Appendix XI. NOISE IMPACT ASSESSMENT

GLEN DHU SOUTH WIND FARM

Noise Impact Assessment

SHEAR WIND.

December 2011

GL Garrad Hassan

GL Garrad Hassan

NOISE IMPACT ASSESSMENT FOR THE GLEN DHU SOUTH WIND FARM

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Introduction

GL Garrad Hassan ("GL GH") was retained by Shear Wind Inc. ("Shear Wind" or "Client") to prepare a Noise Impact Assessment (NIA) of the Glen Dhu South Wind Farm ("Project"). Noise levels at Points of Reception are calculated on the basis of the approved methodology, ISO 9613. The Project is located in the county of Pictou, Nova Scotia.

Shear Wind seeks to supply clean energy to Nova Scotia Power Inc. using state-of-the-art wind energy technology. The Glen Dhu South Wind Farm, comprising 62 GE 1.6-100 wind turbines, is being proposed.

The objectives of this assessment are to:

1. Confirm the sound level limit requirements for the Project;

2. Predict the noise levels generated by the Project and adjacent existing projects at all Points of Reception within 1.5 km of the turbines; and

3. Compare the predicted sound level from the Project with the sound level limit.

The NIA also provides information on the noise sources, the prediction method and the parameters used for the assessment.

1 GENERAL DESCRIPTION OF PROJECT SITE

1.1 General Characteristics

The Project is located in the county of Pictou, Nova Scotia, and has a projected nameplate capacity of 100 MW. The layout consists of 62 GE 1.6-100 wind turbine generators (WTG). More specifically, the Project is located approximately in an area 8 km to 20 km south of the Northumberland Straight and some 30 km east of the city of New Glasgow. The land use of the site is predominantly characterized by forested areas. Photographs included in Figure 1-1 show typical views of the land and features of the area under study.

The Project has been configured using wind turbines strategically sited on lands for which the Client holds lease agreements. The turbines are sited on lands that are in forested areas. Electricity generated by the turbines will be fed to an underground and overhead collector system terminating at a substation. The Glen Dhu South site map showing the locations of the substation, wind turbines, Points of Reception and noise isocontours is presented in Appendix A.

The turbines are located on a plateau where the elevation ranges between 190 m and 275 m asl with the average elevation being 230 m asl.

The Client also owns and operates an existing wind farm adjacent to Glen Dhu South. This existing wind farm is called Glen Dhu North, comprises 27 Enercon E82 2.3MW WTGs, and its noise contribution is included in this analysis.

Figure 1-1: Land Features of the Glen Dhu South Wind Farm Site

1.2 Land Use Description

Land use around the Project is rural and mainly consists of farmland and forest. Some recreational activities include hunting, fishing, snowmobiling and driving ATVs on forest roads as well as trails maintained by various recreational associations.

The area directly affected by the Project is located on private land. Access to the Glen Dhu South Project is provided by small unpaved roads that stem from larger municipal roads leading to nearby towns. The network of unpaved roads was developed due to the previously extensive logging activities on-site.

The Project is located in Pictou county, which is the 6th most populated county out of the 18 counties in the province. It has a population of 46,513 as of 2006 [1] and a population density of 16.3 people per km^2. There are 24 dwellings that are found within 1.5 km of a turbine.

1.3 Points of Reception

The Client provided a list of 116 receptor locations (i.e. Points of Reception) for the Project, which were validated on-site by the Client. Of these, 24 are located within 1.5 km of a Glen Dhu South wind turbine and were considered in this analysis.

The height of these validated dwellings was set to 1.5 m and 4.5 m agl for 1-storey and 2-storey dwellings respectively.

The coordinates of each Point of Reception are listed in Appendix B. None of these receptors is considered sensitive (e.g. daycares, schools, hospitals, senior’s centres) per Health Canada's criteria. [2]

2 APPLICABLE NOISE LIMITS

Nova Scotia Environment and Labour has established the following noise limits:[3]

Leq <= 65 dBA between 0700 and 1900 hours;

Leq <= 60 dBA between 1900 and 2300 hours; and

Leq <= 55 dBA between 2300 and 0700 hours.

It has been verified that no noise limit specific to wind turbines is prescribed by the Nova Scotia Government.

The County of Pictou Land Use Bylaw [4] doesn’t specify any regulation with regards to noise.

Health Canada [2] recommends that technically and economically feasible mitigation measures be applied if the predicted sound level at receptors due to wind turbine operation exceeds 45 dBA, at maximum sound power from the turbine.

This Noise Impact Assessment verifies that the calculated sound pressure level is below 45 dBA for all Points of Reception located in Pictou County.

There are no receptors located in the adjacent county of Antigonish that fall within 1.5 km of a turbine belonging to this Project.

Since specific modeling parameters are not mentioned in the referenced documents, an approach similar to other nearby Canadian jurisdictions has been taken for this analysis. This approach includes using worst case parameters from the Ontario Noise Guidelines and the Quebec ministry of Dévelopement durable, Environnement et Parcs (MDDEP) noise guidelines as inputs into the Glen Dhu South analysis. These parameters are discussed in the subsequent sections of this report.

3 DESCRIPTION OF SOURCES

3.1 Turbine Description

The GE 1.6-100 turbines procured for the Project are horizontal-axis turbines with three-bladed upwind rotors, a rotor diameter of 100 metres, and a hub height of 80 metres. Table 3-1 presents the general specifications of the wind turbine. Coordinates of all turbines are listed in Appendix D.

Table 3-1: Turbine Description – GE 1.6 - 100

Description	Characteristic
Model	GE 1.6 100
Rated power	1.6 MW
Hub height	80 m
Rotor diameter	100 m
Rotor swept area	7854 m^2
Number of blades	3
Cut-in wind speed	3 m/s
Cut-out wind speed	25 m/s
Nominal wind speed	12.0 m/s

3.2 Turbines from Adjacent Glen Dhu North Wind Farm Projects

Shear Wind also owns and operates the existing Glen Dhu North Wind Farm composed of 27 Enercon E82 2.3MW wind turbines that are located within 5 km of the Glen Dhu South Wind Farm. These wind turbines have been considered in this Noise Impact Assessment. The Enercon E82 wind turbines have a hub height of 78 m. Coordinates of the wind turbines were provided by the Client. These turbine locations are also listed in Appendix D.

4 WIND TURBINE NOISE EMISSION RATING

4.1 Noise Emission Rating for the Glen Dhu South Wind Farm

Broadband sound power levels and octave band sound power levels of the GE 1.6-100 wind turbine were provided by the manufacturer and are shown in Appendix C. Measurements were made in accordance with the IEC 61400 – 11 Ed. 2.1 [5] method using standardized wind speeds at 10-m height. The values corresponding to the maximum sound power level of the turbine were retained for the purpose of the noise impact assessment. These values correspond to a 10-m height wind speed of 10 m/s or more. A 1 dBA safety margin was added to the maximum Sound Power Level for additional conservatism.

The octave band sound power levels used for the simulation in this NIA are those stated for each octave band centre frequency in Table 4-2

Table 4-1: Glen Dhu South Project – GE1.6-100 Wind turbine Sound Power Level

GE 1.6-100	Octave Band Sound Power Level (dBA)								
Frequency (Hz)	63	125	250	500	1000	2000	4000	8000	Broadband
PWL (dBA)	87.2	96.2	97.9	96.5	100.8	100.3	91.5	72.6	106.0

*Includes additional 1 dBA safety margin

4.2 Noise Emission Rating for the Adjacent Glen Dhu North Wind Farm

Broadband sound power levels and octave band sound power levels of the E82 E2 2.3 MW wind turbine were provided by the manufacturer and are shown in Appendix C. Measurements were made in accordance with the IEC 61400 – 11 Ed. 2.1 method using standardized wind speeds at 10-m height. The values corresponding to the maximum sound power level of the turbine were retained for the purpose of the noise impact assessment. These values correspond to a 10-m height wind speed of 7 m/s or more.

The octave band sound power levels of the E82 2.3MW turbine were provided by the manufacturer by means of a recent Noise Measurement Report performed by an independent consulting company on a E82 2.3MW wind turbine and were adjusted to the maximum sound power level (including 1 dBA safety margin) of 105.0 dBA.

The octave band sound power levels used for the simulation in this NIA are those stated for each octave band centre frequency in Table 4-2

Table 4-2: Glen Dhu North Project - Enercon E82 2.3MW Wind turbine Sound Power Level

E82 2.3MW	Octave Band Sound Power Level (dBA)								
Frequency (Hz)	63	125	250	500	1000	2000	4000	8000	Broadband
PWL (dBA)	88.4	96.4	96.1	98.7	100.5	95.6	83.3	75.2	105.0

*Includes additional 1 dBA safety margin

4.3 Wind Farm Substation Transformer

The cumulative effect that the substations of both wind farms included in this analysis would have on nearby residents has been considered.

Noise emission from each substation mainly originates from one (1) high-voltage step-up transformer. The equipment proposed for the substations will be compliant with applicable standards (CAN/CSA-C88-M90, IEEE C57.12.90).

The Broadband Sound Power Level for the noise modeling calculations was conservatively assumed to be 100.0 dB(A) and 103.0 dB(A) for Glen Dhu North and South respectively, based on standard CAN/CSA-C88-M90, and for utility scale transformers. The locations of these substation transformers are presented in Appendix D and shown in the Map in Appendix A.

Table 4-3 and Table 4-4 provide the octave band sound power levels of both substation transformers, using a typical transformer octave band sound distribution for a large transformer. They were modeled at a height of 2m agl.

Table 4-3: Glen Dhu North Project – Substation Transformer Sound Power Level

Transformer	**Octave Band Sound Power Level (dBA)**								
Frequency (Hz)	63	125	250	500	1000	2000	4000	8000	Broadband
PWL (dBA)	64.4	81.5	86	99.4	88.6	70.8	66.6	60.5	100.0

Table 4-4: Glen Dhu South Project – Substation Transformer Sound Power Level

Transformer	**Octave Band Sound Power Level (dBA)**								
Frequency (Hz)	63	125	250	500	1000	2000	4000	8000	Broadband
PWL (dBA)	67.4	84.5	89	102.4	91.6	73.8	69.6	63.5	103.0

Noise levels at Points of Reception were calculated based on the cumulative noise from the Glen Dhu North/South wind turbines and substations.

