for the growth of vegetation, such as farming land.* Porous ground is given a ground attenuation of 1. One unique receptor (WR1) is located within the wilderness area and was modeled separately using the ISO recommended ground attenuation of 1 as the receptor is surrounded by soft vegetated ground and will be for the foreseeable future as outlined in the Wilderness Areas Protection Act.

In addition to the proposed 22 turbines, NSECC requires that existing turbines within 3.0 km of the proposed project be included in the sound modeling. Two existing turbines located east of the proposed project (Maryvale Wind project) which were included in the modeling. The Glen Dhu Wind Project is located west of the project and a total of 9 turbines were also included in the analysis. Table 1 summarizes the proposed turbine positions, Table 2 summarizes the location of the existing turbines and Table 3 shows the coordinates of the turbines that are currently under construction. Tables 4 to 7 summarize each of the turbine specifications. The total sound power output at various wind speeds for each turbine model were supplied by their respective manufacturers and shown in Table 8.

Table 1: Eigg Mountain Proposed Turbine Positions

Receptor ID	Easting* (m)	Northing * (m)	Elevation (m)	dBA
A	572,000	5,059,371	124.3	36
B	571,825	5,059,864	119.4	36
C	572,025	5,059,865	116.9	36
D	572,092	5,059,870	116.1	36
E	571,907	5,059,898	118.9	36
F	571,873	5,059,898	119.4	36
G	571,654	5,060,100	135.9	36
H	570,198	5,060,824	193.6	37
I	570,226	5,060,875	198.8	38
J	571,197	5,061,747	145.6	37
K	571,141	5,062,106	190.2	38
L	571,141	5,062,128	191.3	38
M	571,989	5,062,355	111.8	36
N	571,676	5,059,288	148.9	37
O	571,267	5,059,366	202.7	38
P	568,726	5,058,948	258.1	37
Q	569,683	5,059,799	200.1	37
R	569,600	5,059,925	205.0	37
S	569,702	5,060,167	198.2	37
T	571,991	5,062,357	111.8	36
U	571,594	5,059,935	121.0	36
V	571,793	5,059,690	120.7	36
W	571,071	5,061,921	197.2	38
X	570,867	5,061,455	151.9	38
Y	571,289	5,058,160	242.6	37
Z	562,850	5,064,260	154.5	36
AA	565,065	5,065,369	96.8	36
AB	565,302	5,065,388	104.1	36
AC	565,305	5,065,323	101.6	36
AD	565,868	5,065,658	85.8	36
WR1 **	565,936	5,063,334	264.6	40

* UTM, NAD83(CSRS), Zone 20

** Serrated Trailing Edge

Table 2: Existing Turbine Positions (Maryvale).

Id	Model	Easting (m)*	Northing (m)*
1	Vensys 77	572,478	5,064,309
2	Vensys 77	572,749	5,064,258

* UTM, NAD83(CSRS), Zone 20

Table 3: Existing Turbine Positions (Glen Dhu).

Id	Model	Easting (m)*	Northing (m)*
1	E-82	562,130	5,059,751
2	E-82	561,800	5,059,596
3	E-82	561,769	5,059,192
4	E-82	561,362	5,059,386
5	E-82	562,329	5,059,198
6	E-82	561,575	5,058,622
7	E-82	561,867	5,058,457
8	E-82	562,394	5,058,428
9	E-82	562,600	5,058,049

UTM, NAD83(CSRS), Zone 20

Table 4: Proposed Turbine Specifications

Item	Specification
Manufacturer	Nordex
Model	N163/6.X STE*
Hub Height	118 m
Rotor Diameter	163 m
Operation Mode	Level 0
Rated Power Output	7,000 kW

* Serrated Trailing Edge Option

Table 5: Existing Turbine Specifications - Vensys

Item	Specification
Manufacturer	**Vensys**
Model	Vensys 77
Hub Height	85 m
Rotor Diameter	77 m
Operation Mode	Level 0
Rated Power Output	1,500 kW

Table 6: Existing Turbine Specifications - Enercon

Item	Specification
Manufacturer	Enercon
Model	E-82
Hub Height	78 m
Rotor Diameter	82 m
Operation Mode	Level 0
Rated Power Output	2,000 kW

Table 7: Sound Power Levels for the Proposed and Existing Turbines (dBA).