5 NOISE IMPACT ASSESSMENT

The predicted overall (cumulative) sound pressure levels at each critical noise receptor for the aggregate of all wind turbines and substations associated with the Project were calculated based on the ISO 9613 method [6], using the CadnaA software. The simulation was run with the noise emission ratings of the wind turbines and substation transformer as specified in Section 4.

The ISO 9613 standard provides a prediction of the equivalent continuous A-weighted sound pressure level at a distance from one or more point sources under meteorological conditions favorable to propagation from sources of sound emission. These conditions are for downwind propagation, or, equivalently, propagation under a well-developed moderate ground-based temperature inversion, which commonly occurs at night. Downwind propagation conditions assume a wind direction within an angle of + 45º of the direction connecting the centre of the dominant sound source and the centre of the specified receiver region, with the wind blowing from source to receiver.

The method consists of octave-band algorithms (i.e. with nominal midband frequencies from 63 Hz to 8 kHz) for calculating the attenuation of the emitted sound. The algorithm takes into account the following physical effects:

- Geometrical divergence – attenuation due to spherical spreading from the sound source;
- Atmospheric absorption – attenuation due to absorption by the atmosphere;
- Ground effect –attenuation due to the acoustical properties of the ground.

The following ISO-9613-2 parameters [7] were set as follows, for a conservative worst case scenario:

- Ambient Air Temperature: 10ºC
- Ambient Barometric Pressure: 101.32 kPa
- Relative Humidity: 70%
- Topography: Digital topographical data from the NTDB
- Ground Attenuation (G): 0.7 (site conditions considered as "mixed ground")

For ground attenuation (G), it should be noted that from ISO 9316 standard, G should be set to 1 for porous ground, “which includes ground covered by grass, trees or other vegetation, and all other ground surfaces suitable for the growth of vegetation, such as farming land”. For hard ground such as “paving, water, ice, concrete and all other ground surfaces having a low porosity,” G should be set to 0. “Tamped ground, for example, as often occurs around industrial sites, can be considered hard.”

Additional calculations concerning propagation through foliage were not performed in this impact assessment, implying that the values calculated for sound attenuation are likely to be conservative in areas where there is foliage present in the line of sight between any turbine and a noise receptor. In addition, the ISO 9613 model is conservative as it assumes that the propagation of the sound from the WTGs to the source is downwind for all the WTGs at the same time. Consequently, the values calculated for sound attenuation are likely to be conservative in those cases where the line of sight between a turbine and a noise receptor is blocked by trees or shrubs or if the wind direction is taken into account in the noise impact assessment. The estimated accuracy of the ISO 9613 method, as stated in ISO 9613-2, is ± 3 dB.

The noise impact was calculated for each Point of Reception located within 1.5 km of a turbine from the Glen Dhu South Project, and the calculated noise level was then compared with the applicable noise limit of 45 dBA in accordance with Health Canada requirements. Noise levels were calculated at a height of 1.5 m and 4.5 m agl for 1-storey and 2-storey Points of Reception respectively.

6 WIND TURBINE NOISE IMPACT ASSESSMENT SUMMARY TABLE

6.1 Results

The noise level at each Point of Reception within 1.5 km of any turbine of the Glen Dhu South Project is tabulated in Table 6-1. For each receptor, the following information is provided:

- Distance to the closest wind turbine;
- Sound pressure level at the receptor location at the applicable receptor height;
- Sound level limit for that receptor;
- Whether or not the noise levels at the receptor comply with the prescribed limit (for continued reference, compliance is confirmed for all receptors).

The shortest distance between a Glen Dhu South wind turbine and a Point of Reception is 609 m between receptor 71 and Turbine 31.

The results show that the Glen Dhu South Project complies with the applicable environmental noise guidelines cited in section 2. A noise iso-contour map illustrating the contribution of the all wind turbines and the transformer is presented in Appendix A.

Table 6-1: Wind Turbine Noise Impact Assessment Summary – Glen Dhu South Wind Farm (Including Adjacent Wind Farms)

Point of Reception ID	Receptor Height agl. [m]	Distance to Nearest Turbine [m]	Nearest Turbine [ID]	Calculated Sound Pressure Level at Receptor [dB(A)]	Applicable Noise Limit [dB(A)]	Compliance With Limit (Yes/No)
1	4.5	622	44	41.6	45	Yes
2	1.5	704	44	39.0	45	Yes
3	1.5	798	44	38.1	45	Yes
4	4.5	823	44	39.6	45	Yes
5	4.5	944	44	38.4	45	Yes
6	1.5	1410	44	34.6	45	Yes
7	1.5	1100	39	35.0	45	Yes
8	4.5	1109	39	36.9	45	Yes
14	1.5	1074	39	36.0	45	Yes
57	1.5	1419	43	32.1	45	Yes
58	1.5	1382	43	32.6	45	Yes
62	1.5	1280	39	33.8	45	Yes
71	1.5	609	31	41.8	45	Yes
72	4.5	803	28	41.1	45	Yes
99	4.5	1277	43	34.9	45	Yes
100	4.5	1120	39	33.8	45	Yes
102	4.5	807	39	39.9	45	Yes
103	1.5	764	39	36.2	45	Yes
104	4.5	867	39	39.6	45	Yes
109	4.5	1494	21	33.9	45	Yes
110	4.5	718	1	39.7	45	Yes
111	1.5	837	1	37.4	45	Yes
112	1.5	1204	1	35.1	45	Yes
116	1.5	763	39	39.1	45	Yes

7 CONCLUSION

When modeled according to the ISO 9613 standard and the conditions specified in this report, the predicted sound level produced by the wind turbines and substation was found to be within the permissible sound level of 45 dBA for all the noise receptors identified. The results are therefore compliant with the most stringent applicable requirement for this region (Health Canada requirement).

Attenuation due to sound propagation through foliage, which is listed as an Appendix to ISO 9613, was not considered in this NIA. In addition, it should be noted that the ISO 9613 model is conservative as it assumes that the propagation of the sound from the WTGs to the source is downwind for all the WTGs at the same time. Consequently, the values calculated for sound attenuation are likely to be conservative in those cases where the line of sight between a turbine and a noise receptor is blocked by trees or shrubs or if the wind direction is taken into account in the noise impact assessment.

8 REFERENCES

[1] 2006 Statistics Canada Community Profile: Pictou County, Nova Scotia - www.statcan.gc.ca

[2] Health Canada, 2006. Wind Farm Fact Sheet – Draft Document and *Health Canada Noise Impact Assessment Guidance for Environmental Assessments*. (to be issued)

[3] Guidelines for Environmental Noise Measurement and Assessment.

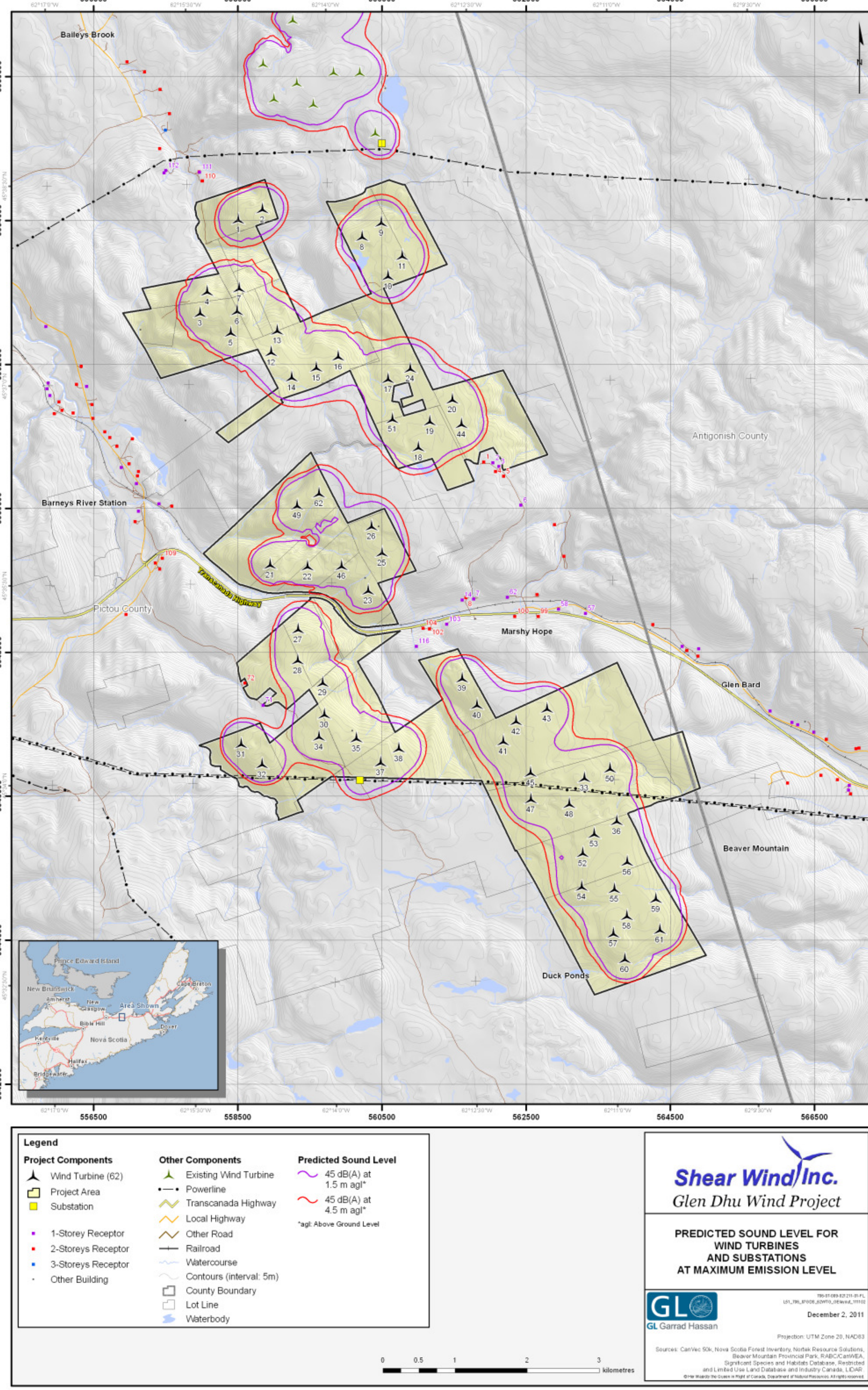
[4] County of Pictou Land Use By law, October 2007.

[5] International Electrotechnical Commission (IEC), 2006. IEC 61400 – 11 Ed. 2.1 Wind turbine generator systems – Part 11: Acoustic noise measurement techniques. 46 p.

[6] International Organization for Standardization (ISO), 1993. Acoustics - Attenuation of Sound During Propagation Outdoors - Calculation of the Absorption of Sound by the Atmosphere. ISO 9613-1. 33 p.

[7] International Organization for Standardization (ISO), 1996. Acoustics - Attenuation of Sound During Propagation Outdoors - General Method of Calculation. ISO 9613-2. 25 p.

APPENDIX A NOISE ISO-CONTOUR MAP



Baileys Brook
Barneys River Station
Pictou County
Antigonish County
Transcanada Highway
Marshy Hope
Glen Bard
Beaver Mountain
Duck Ponds
Prince Edward Island
New Brunswick
Amherst
New Glasgow
Area Shown
Cape Breton
Bible Hill
Dover
Kentville
Nova Scotia
Halifax
Bridgewater
556500
558500
560500
562500
564500
566500
5056000
5054000
5052000
5050000
5048000
5046000
5044000
5042000
Legend
Project Components
Wind Turbine (62)
Project Area
Substation
1-Storey Receptor
2-Storeys Receptor
3-Storeys Receptor
Other Building
Other Components
Existing Wind Turbine
Powerline
Transcanada Highway
Local Highway
Other Road
Railroad
Watercourse
Contours (interval: 5m)
County Boundary
Lot Line
Waterbody
Predicted Sound Level
45 dB(A) at 1.5 m agl*
45 dB(A) at 4.5 m agl*
*agl: Above Ground Level
0 0.5 1 2 3 kilometres
Shear Wind Inc.
Glen Dhu Wind Project
PREDICTED SOUND LEVEL FOR WIND TURBINES AND SUBSTATIONS AT MAXIMUM EMISSION LEVEL
GL Garrad Hassan
December 2, 2011
Projection: UTM Zone 20, NAD83
Sources: CanVec 50k, Nova Scotia Forest Inventory, Nortek Resource Solutions, Beaver Mountain Provincial Park, RABC/CanWEA, Significant Species and Habitats Database, Restricted and Limited Use Land Database and Industry Canada, LIDAR

APPENDIX B COORDINATES OF POINTS OF RECEPTION

Coordinates of Points of Reception within 1.5 km from Glen Dhu South Project

Point of Reception ID	Easting [m][4]	Northing [m]
1	561918	5050647
2	562046	5050636
3	562129	5050583
4	562082	5050514
5	562196	5050448
6	562435	5050045
7	561777	5048744
8	561670	5048764
14	561620	5048730
57	563332	5048542
58	562955	5048602
62	562245	5048769
71	558858	5047263
72	558603	5047574
99	562676	5048502
100	562348	5048501
102	561166	5048328
103	561404	5048391
104	561078	5048338
109	557461	5049309
110	558015	5054552
111	557975	5054675
112	557505	5054696
116	560983	5048086

[4] UTM20-NAD83

APPENDIX C NOISE SPECIFICATIONS OF THE GE 1.6 – 100 AND ENERCON E82 2.3MW WIND TURBINES

1 Introduction

This document summarizes the acoustic emission characteristics of 1.6-100 wind turbine for normal operation, including calculated apparent sound power levels $L_{WA,k}$, uncertainty levels associated with the apparent sound power levels, and tonal audibility.

All provided sound power levels are A-weighted.

GE continuously verifies specifications with measurements, including those performed by independent institutes. If a wind turbine noise performance test is carried out, it needs to be done in accordance with theregulations of the international standard IEC 61400-11, ed. 2.1: 2006 and Machine Noise Performance Test document.

2 Normal Operation Calculated Apparent Sound Power Level

The apparent sound power levels $L_{WA,k}$ are initially calculated as a function of the hub height wind speed v_{HH}. The corresponding wind speeds v_{10m} at 10 m height above ground level have been evaluated assuming a logarithmic wind profile. In this case a surface roughness of z_{0ref} = 0.05 m has been used, which is representative of average terrain conditions.

$$v_{10m} = v_{HH} \frac{\ln\left(10m / z_{0ref}\right)}{\ln\left(hub\ height / z_{0ref}\right)} \quad [1]$$

The calculated apparent sound power levels $L_{WA,k}$ and the associated octave-band spectra are given in Table 1 and Table 2 for two different hub heights. The values are provided as mean levels as a function of v_{10m} for normal operation (NO) over cut-in to cut-out wind speed range. The octave-band spectra are for information only.

Wind speed at 10 m height (m/s)	Wind speed at hub height (m/s)	1.6-100 80 m hub height L_{WA} (dBA)	63 Hz Octave band level (dBA)	125 Hz Octave band level (dBA)	250 Hz Octave band level (dBA)	500 Hz Octave band level (dBA)	1000 Hz Octave band level (dBA)	2000 Hz Octave band level (dBA)	4000 Hz Octave band level (dBA)	8000 Hz Octave band level (dBA)	16000 Hz Octave band level (dBA)
5	7.0	94.8	77.4	84.7	88.4	89.8	87.5	85.5	81.0	65.6	26.9
5.5	7.7	97.2	79.4	86.9	90.9	92.4	90.3	87.0	82.3	66.3	25.2
6	8.4	99.5	81.4	88.9	92.1	94.3	93.8	89.8	83.9	67.4	25.1
6.5	9.1	101.5	83.1	90.5	92.0	95.1	97.3	93.6	85.7	69.0	27.3
7	9.7	103.3	84.8	92.4	93.4	95.7	99.2	96.4	87.8	70.7	29.7
8	11.1	104.9	86.3	94.4	95.5	95.9	100.4	99.2	90.0	72.2	33.6
9	12.5	105.0	86.4	94.9	96.3	95.7	100.2	99.3	90.3	72.4	32.2
10 – cutout	14 - cutout	105.0	86.2	95.2	96.9	95.5	99.8	99.3	90.5	71.6	32.2

Table 1: Normal Operation Calculated Apparent Sound Power Level, 1.6-100 with 80 m hub height as a function of 10 m wind speed (z_{0ref} = 0.05 m), the octave band spectra are for information only

[1] Simplified from IEC 61400-11, ed. 2.1: 2006 equation 7

Sound Power Level for the E-82 E2 with 2300 kW rated power

in relation to wind speed at 10 m height					
V_s in 10 m height / hub height	78 m	85 m	98 m	108 m	138 m
5 m/s	96,3 dB(A)	96.6 dB(A)	97.2 dB(A)	97.5 dB(A)	98.2 dB(A)
6 m/s	100.7 dB(A)	101.0 dB(A)	101.6 dB(A)	101.9 dB(A)	102.6 dB(A)
7 m/s	103.3 dB(A)	103.5 dB(A)	103.6 dB(A)	103.6 dB(A)	103.8 dB(A)
8 m/s	104.0 dB(A)	104.0 dB(A)	104.0 dB(A)	104.0 dB(A)	104.0 dB(A)
9 m/s	104.0 dB(A)	104.0 dB(A)	104.0 dB(A)	104.0 dB(A)	104.0 dB(A)
10 m/s	104.0 dB(A)	104.0 dB(A)	104.0 dB(A)	104.0 dB(A)	104.0 dB(A)
95% rated power	104.0 dB(A)	104.0 dB(A)	104.0 dB(A)	104.0 dB(A)	104.0 dB(A)
Measured value at 95% rated power				*103,4 dB(A)* *KCE 209244-03.03*	

in relation to wind speed in hub height									
wind speed at hub height [m/s]	7	8	9	10	11	12	13	14	15
Sound Power Level [dB(A)]	96.6	99.9	102.6	103.5	104.0	104.0	104.0	104.0	104.0

1. The relation between the sound power level and the standardized wind speed in 10 m height as shown above is valid on the premise of a logarithmic wind profile with a roughness length of 0.05 m. The relation between the sound power level and the wind speed at hub height applies for all hub heights. During the sound measurements the wind speeds are derived from the power output and the power curve of the WEC.
2. A tonal audibility of $\Delta L_{a,k} \leq 2$ dB can be expected over the whole operational range (valid in the near vicinity of the turbine according to IEC 61 400 -11 ed. 2).
3. The sound power level values given in the table are valid for the **Operational Mode I** (defined via the rotational speed range of 6 – 18 rpm). The respective power curve is the calculated power curve E-82 E2 dated November 2009 (Rev. 3.x).
4. The values displayed in the tables above are based on official and internal measurements of the sound power level. If available the official measured values are given in this document as a

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Approved / date:	MK/ 04/2010		
Revision /date:	1.0/ April 2010		

APPENDIX D COORDINATES OF TURBINES

Coordinates of turbines in the Glen Dhu South Wind Farm (UTM20-NAD83)

Turbine ID	Easting [m]	Northing [m]
1	558509	5054031
2	558842	5054174
3	557979	5052731
4	558077	5053028
5	558403	5052457
6	558493	5052756
7	558521	5053075
8	560226	5053790
9	560492	5053985
10	560586	5053242
11	560783	5053525
12	558966	5052187
13	559050	5052488
14	559250	5051836
15	559589	5051973
16	559893	5052125
17	560588	5051813
18	561006	5050864
19	561167	5051226
20	561480	5051531
21	558953	5049233
22	559471	5049211
23	560309	5048875
24	560894	5051960
25	560504	5049401
26	560359	5049769
27	559339	5048336
28	559335	5047905
29	559682	5047595
30	559703	5047148
31	558550	5046738
32	558840	5046456
33	563313	5046268
34	559628	5046841
35	560146	5046817
36	563758	5045667
37	560483	5046482
38	560737	5046678
39	561613	5047656
40	561819	5047281

41	562183	5046777
42	562363	5047054
43	562791	5047230
44	561607	5051186
45	562565	5046340
46	559943	5049217
47	562570	5045970
48	563103	5045905
49	559327	5050059
50	563668	5046397
51	560646	5051260
52	563286	5045224
53	563448	5045492
54	563273	5044759
55	563727	5044725
56	563904	5045101
57	563713	5044109
58	563899	5044352
59	564301	5044588
60	563872	5043750
61	564357	5044160
62	559629	5050227
Substation	560200	5046220

Coordinates of turbines in the Glen Dhu North Wind Farm (UTM20-NAD83)

Turbine ID	Easting [m]	Northing [m]
E1	562125	5059750
E2	561800	5059600
E3	561360	5059386
E4	561769	5059194
E5	562325	5059200
E6	561029	5058823
E7	561574	5058623
E8	561864	5058459
E9	562391	5058429
E10	560602	5058324
E11	561578	5058221
E12	562600	5058050
E13	560519	5057799
E14	562550	5057725
E15	561204	5057723
E16	562081	5057640
E17	559842	5057410
E18	559593	5057108
E19	559939	5056995
E20	559267	5056802
E21	558857	5056191
E22	559835	5056076
E23	560200	5056073
E24	559006	5055705
E25	559325	5055926
E26	559555	5055631
E27	560412	5055229
Substation	560503	5055072

Appendix XII. PROJECT TEAM MEMBERS' CVs

McCallum Environmental Ltd.