*

Wind Farm	Model	Wind Speed (m/s @ 10 m)							
		6	7	8	9	10	11	12	Up to cut-out
Eigg Mountain	N163 6.X 7000 STE *	106.6	107.4	107.4	107.4	107.4	107.4	107.4	107.4
Maryvale	Vensys 77	100.1	101.6	101.9	101.7	101.2	102.0	102.0	102.0
Glen Dhu	Enercon E-82	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0

Serrated Trailing Edge

The proposed turbines were modeled using the Serrated Trailing Edge (STE) option which refers to modified rotor blades which reduce turbine noise. All of the existing turbines were modeled with regular blades which results in slightly higher sound pressure levels. All turbines were modeled operating at full power or Level 0 which means the turbines are generating power at full capacity and therefore also operating at their highest noise level.

The spatial location of all the buildings located within 2.0 km of the proposed turbines were extracted from the Nova Scotia Topographic database. Recent satellite imagery was manually reviewed and additional potential receptors were identified. Field verification was completed and each of the potential receptors was classified as to whether it was habitable. Potential receptors including former buildings which had been demolished, burned or have fallen down as well as abandoned (non maintained, missing roof shingles, broken windows, animals using the structure for shelter, etc.) and active industrial buildings were classified as non habitable. All non habitable receptors as well as garages and sheds in close proximity to homes were not modeled. Receptors with which the owners have agreements with the project developer were considered participating receptors and were also excluded from the analysis.

A total of 31 receptors were modeled of which 30 were modeled using a ground attenuation of 0.7 (Figure 1). A detailed analysis for one unique receptor (WR1) was completed and the location and modeling results are shown in Figure 2. The individual coordinates, elevation and modeled A-weighted sound pressure levels for each receptor are shown in Table 9.