Meghan Milloy, BSc. (Bio), MES
Sr. Project Manager

Years in Practice
10

Certifications
Nova Scotia Advanced Wetlands Delineator and Evaluator

Memberships
Nova Scotia Wetlands Delineation, Maritime College of Forest Technology

Auditing Association of Canada (AAC) - Regional Chapter Committee Member

Education
Master in Environmental Studies (MES), York University, Toronto, Ontario, 1999
BSc. (Biology), Dalhousie University, 1997
BA (Political Science), Honours, Dalhousie University, 1997

Training
- Nova Scotia Advanced Wetlands Delineation and Evaluation Course, 2009;
- Water Management and Wetland Restoration Training Course, 2009;
- Identifying and Delineating Wetlands for Nova Scotia, 2008

Experience Summary

Ms. Milloy oversees, manages, and executes environmental projects. She completes wetland delineations and characterizations, and guides clients through the environmental and permitting stages of development projects. Ms. Milloy also guides clients through provincial and federal environmental assessment requirements. Ms. Milloy has submitted multiple applications for Transport Canada, under the Navigable Waters Protection Program, has submitted numerous Department of Fisheries and Oceans HADD applications (freshwater and marine) and has developed HADD compensation programs. Ms. Milloy regularly completes applications for wetland alteration and development across Atlantic Canada, and has developed and implemented wetland compensation programs. Ms. Milloy is a trained wetland restoration professional. Ms. Milloy is also knowledgeable in preparing Environmental Management Plans and Emergency Preparedness Plans for development projects.

Ms. Milloy is also involved with programs including the remediation of contaminated commercial and residential sites, and the execution of Phased Site Assessments in accordance with the Nova Scotia Management of Contaminated Sites Guidelines and CSA. Ms. Milloy is knowledgeable in risk assessment processes, and completes both qualitative and quantitative risk assessments for commercial and residential properties. Ms. Milloy has extensive experience working with the Atlantic Risk Based Corrective Action (RBCA) risk assessment process for hydrocarbon-impacted sites, and is proficient in plume characterization and exposure assessment.

Selected Project Experience

- Completion of provincial permitting requirements including wetland alteration and compensation planning, and watercourse alteration for a proposed marine terminal and associated 20 km rail and transmission line in Nova Scotia.
- Coordination and completion of federal and provincial regulatory requirements for a large scale commercial and residential development and associated marina in Dartmouth Nova Scotia involving HADD permitting, wetland infill and compensation planning, and completion of a phased assessment, risk assessment and completion of a Certificate of Compliance.
- Completion of 20-30 projects involving wetland delineation, wetland alteration and infill, and compensation planning for numerous residential and commercial large-scale developments across Nova Scotia and New Brunswick.
- Developed and implemented wetland restoration and creation projects as compensation for wetland losses for numerous development clients.
- Completion of more than 50 phased site assessment and remediation projects - Phase I, II, III and risk assessment for commercial property transfers.

Environmental Experience

McCallum Environmental Ltd., Nova Scotia

Project Manager - Provides project management expertise for site and/or route selection, constraints mapping, regulatory consultation, environmental assessments, wetland alteration and restoration planning, environmental protection plan development, regulatory applications, construction monitoring, and reclamation for small and large scale industrial projects. Other responsibilities include marketing, budget management, report preparation and client service.

Strum Environmental Services Ltd., Nova Scotia

Project Manager- From 2000- 2010, provided project management expertise for development clients across Atlantic Canada. Projects included environmental assessment, large scale commercial and residential developments, wetland alteration projects, wetland compensation planning and implementation, wetland restoration and creation projects, phased site assessments, and risk assessment and management.

Environmental Sciences Group, Kingston, ON

Environmental Scientist- in1997/1998, provided contaminant and project management expertise to Department of National Defense in the Canadian Arctic in support of remediation of several remote military sites. Identified areas required for remediation and completed associated boundary soil and sediment confirmatory sampling and analysis.

McCallum Environmental Ltd.

Robert McCallum, P.Biol

Years in Practice
14

Memberships
Member of Alberta Society of Professional Biologists (ASPB), 2001
AB# 875

Certifications
Watercourse Alteration Certification, Nova Scotia, 2013

Education
Bachelor of Science, Biology/ Environmental Studies, University of Victoria, BC

Training
- Project Management Fundamentals, 2010
- ISO 14064-1 Essentials: Greenhouse Gas Inventories
- ISO 14064-2 Expert – Greenhouse Gas Projects (Carbon Emissions Reduction Expert Course)
- Standard First Aid w/ CPR Level C 2012
- H2S Alive, 2011

Experience Summary

Mr. McCallum is a Registered Professional Biologist with 14 years of experience within the environmental consulting industry. He has completed over 100 Federal environmental assessments (under the Canadian Environmental Assessment Act) and hundreds of Provincial environmental assessments. He was a Responsible Authority under CEAA with the Department of Indian and Northern Affairs. He has assisted numerous clients with corporate environmental project management, environmental operations coordination, regulatory audits, regulatory response and compliance, liability assessments of properties or companies prior to acquisition, and operational project management.

His professional field experience has encompassed environmental management, construction supervision, site assessments, spill response, site remediation, and reclamation projects. He has liaised between Industry, Regulators, First Nations, Special Interest Groups, and working interest partners as required.

Selected Project Experience

WIND POWER PROJECTS

- Completed the Provincial Environmental Assessment for the 25.2 MW Hampton Mountain Wind Power Project, Bridgetown, Nova Scotia. The Project received Ministerial approval on January 10, 2011.
- Completed Environmental Protection Plan, Erosion & Sedimentation Control Plan, acting as Environmental Monitor and regulatory specialist, and completion of the Federal Cumulative Effects Assessment for the Glen Dhu Wind Power Project in Nova Scotia for Shear Wind Inc.;
- Coordination and completion of the environmental assessment, EPP, and regulatory applications for an 80 MW wind power project in Central Alberta, Canada for Nexen Inc;
- Coordination and completion of all regulatory applications for a 65 MW wind power project in Southern Alberta for Shear Wind Inc.;
- Coordination of regulatory permitting and environmental assessments for a 65 – 100 MW Wind Power Project in New Brunswick (anonymous client);
- Completion of preliminary constraints and regulatory analysis for 3 different wind power projects in Saskatchewan as a component of the Saskatchewan RFP process;
- Construction monitoring for EPP compliance, and reclamation management, at the Kettle Hills Wind Power Project, Alberta;

ALTERNATIVE ENERGY PROJECTS

- Coordination and completion of the 10 year Alberta Environment renewal application for the 105 MW Balzac Thermal Power generating station for Nexen Inc.;

OIL & GAS PROJECTS WHICH REQUIRE FEDERAL APPROVALS

- Completion of 53 regulatory compliance audits for three oil and gas clients in Alberta;
- Completion of site selection, CEAA screening document, first nation consultation, regulatory consultation, and surface land application for a wellsite, access road, and pipeline for Eagle Rock Exploration Inc;
- Completion of site selection, CEAA screening documents, first nation consultation, regulatory consultation, and surface land applications for 10 wellsites, access road, and pipelines for Maverick Oil & Gas Ltd on the Louis Bull First Nation since 2006;
- Completion of the Cumulative Effects Assessment and Environmental Protection Plan for a 107 shallow gas well program on federally regulated PFRA lands in S.W. Saskatchewan for submission to the Canadian Wildlife Service and Environment Canada;
- Completion of all CEAA environmental applications for 53 oil and gas developments on the Hay Lake I.R. #209, Alberta, since 2001. Conducted construction compliance monitoring, reclamation and completed regulatory compliance audits for ongoing activities
- Completion of construction monitoring for environmental compliance for a 10 km water pipeline for the Joffre Gas Plant, Alberta;

OTHER PROJECTS

- Completion of the CEAA screening document and NAV Canada application for the Deer Lake Regional Airport Authority (Newfoundland) Runway expansion, access road relocation, and transmission line relocation, including DFO and NAV Waters application.
- Assistance with project management and regulatory permitting for the 2010 Heritage Gas pipeline expansion within the Halifax Regional Municipality, Halifax, N.S.;

Environmental Experience

McCallum Environmental Ltd., Nova Scotia

President - Since 2001, has provided project management expertise for site and/or route selection, constraints mapping, land acquisition, first nation/public consultation, regulatory consultation, environmental assessments, environmental protection plan development, survey supervision, regulatory applications, license and permit acquisitions, construction monitoring, and reclamation for small and large scale industrial projects. Other responsibilities include marketing, budget management, report preparation and client service.

Indian Oil & Gas Canada, Department of Indian & Northern Affairs, AB

Environmental & Surface Land Analyst (Responsible Authority under CEAA) - applied federal environmental legislation (CEAA, CEPA, Fisheries Act, and Indian Oil & Gas regulations (1995), which incorporate provincial legislation, on oil and gas producing Indian reserves in Canada. Analyzed environmental assessments for proposed projects and conducted site inspections where required (acting as the Responsible Authority under CEAA). Audited projects to ensure compliance with federal and provincial legislation. Negotiated and resolved environmental issues while maintaining an effective working relationship with First Nations, industry, IOGC and other federal and provincial regulators. Conducted reclamation inquiries to ensure compliance with reclamation criteria.

Stantec Consulting Ltd., AB

Project Manager - responsibilities included marketing, budget management, report preparation and client service. Project experience related to reclamation and environmental monitoring of construction projects. Completed federal and provincial environmental assessments, conservation and reclamation plans, designed and monitored environmental Protection Plans for developments in environmentally sensitive areas. Completed Phase I and Phase II Contamination Assessments and dig & dump supervision and closure sampling.

Pioneer Land Services Ltd., Calgary, AB

Assistant Environmental Manager -responsibilities included employee time management, billings, report preparation and quality control, marketing and client service. Consulting responsibilities included project management of reclamation programs, environmental monitoring of pipeline and wellsite construction projects. Completed environmental assessments as per provincial and federal requirements, designed and monitored environmental Protection Plans for developments in environmentally sensitive areas, Phase I and Phase II Contamination Assessments. Developed Emergency Response Plans for field personnel.