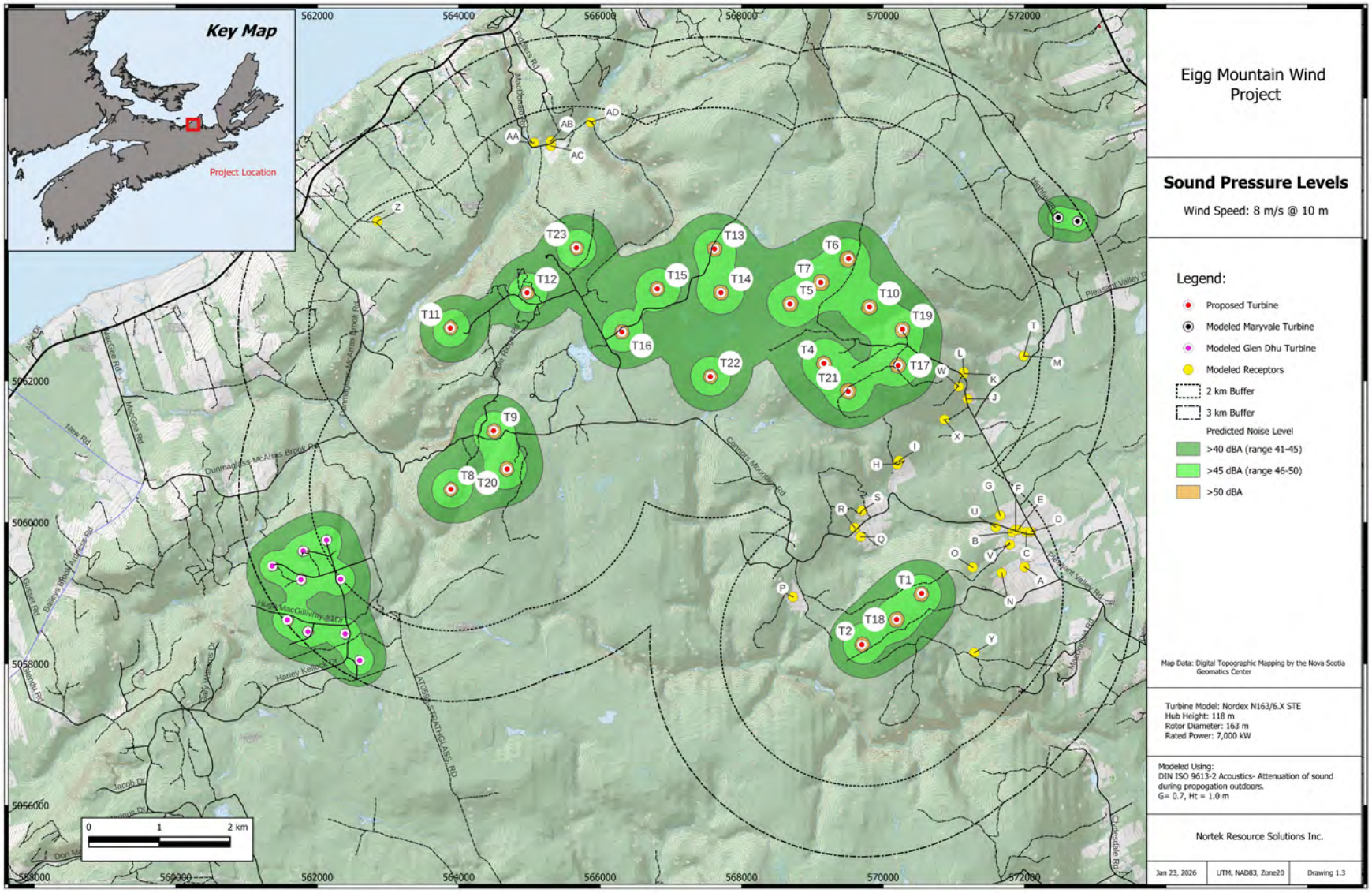

Figure 1: Modeled Sound Pressure Levels for the Proposed Eigg Mountain Wind Farm.