Melanie MacDonald

Years in Practice

4

Education

Masters of Resource and Environmental Management

B.Sc. Advanced Major in Biology & Interdisciplinary Studies in Aquatic Resources

Training

- Health Safety and Environmental Leadership training and Advanced Safety Audit training, 2009
- Emergency Operations Centre crisis management training, 2006-2008
- Introduction to the Fisheries Act and Navigable Waters Protection Act course – ESAA
- Bear Awareness training and ATV training – Alberta Safety Council, 2006
- Site Supervisor Safety Training, Construction Safety Training System and W.H.M.I.S., 2005

Summary

Ms. MacDonald has worked in biology related environmental consulting since 2003. She has worked on both research related field assessments and project related field assessments in Nova Scotia, New Brunswick and Alberta.

Experience

McCallum Environmental Ltd., Halifax, Nova Scotia

Environmental Assessment and Approvals Specialist

May-Aug 2011, Jan 2012-Present

Completing biophysical assessments, including flora and fauna surveys, with emphasis on species at risk. Completing wetland and watercourse delineations and assessments and coordinating migratory bird and bat monitoring. Communicating field survey results and methodologies for Environmental Assessments and other Provincial regulatory application.

Amec Colt, Shell/Albian Sands Expansion 1 - Fort McMurray, Alberta.

Environmental Specialist and Area Environmental Lead

July 2008 – October 2009.

Proactively monitored construction activities via inspections, audits and Environmental Work Permits & Protection Plans to ensure compliance with regulatory approvals, the projects' Environmental Control Plan, and best management practices. Investigated and reported incidents, and liaised between contractors and project owners. Implemented Environmental Awareness and communicated issues via weekly newsletters. Developed a greater business sense, working as an independent contractor to Amec Colt.

Canadian Natural Resources Ltd. - Fort McMurray, Alberta

Regulatory and Environmental Specialist

October 2005 – July 2008

Conducted extensive field work in various fish and wildlife programs. Communicated issues with government agencies, contractors and external stakeholders. Performed on-call duties, spill response, and non-compliance reporting and response. Expanded upon site wide procedures for protection of water, wildlife and waterbirds. Played a pivotal role in planning & completion of a fish salvage of 38 km of the Tar River, and in construction of a 77 hectare fish habitat compensation lake (Horizon Lake). Horizon Lake earned CAPP Steward of Excellence Award for Environmental Performance. Hired, trained, and supervised teams of up to four summer interns. Chaired the regional 'Oil Sands Bird and Wildlife Protection Committee.

Nature Conservancy of Canada - Bedford, Nova Scotia

Conservation Intern.

May – August 2005

Worked with NCC staff and local stewards to compile flora, fauna and ecosystem inventories, and write natural area management plans for conservation lands. Mapped property features, delineated aquatic and terrestrial habitats, identified conservation threats & anthropogenic disturbances.

Department of Fisheries and Oceans - Moncton, NB

Survey Assistant

September 2004.

Participated in a multi-species bottom trawl survey in the Southern Gulf of Se. Lawrence aboard the C.C.G.S. Alfred Needler. Gained experience in identification and sampling of marine fishes and invertebrates. Learned to work efficiently in a non-conventional work environment.

St. Mary's River Association - Sherbrooke, Nova Scotia

Species at Risk Field Biologist and Stewardship Coordinator

May – September 2004.

Performed an ecological study of Wood Turtles in the St. Mary's River watershed, expanding the knowledge of local population demographics. Extensive field work to locate, mark and measure turtles and nesting sites. Designed various educational media and delivered presentations to diverse audiences. Gathered anecdotal evidence from local residents, and coordinated volunteer activities. Authored a report on nesting ecology and stewardship for the NS Dept. of Natural Resources

Relevant Experience and Training

Dr. John Kearney

John F. Kearney & Associates

1. Digby Neck Wind Farm – Post-Construction Monitoring-2010-2012
2. Glen Dhu II Follow Breeding Studies 2010-2011
3. Nuttby Mountain Wind Farm-Post-Construction Monitoring-2010-2012
4. Glen Dhu Wind Energy-Post-Construction Monitoring-2011-2012
5. Antigonish Wetlands Compensation Project for Highway 104 Twinning -2010
6. Point Tupper Wind Farm Post-Construction Monitoring -2010
7. Maryvale Wind Project Post-Construction Monitoring – 2010-2011
8. Glen Dhu Wind Farm – Construction Monitoring -2010
9. Glen Dhu Wind Energy – Follow-Up Breeding and Autumn Migration Studies – 2009
10. Highway 125 Bird Screening -- 2009
11. Highway 113 Pre-Construction Monitoring -2009
12. Avian Baseline Study and Environmental Assessment of Glen Dhu Wind Energy, Pictou-Antigonish Counties, Nova Scotia, June 2007-July 2008.
13. Avian Baseline Study at proposed wind farm at Culloden, Digby Co., 2007-2008
14. Post EA avian monitoring, proposed Maple LNG Terminal, Guysborough County, Nova Scotia, 2008-2012.
15. Environmental anthropologist (PhD), with experience in resource and environmental management and assessment process for over 30 years in fisheries, aquaculture, oil and gas, tourism, mining, watershed developments, tidal power, wind energy, and post-tsunami reconstruction in S.E. Asia.
16. Masters in Environmental Studies at Dalhousie University with specializations in ecology, environmental law, and environmental impact assessment.
17. BSc. in Biology at Acadia University
18. Can identify all the birds of Eastern Canada by sight and sound. Experienced with identification of birds throughout North America, Mexico, Chile, much of Europe, South Africa, India, Sri Lanka, Vietnam, Malaysia, and the Philippines.
19. Proficient in statistical analyses using SPSS and other software.

STEPHEN DAVIS, D.PHIL
Phone: (902) 441-9481
E-mail : steve.davis@eastlink.ca
Years of experience: 40+
Years with DM&A (formerly DAC) : 22

ARCHAEOLOGICAL IMPACT ASSESSMENT
ENVIRONMENTAL EFFECTS MONITORING
MITIGATION DESIGN
CULTURAL RESOURCE DATA ANALYSIS
ARCHAEOLOGICAL SENSITIVITY TRAINING

EDUCATION

1987 D.Phil. Prehistory - University of Oxford, England.
1975 Master of Arts, Anthropology – Memorial University of Newfoundland.
1971 Bachelor of Arts, Honours in Anthropology - University of New Brunswick

PROFESSIONAL DEVELOPMENT AND CERTIFICATION

WHMIS: Certified 2008

PROFESSIONAL MEMBERSHIPS AND AFFILIATIONS

Federal Heritage Legislation Committee for the protection of heritage resources on Federal lands.
Atlantic Province consultant for the "Proposed Act respecting the protection of archaeological heritage in Canada". The Bastion Group Heritage Consultants, Victoria, B. C.; for the Department of Communications, Canada.
Member of the Canadian Archaeological Association
Member of the Council for Northeast Historical Archaeology

RELEVANT PROJECTS AND RESPONSIBILITIES

Stephen Davis is President of Davis MacIntyre & Associates Limited. After teaching archaeology for thirty-seven years he is presently Professor Emeritus of Anthropology at Saint Mary's University, Halifax. He has been granted the President's Award for Excellence in Research (Saint Mary's University) and most recently the 2011 Smith-Wintemburg Award for outstanding contribution to the field of archaeology in Canada (Canadian Archaeological Association).

The principal investigator for archaeology has had field experience in the Canadian High Arctic, the Barrens and Eastern Arctic. This includes field surveys and excavations of sites on Dundas and Devon Islands in Nunavut as well as work in the interior Barrens along the northeastern shore of Dubawnt Lake. His experience in the Eastern Arctic dealt with First Nations sites in southern Labrador, which included a sacred burial site. While employed by the Archaeological Survey of Canada he dealt with the full range of cultural traditions defined in the Arctic from early Independence 1 sites through Dorset and Thule.

Through research and consultancy experience over a forty-year period, Dr. Davis has worked on projects in Spain, Norway, Maine, the British Isles, N.W.T., Ontario and the Canadian Arctic. With a growing public interest in protecting cultural resources of all types, Dr. Davis has become involved with numerous projects involving historic site archaeology. During his professional career he has directed archaeological investigations of prehistoric sites, historic sites and conducted hundreds of cultural resource assessment surveys under the guidelines for a Category C Permit (Nova Scotia Museum). These activities have resulted in over 100 publications in the form of books, book chapters, journal articles and contractual documents.

Representative projects include:

- Little River Reservoir Project, Saint John NB – Dillon Consulting / City of Saint John: heritage resource impact assessment including refining and field-truthing a predictive model based on changing water levels.
- Muggah Creek Shipwreck, Sydney NS - Sydney Tar Ponds Agency: archaeological assessment and recording of a beached shipwreck in the Sydney Tar Ponds, also known as Muggah Creek.
- Route 11 Pokemouche to Janeville, NB - New Brunswick Department of Transportation: CEAA Screening and Provincial EIA. Archaeological background study and reconnaissance of a proposed highway corridor over 50km in length.
- Deep Panuke Landfall Preparation, Goldboro NS - EnCana Corporation: monitoring and mitigation of the near shore development of the Deep Panuke natural gas project, and heritage sensitivity training.
- Morell Lagoon Upgrade, PEI – Community of Morell: Monitoring of lagoon upgrades in the vicinity of a known Acadian / Mi'kmaq cemetery.

20. Proficient in field survey methodologies, bird banding, taxidermy, and museum collections.
21. Participated in many scientific surveys on a volunteer basis including Maritime Breeding Bird Atlas (both editions), the Breeding Bird Surveys, the Maritime Shorebird Survey, Project Feederwatch, and the Christmas Bird Counts.
22. Past employment as bird biologist/technician with Cornell Lab of Ornithology, NS Department of Natural Resources, Health Canada, and Robie Tufts Museum.

SENIOR ARCHAEOLOGIST

LAURA DE BOER, M.A.
Phone: (902) 209-4004
E-Mail: laura.deboer@eastlink.ca

ARCHAEOLOGICAL IMPACT ASSESSMENT
ENVIRONMENTAL EFFECTS MONITORING
DESKTOP STUDIES
ARCHIVAL RESEARCH
STRUCTURAL RECORDING

EDUCATION

Master of Arts, European Historical Archaeology – University of Sheffield (UK)
Bachelor of Arts, Honours in Anthropology – Saint Mary's University

PROFESSIONAL DEVELOPMENT AND CERTIFICATION

WHMIS: Certified 2008
Emergency First Aid & CPR Level A certified (St. John Ambulance) 2010

PROFESSIONAL MEMBERSHIPS, AWARDS, AND AFFILIATIONS

Board member, Industrial Heritage Nova Scotia
Member, Canadian Archaeological Association
Member, Nova Scotia Archaeology Society
John Harvey Memorial Writing Award, Nova Scotia Archaeology Society
Prince John Loewenstein Anthropology Award (Writing), Saint Mary's University Anthropology Department
AUUHC Conference award – Best Presentation, University of Prince Edward Island
Nelly B. Grey Memorial Scholarship, Saint Mary's University

RELEVANT PROJECTS AND RESPONSIBILITIES

Ms. de Boer is a Senior Archaeologist who has been involved in archaeological field survey and excavations since 2006. She began working in the consulting field in 2008. She is experienced in a range of work pertaining to the historical or post-contact period of Nova Scotia, with a focus on the archaeology of standing buildings and of industrialization. Her projects as a consultant and previously as a student have included cemeteries, populous urban sites, areas reclaimed by wilderness, and industrial sites. She has also been involved in archaeological field surveys in Italy and the United Kingdom. Ms. de Boer has held archaeological research permits in Nova Scotia under the Special Places Protection Act, is qualified to hold permits in PEI, and has conducted archaeological research in New Brunswick.

As a senior and previously as a junior archaeologist, her responsibilities have included conducting field reconnaissance and excavation (test units, forest and mountain field surveys, and large-scale construction site excavation and monitoring, recording and profiling of test units); extensive research in public and private archives; analysis of historical mapping; compiling museum reports under Special Places Protection Act legislation; laboratory processing of artifacts; and the recording and drafting of sites, structures, and shipwrecks. Ms. de Boer's academic experience prior to her consulting work has included the use of basic AutoCAD programming, Leica Total Station survey, vector-based graphics work, and geophysical surveying.

Representative projects include:

- Wilkes Subdivision, Rusagonis NB – Dillon Consulting: Archaeological background study and survey to ground-truth predictive modelling.
- Route 11 Pokemouche to Janeville, NB - New Brunswick Department of Transportation: CEAA Screening and Provincial EIA. Archaeological background study and reconnaissance of a proposed highway corridor over 50km in length.
- Muggah Creek Shipwreck Recording, Sydney NS - Sydney Tar Ponds Agency: archaeological recording and drafting of a beached shipwreck prior to its removal during the Tar Ponds Clean-up.
- Melford International Terminal, Melford NS - AMEC Earth & Environmental: archaeological resource impact assessment including recording and mitigation of archaeological and built heritage resources.
- Point Pleasant Park Archaeological Research, Halifax NS - Halifax Regional Municipality: Design and execution of archaeological research program for management and rehabilitation of historic roadways
- Digby Wastewater Treatment Project – Town of Digby: Archaeological testing and recording following an impact assessment also conducted by DM&A.
- Bailey's Cemetery – Xstrata Coal: Archaeological excavation to identify fourteen grave shafts at Bailey's Cemetery, Donkin, Cape Breton.

VICE PRESIDENT / SENIOR ARCHAEOLOGIST

APRIL MACINTYRE, M.A.
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ARCHAEOLOGICAL RESOURCE IMPACT ASSESSMENT
ENVIRONMENTAL EFFECTS MONITORING
MITIGATION DESIGN
LABORATORY ANALYSIS
HISTORICAL, ARCHIVAL, AND ORAL NARRATIVE RESEARCH

EDUCATION

2005 Master of Arts, Anthropology – Memorial University of Newfoundland.
1999 Bachelor of Arts, Honours in Anthropology - Saint Mary's University.

PROFESSIONAL DEVELOPMENT AND CERTIFICATION

WHMIS: Certified 2008

PROFESSIONAL MEMBERSHIPS AND AFFILIATIONS

Research Associate, Nova Scotia Museum (2008-2010)
Member of the Canadian Archaeological Association
Member of the Society for Historical Archaeology
Member of the Council for Northeast Historical Archaeology
Vice- President of the Nova Scotia Archaeology Society (2007-2009)

RELEVANT PROJECTS AND RESPONSIBILITIES

April MacIntyre is Vice President of DAC. She has been employed in the consulting field since 1997 and was involved with various archaeological projects at Saint Mary's University prior to that. Her specialization is in the historic archaeology of Nova Scotia. Ms. MacIntyre has extensive experience in field and laboratory methods as well as in conducting documentary research and is well-trained in eighteenth- and nineteenth-century material culture identification and analysis. She has been involved in various historic and precontact archaeological investigations including burial sites. Ms. MacIntyre is qualified to hold Category A, B and C heritage research permits with the Nova Scotia Museum. She has produced several contractual reports and is actively involved in research and publishing.

Representative projects include:

- Donkin Mine Redevelopment Project / Bailey Cemetery Research Project - CBCL Limited: Archaeological Resource Impact Assessment of the Donkin Mine site as well as archaeological delineation of an unmarked historic cemetery as part of a community liaison project.
- Little Bras d'Or Bridge - CBCL Limited / NSTIR: Archaeological reconnaissance and mitigation design for a 100-series highway bridge replacement.
- Big Glace Bay Lake Bridge - CBCL Limited / NSTIR: Archaeological reconnaissance and mitigation design for a 200-series highway bridge replacement.
- Melford International Terminal - AMEC Earth & Environmental: archaeological resource impact assessment and mitigation design as part of Provincial and Federal environmental assessments, as well as associated reports and mapping.
- Salter's Gate / Marriott Courtyard Hotel - Salter's Gate Construction: archaeological monitoring, mitigation, excavation and artifact analysis for an urban development project in metropolitan Halifax; as well as development of an interpretive display as part of the hotel design.
- Dalhousie Mountain Wind Farm - RMSenergy Ltd.: Archaeological reconnaissance and mitigation design of a 51 MW wind farm.
- Nuttby Mountain Wind Farm - CBCL Limited: Archaeological reconnaissance and mitigation design of a 45 MW wind farm.
- Gaspereau Lake Reservoir - Kwilmu'kw Maw-klusuaqn Negotiation Office: Archaeological consultant for determination of best-practices protocol for an archaeological resource impact assessment.

GL Garrad Hassan

PIERRE HERAUD

1. Family Name:	Héraud
2. First Name(s):	Pierre
3. Date of Birth:	1974
4. Nationality:	France / Canada
5. Civil Status:	NA

6. Education:

Institution:	Date	Degree obtained
Le Groupe Qualiso, Montréal, Canada	2006	OHSAS 18000, "Occupational Health and Safety Management", Certification
Université de Provence, France	2002	Ph. D. in Fluid Mechanics

7. Language Skills: (Mark skills as EX for Excellent, VG for Very Good, G for Good, F for Fair and B for Basic)

Language	Reading	Writing	Speaking
Mother Tongue: French	EX	EX	EX
English	VG	VG	VG

8. Membership in professional bodies:	Canadian Wind Energy Association
9. Other skills:	Programming skills: MATLAB, C/C++, Fortran
10. Present position:	Senior Team Leader, Project Development Group
11. Years with the firm:	6
12. Key qualifications	• Project Management: 5+ years of PM in wind farm development. • Team Management: 3+ years, team up to 26 engineer and specialist. • Owner Engineer services: 1.5 year of technical support during wind farm construction • Independent Engineer services: Review of contractual documentation, M&A risk assessment; • Turbine Measurement: 2 projects of Power Curve measurement completed (5 wind turbines).

13. Specific Experience:		
Position	**Date**	**Task performed**
GL Garrad Hassan, Montreal Senior Team Leader, PD Group	2010 – 2011	• Management of North-America Project Development Services team (8 engineers); • Project management & Business development responsibilities • Development of protocols, tools and template for various services (Shadow Flicker analysis, Noise Impact Assessment, Layout Design, etc …) • “Owner Engineer” for Glen Dhu Wind Project, NS: technical support from bidding processes to taking-over of the wind farm, Management of multidisciplinary team;
Helimax Energy Inc., Montréal Director of Operation	2009	• Management of GL Montreal office: 25+ engineers and specialist (GIS, Meteorology) • Review and approval of technical report and proposals; • Project Management: Client relation, coordination of internal team and subcontractors; • Turbine measurement technical leader.
Helimax Energy Inc., Montréal Practice Leader, Engineering	2008	• Maintenance and updating of company’s engineering knowledge and protocols; • Production of comprehensive Energy yield reports and quality control of the deliverables; • Project Management: Client relation, coordination of internal team and subcontractors; • Redaction of offer for the testing of wind turbine (Noise, load, power, power quality); • Remote and on-site problem solving of wind monitoring instrumentation; • Wind farm configuration and micro-siting; • Wind turbine performance testing, including site calibration and uncertainty analysis.

Helimax Energy Inc., Montréal Wind Farm Specialist, Engineering	2005 – 2008	• Application of expertise in fluid mechanics and experimental physics to wind energy engineering; • Meteorological tower configuration for proper wind resource assessment; • Wind farm configuration and micro-siting; • Wind turbine performance testing, including site calibration and uncertainty analysis; • Turbulence and wake effect modeling; • Quantitative characterization of terrain complexity; • Development of computer tools (C++).

14. Others (e.g. Publlications)

Presentations and Publications

TUSCH M., MASSON C. and HÉRAUD P. MODELING OF TURBULENT ATMOSPHERIC FLOW AROUND TUBULAR AND LATTICE METEOROLOGICAL MASTS, Journal of solar energy engineering, 2011, vol. 133, no1 & 2010 CanWEA presentation.

HÉRAUD P. APPROACHES FOR MEASURING POST-CONSTRUCTION NOISE IMPACT. Poster presented at AWEA's WINDPOWER 2008 Conference & Exhibition. Houston, 1-4 June 2008.

HÉRAUD P. POWER CURVE MEASUREMENTS: PITFALLS OF THE IEC 61400-12-1. Poster presented at AWEA's WINDPOWER 2008 Conference & Exhibition. Houston, 1-4 June 2008.

HÉRAUD, P. and F. PELLETIER. Wind Farm Noise: Fears, Facts and Misconceptions. Poster presented at AWEA's WINDPOWER 2007 Conference & Exhibition. Los Angeles, 3-6 June 2007.

SIBUET-WATTERS, C. and P. HÉRAUD. Comparison between WAsP and CFD Simulations. Poster presented at AWEA's WINDPOWER 2007 Conference & Exhibition. Los Angeles, 3-6 June 2007.