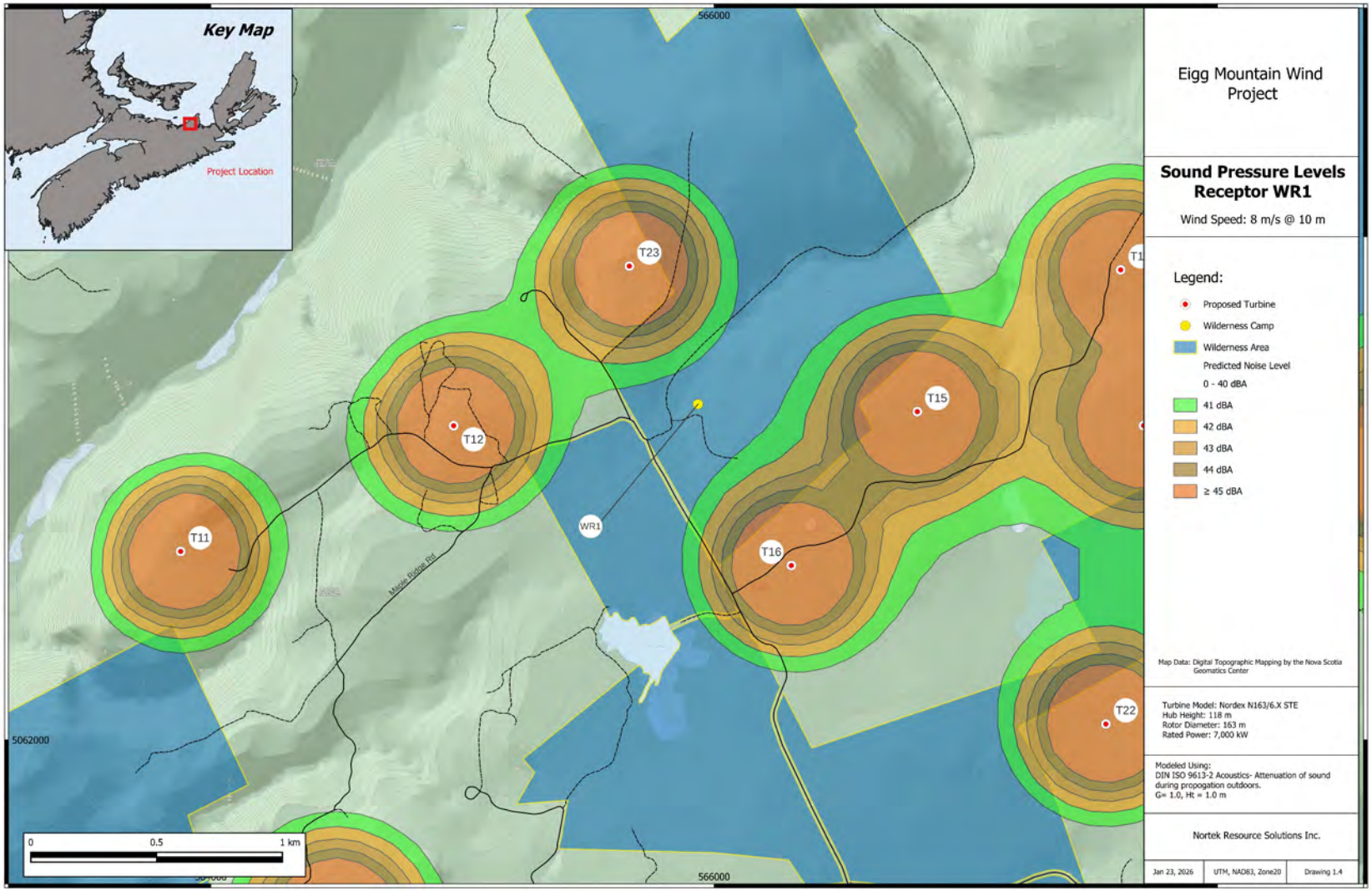

Figure 2: Modeled Sound Pressure Levels for the Unique Receptor WR1.

Table 8: Modeled Receptor Coordinates and Resulting Sound Levels.

Receptor ID	Easting* (m)	Northing * (m)	Elevation (m)	dBA
A	572,000	5,059,371	124.3	36
B	571,825	5,059,864	119.4	37
C	572,025	5,059,865	116.9	36
D	572,092	5,059,870	116.1	36
E	571,907	5,059,898	118.9	36
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AC	565,305	5,065,323	101.6	37
AD	565,868	5,065,658	85.8	36
WR1 **	565,936	5,063,334	264.6	40

* UTM, NAD83(CSRS), Zone 20

*** Unique Receptor*

2.3 Sound Modeling Results

The results of the analysis indicate that predicted sound pressure levels will not exceed 40 dBA for the modeled receptors based on the proposed turbine locations. Figure 1, Figure 2 and Table 8 show that all of the modeled receptors within 2.0 km of the proposed wind farm meet the 40 dBA threshold for sound power levels (including 35.0 dBA background noise). Therefore, no noise mitigation measures are recommended.

3.0 References

International Organization for Standardization (1996). ISO 9613-2: Acoustics –Attenuation of sound during propagation outdoors – Part 2: General method of calculation.

Ontario Ministry of the Environment (2008). Noise guidelines for wind farms. Ontario.

Nova Scotia Department of Environment and Climate Change. Environmental Assessment Supplemental Checklist: Wind Energy Projects, https://novascotia.ca/nse/ea/docs/environmental-assessment-supplemental-checklist-wind-energy-projects-en.pdf

Nova Scotia Topographic Database, https://gis8.nsgc.gov.ns.ca/DataLocatorASP/main.html.

Wilderness Areas Protections Act. SNS 1998, c 27. (Nova Scotia Statutes 1998, Chapter 27).