HÉRAUD, P. and F. PELLETIER. Wind Farm Noise: Fears, Facts and Misconceptions. Poster presented at CanWEA 2006 Conference and Trade Show. Winnipeg, 22-25 October 2006.

SIBUET-WATTERS, C. and P. HÉRAUD. Comparison between WAsP and CFD Simulations. Poster presented at CanWEA 2006 Conference and Trade Show. Winnipeg, 22-25 October 2006.

CLANET C., HÉRAUD P. and SEARBY G. "On the Motion of Bubbles in Vertical Tubes of Arbitrary Cross-sections." Journal of Fluid Mechanics vol. 519 (2004), pp. 359-76.

HÉRAUD, P. Étude de la dynamique de bulles infinies [Study on the dynamic of infinite bubbles]. Doctoral thesis.

SHANT DOKOUZIAN

1. Family Name	Dokouzian
2. First Name(s)	Shant
3. Date when Joined Company	2006
4. Citizenship	Canadian

5. Language Skills: (Mark skills as EX for Excellent, VG for Very Good, G for Good, F for Fair and B for Basic)

Language	Reading	Writing	Speaking
French (Native)	EX	EX	EX
English	EX	EX	EX
Spanish	G	G	G

6. Present Position Senior Project Manager

Company	Date from-to	Roles and Responsibilities

GL Garrad Hassan North America
Senior Project Manager
	2006 to present	Project Manager
		• Liason with the Client;
		• Work organization for internal team;
		• Work organization with subcontractors;
		• Negotiations with Suppliers;
		• Quality Control;
		• Reporting;
		• Review of Turbine Supply Agreements and BOP Contracts;
		• Owner Engineering.
		
		Lead Engineer, responsibilities:
		• Design, configuration, and optimization of wind farms;
		• Energy yield calculations, including:
		  o Availability, aerodynamic, and electrical losses;
		  o Uncertainty analysis (probability of exceedance Px);
		• Extreme wind, turbulence and flow angle analyses;
		• Comparative analysis and selection of wind turbines;
		• Execution of power performance tests in conformity with recognized standards;
		• Selection of optimal positions for installing wind monitoring towers;
		• Installation, commissioning and trouble-shooting of wind monitoring towers;
		• Site visits for the validation of constraints and turbine positions;
		• Noise analysis;
		• Visual impact analysis;
		• Writing of technical reports.

SNC-Lavalin **Project manager and Contract Specialist**	2003-2006	Project manager and Contract Specialist for the $1.4 billion Alouette Aluminium smelter expansion (Sept-Îles) and the Varennes ethanol plant (Varennes)

		• Prepare tender documents for major construction and service contracts ($150 million); • Coordinate and represent project team during tender period, including tender meetings, with contractors; • Lead clarification meetings with contractors and internal multidisciplinary teams; • Analyse tenders, negotiate and award contracts on behalf of project team and client; • Prepare contract documents and administrate contracts; • Analyze and negotiate major claims for contract closing
Spectra-Telecom, S.T. Inc. (co-owned by SNC-Lavalin and Telesystem), **Design and Construction / Project Management**	1997-2002	• Design and Construction / Project Management in British Columbia and Alberta for the implementation and expansion of wireless telecommunication networks, responsibilities: • Manage engineering team, including supervision and leadership of employees for the design and implementation of wireless telecommunications infrastructures with particular emphasis on rooftops, towers, and monopoles; • Establish concepts and participate in the civil, structural, electrical and telecom design of wireless telecommunications infrastructures; • Interact with clients, municipality and land acquisition specialists in determining best candidate for infrastructure build; • Participate in community consultations as infrastructure specialist; • Perform pre-engineering inspections and assessments; • Perform project tendering, bid evaluation, award and construction management; • Coordinate and assign tasks to sub-consultants; • Coordinate administrative tasks and co-manage office budget (2000 only); • Administrate and perform final inspections on projects; • Prepare design and construction management proposals
Microcell Connexions Inc, **Construction Manager**	1998	• Assist project manager for Calgary network implementation and deployment; • Manage the construction of Nortel battery back-up additions in Vancouver
Ministère des Transports du Québec **Construction Manager**	1994	• Supervise the construction and repair of highway infrastructure; • Administrate construction sites

7. Education

Institution	Date from-to (mmyy)	Academic Qualifications
École de technologie supérieure (ETS), Montreal	2006	Master's level course in Wind Energy and Turbines
McGill University (Montréal)	1992-1996	Bachelor's degree in Civil Engineering (Major in Structures)
Collège Jean-de-Brébeuf (Montréal)	1990-1992	Applied Science Diploma

8. Membership in Professional Societies	• Order of Engineers of Quebec; • Canadian Wind Energy Association; • "ASP-Construction" card (Quebec occupational health and safety (OHS) on construction sites); • H&S qualification (Hydro-Québec) for high-voltage sites

9. Accomplishments and Recognitions	• 8 years of experience as Project Manager; • Technical Expertise in configuration and optimization of wind farms; Performed a wide range of tasks, including wind resource assessment, energy yield analyses, wind farm layouts, comparative analysis of wind turbine models, extreme wind analysis, balance of plant assessment, noise and interference studies; Review of TSA and BOP Contracts, Owner engineer
10. Publications	•

11. Project Experience

Project Title	**Greengate Power Corporation (700 MW under development, in permitting stage)**
Date:	2008 to present
Company	Helimax – GLGH
Location	Projects in Alberta, Canada – Project office in Montreal, Canada
Position	Project Manager and Technical lead
Task Description	• Liason with the Client; Work coordination of the internal team and subcontractors from the conceptual initiation of the project to the pre-construction phase; • Lead engineer: Wind resource assessment, Energy calculations, Micro-siting, Constraints validation, Turbine Technology Validation, Due Diligence and Owner's Engineer services.
Project Title	• **MASDAR – Wind Resource Assessment in United Arab Emirates**
Date:	• 2008-ongoing
Company	• Helimax- GLGH
Location	• Project in United Arab Emirates – Project office in Montreal, Canada
Position	• Project Manager & Lead Engineer
Task Description	• Liason with the Client including meetings in UAE; Coordination of internal team and subcontractors in UAE; Tower procurement including contacts and negotiations with meteorological tower manufacturers; Coordination of international permits; Delivery and multi-company installation activity; Wind resource assessment; Energy calculations; Micro-siting.
Project Title	**Cartier (Anse-a-Valleau; Baie-de-Sables)**
Date:	2006 – to present
Company	Helimax
Location	Projects in Gaspésie, Québec – Project office in Montreal, Canada
Position	Wind Farm Analyst and Specialist
Task Description	• Micro-siting; Energy calculations; Noise simulations.
Project Title	**Alouette Aluminium Smelter Expansion (1.4B$)**
Date:	2003 to 2005

Company	SNC-Lavalin
Location	Project in Sept-îles, Québec – Project office in Sept-îles and Montreal, Québec
Position	Project Manager and Major Contract Negotiator
Task Description	• Prepared tender documents for major construction and service contracts ($150 million); Coordinated and represented project team during tender period, including tender meetings with contractors; Contract negotiation with suppliers and contractors; Major claims ($1M and up)
Project Title	**Microcell (Fido) and Bell Mobility (80M$) network implementations**
Date:	1997 to 2002
Company	Spectra Telecom
Location	Project offices in Western Canada
Position	Infrastructure Engineering Manager (Bell), Project Manager (Microcell)
Task Description	• Managed engineering team, including supervision and leadership of employees, for the design and implementation of wireless telecommunications infrastructures.

AREN NERCESSIAN

1. Family Name	NERCESSIAN
2. First Name(s)	AREN
3. Date when Joined Company	2008
4. Citizenship	Canadian

5. Language Skills: (Mark skills as EX for Excellent, VG for Very Good, G for Good, F for Fair and B for Basic)

Language	Reading	Writing	Speaking
Armenian	EX	EX	EX
English	EX	EX	EX
French	EX	EX	EX

6. Present Position Engineer Project Development & Optimization

Company	Date from-to	Roles and Responsibilities
GL Garrad Hassan North America Engineer Project Development & Optimization	2008 to present	• Layout Design and Optimization • Noise Analysis • Shadow Flicker Analysis • Visual Simulations • Permanent met mast positioning

7. Education

Institution	Date	Academic Qualifications
McGill University	2007	B.Eng Mechanical

8. Membership in Professional Societies	• OIQ student section member
9. Accomplishments and Recognitions	• Graduated with Distinction • Dean’s Honour List (top 10%)

John A. Thompson, CET
171 Fiddlers, Rd. Arisaig
Antigonish NS
Cell (902) 968-1137
Email: john.a.thompson14@gmail.com

OBJECTIVE

To obtain a position, which will allow me to make a positive contribution by using my technical ability, training and experience. To also build on and expand my skill set and gain additional experience and knowledge.

EDUCATION

Nova Scotia Community College Institute of Technology (NSCC-IT) 2002 – 2004

- Diploma in Mechanical Engineering Technology.
- Certified Engineering Technologist (TECHNOVA)

SKILLS

Computer Skills

- Software: Microsoft Office, AutoCAD, Autodesk Inventor 3-D.
- Operating Systems: All versions of Windows and windows programs.
- Trained in the use of Ontrack cost tracking & PO creation Software.

Non-Technical Skills

- Exceptional work ethic developed through various experiences from my home life and career.
- Strong communication skills both written and verbal.
- Project and time management skills developed through experiences with being on a team/crew during time sensitive projects.
- Teamwork skills acquired through numerous work experiences as well as playing on competitive minor hockey teams.
- Able to operate equipment such as tracked dozer, front end loader, forklift, tracked hoe, skid-steer, side-boom, as well as various hand and power tools.
- Working on and Leading crews in adverse conditions.

EXPERIENCE

Mortenson Construction Canada July 2011 – Oct. 2011

Field Supervisor / Process Steward (Kaizen Dept.)

- Worked as a Process Steward in the Kaizen department. Role is to promote, monitor, and focus on continuous improvement and providing value to the Customer.
- Persons in this role are looked at as a Superintendent in training.
- Organize the project approach to Continuous Improvement specifically designed to improve safety, quality and efficiency using Lean/Kaizen techniques.
- Worked closely with Senior Project Manager and Senior Superintendent to assess current process state and areas of needed improvement.
- Observed and assessed work processes and used information to suggest areas of process improvement.
- Interact with trades crews to gather their views / ideas for improvement
- Create value stream mapping to show current state and areas of possible improvement.
- Help create and modify Standardized Work Instructions.

Shear Wind Inc. (Glen Dhu Wind Farm, Nova Scotia) July 2010 – Jan 2011

Owner Representative
- Worked as an Owner Representative during the construction of 27 Enercon wind turbine project west of Antigonish, Nova Scotia.
- Dealt with safety issues, participated as a member of the site safety committee as well as was on the emergency/first responders team.
- Worked closely with Shear Wind's owners engineers (GLGH) to perform QA checks and to monitor all work being performed on site (Civil, Mechanical, Electrical).
- Performed field checks and issued punch lists to General Contractors.
- Tracked and documented progress site wide on a daily basis and reported to all involved parties (contractors, independent engineers, investors etc.).
- Worked with Contractors to help with day to day management of the project.
- Participated in field decisions and solutions for various issues related to construction.
- Represented SWI in Mortenson's "Catch the Wind" Presentation at local schools.
- Worked with lawyers to complete lease agreements with land owners.

McCallum Environmental Ltd. (Nova Scotia) June 2010 – Present

Contractor
- Worked as a contractor to assist and perform tasks related to the environmental assessment of lands to be used for the Phase II of SWI wind development.
- Monitored and maintained Bat detectors (for several months) set up to gather data in lands to be used for SWI Phase II Wind farm.
- Use knowledge of local area to execute moose transect by snowmobile to gather ongoing data for Shear Wind (very scarce moose population in this area).

TAHK Projects Inc. (Sherwood Park, Alberta) Aug 2009 - Dec 2009

QA/QC Controller
- Worked as part of the QA/QC team for the completion of piping for Tank #3 at the Repsol-Irving, Canaport LNG Terminal in St.John N.B.
- This project was quite a learning experience, and was by far the most involved QA/QC program I have ever been involved in.
- Created and updated many different documents that were required during the construction of a Liquified Natural Gas Facility (said to be one step below a Nuclear Facility in terms of QA/QC).
- Had to be familiar with different codes such as; ASME B31.1, ASME B31.3, and also the clients (CANAPORT-Owner codes and specifications).
- Became familiar with the welding specifications used for Cryogenic service (LNG is kept at minus 160 °C).
- Compiled and submitted "Test Packages" to SNC Lavalin representatives for final review.
- Worked with CWB Level II welding inspectors to compile an NDT database which showed every weld completed by TAHK Projects and tracked all the associated NDT for each weld.
- Performed field inspections / verifications as per punch lists, when required.

Grantech Engineering International Inc. (Calgary, Alberta) 2008 - 2009

Field Engineer / Junior Project Manager

- Worked as a field engineer for a 30 km 12" sales line which serviced a 80MMscf/day sour gas plant.
- Acted as a company representative and maintained liaison with shippers, landowners, contractors, and vendors.
- Supervised contractors and ensured safe practices and procedures were adhered to, as well as Environmental concerns.
- Was present during critical Creek and River crossings / bores to monitor progress and environmental impact along with a hired Environmental Consultant (Inspector).
- Demonstrated knowledge in operating standards, codes, rules and regulations that impact mechanical maintenance and pipeline operations and supports industry EH&S program.
- Responsible for ensuring all mechanical/operational activities meet or exceed industry, company, and regulatory compliance.
- Provided technical and administrative field support for construction and engineering projects including QA/QC supervision and verification, project cost tracking and reporting, maintained appropriate project records and documents and submitted daily field/progress reports to head office.
- Quality Assurance/Quality Control of IFC Drawings
- Review of process flow diagrams
- Review of Piping and Instrumentation Diagrams
- Review of Vendor mechanical drawings
- Review of ISO drawings
- Comparison of IFC to As Built
- Red Line of all of the above for As Built accuracy
- As a team member, conducted pre-commissioning mechanical maintenance and compliance checks and participated in the commissioning stages through to final plant start-up of a new 80MMscf/day sour gas plant.
- Provided support to help plant operators learn plant process after startup.

D-Line Construction (Grande Prairie, Alberta) 2007 - 2008

Lead Hand / Foreman

- Involved in many aspects of pipeline and facility construction, both new construction and maintenance refits.
- Obtained useful knowledge and field experience pertaining to the extraction, treatment and transportation of an oil / gas commodity.
- Took part in many different types of construction projects such as: new well tie-in construction, dig up programs to replace faulty or corroded sections of pipeline, various hot-line dig-ups and tie-ins, riser installation and construction of riser (camelback) sites.
- Exposed to quality control procedures, including high pressure hydro testing and material handling.
- Was competent in operation of equipment in key moments of construction.

IPAC Services / Aron Services (Grande Prairie, Alberta) 2006 - 2007

Pipeline / Facility Hand

- Involved in many aspects of pipeline and facility construction, both new construction and maintenance refits.
- Obtained useful knowledge and field experience pertaining to the extraction, treatment and transportation of an oil / gas commodity.
- Took part in many different types of construction projects such as: new well tie-in construction, dig up programs to replace faulty or corroded sections of pipeline, various hot-line dig-ups and tie-ins, riser installation and construction of riser (camelback) sites.
- Exposed to quality control procedures, including high pressure hydro testing and material handling.
- Was competent in operation of equipment in key moments of construction.

Veritas DGC Land (Fort McMurray and North Eastern BC areas) Winter **-** 2006
Seismic Line worker / Line-boss
- Involved in heli-portable operations and learned much about seismic field work.
- Proved myself as a quick learner and obtained a line-boss position.

Fisherman's Helper (Nova Scotia) 2005 - 2007
General Laborer
- Involved in three fisheries, all of which are labor intensive. (Lobster, Herring and Mackerel).
- Mechanical aptitude an asset for maintenance & repairs, both on land and water.

Eastern Canadian Structures LTD. (NSCC-IT School Work-Term) 2004
CAD Operator & Designer
- Created and edited CAD designs for numerous steel structures that included industrial shop fabrication drawings and approval drawings for upcoming projects being quoted at the time.
- Applied and built upon both computer and design skills through the use of AutoCAD drafting software.
- Developed skills pertaining to the design of steel structures.
- Extended my knowledge to team and worked cooperatively to successfully complete projects in a timely manner.

VAS MacGillivray Construction (High School - Summer Employment) 2001 - 2004
Carpenter's Apprentice
- Involved in all aspects of new construction as well as renovation.
- Furthered teamwork skills while working with several carpenters and other trades people.
- Often given the responsibility to complete tasks on my own and supervise the completion of smaller tasks.

Arisaig Fisheries (High School - Summer Employment) 2000 - 2002
Laborer / Forklift Operator
- Carried out tasks including but not limited to shipping and receiving, forklift operation and fish stock retailing.
- Assigned and entrusted with the handling, preserving and selling of fish stock.

Donald Ross (High School - Summer Employment) 2000
Carpentry Assistant
- Initiated and built a skill base that proved to be useful in home renovation and construction.

Thompson Lumber Company (Family Business) 1994 - 1998
Laborer
- Worked at a family run sawmill. Worked in a lumberyard, planner mill and ran an edger.
- Began training to become a sawyer.
- Became skilled at optimizing recovery and determining economic value in individual raw products being produced in the milling process.
- Acquired a knowledge base and experience in producing dressed (planed) grade stamped lumber which met provincial and national lumber grading standards.

ADDITIONAL TRAINING

- WHMIS
- Occupational Health and Safety
- Certified Standard First Aid, CPR-C (ESO) and AED (St. John Ambulance)
- Certified Emergency First Aid – Industry (St. John Ambulance)
- H_2S Alive
- Valid Driver's license
- Advanced Fall Protection (AB,BC)
- Rescue Fall Protection (AB, BC)
- Extinguisher Firefighting Level II

INTERESTS / HOBBIES

- Interest in anything mechanical; enjoy learning how things work and how to repair them. (Trucks, dirt bikes, equipment, etc.).
- Self taught welder with an interest in fabrication.
- Outdoor activities (hunting, boating, fishing, camping, four-wheeling, dirt biking)
- Sports (hockey, softball, Snowboarding/Wakeboarding)

REFERENCES AVAILABLE UPON REQUEST

Jody R. Hamper

2796 Laggan Rd., Barney's River, NS, B0K 1A0 902-759-3412

Experience

E & R Langille Contracting, New Glasgow, NS, (2007-present)

Logging Crew Supervisor

- Cut block lay-out
- Supervising work crews
- Coordinating transportation, floating schedules
- Collecting and monitoring time cards for payroll
- Timber Cruising

M & R Ross, New Glasgow, NS, (2006-2007)

Harvest Block Layout

- Laying out the harvest blocks for harvesting crew
- Supervising work crews

Education

1999 **Maritime Forest Ranger School, Fredericton, NB**
Forest Technician, Certified (Graduated with Honours)

1996-1998 **Holland College, Charlottetown, PEI**
Diploma in Renewable Resource Management

Skills

Emergency First Aid, comfortable with Microsoft Office, experience using GPS and GIS, work well on my own or with a team, detailed oriented

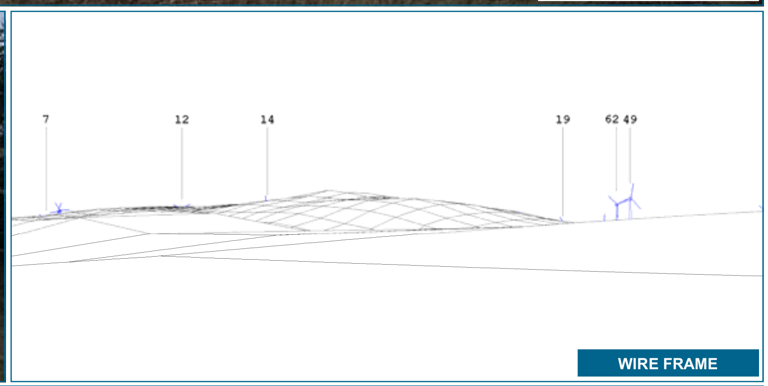
Additional Information & Interests

Volunteer Fire Fighter with Barney's River Volunteer Fire Department
Member of Masonic Lodge, Pictou County Shrine Club
Interests include hiking, rafting, playing hockey and travelling.

Appendix XIII. PHOTOMONTAGES AND VISUAL ZONE OF INFLUENCE

VISUAL SIMULATION

ORIGINAL PHOTO



WIRE FRAME

Note:
* The Wire Frame Technical drawing does not take into consideration vegetation. It is possible that wind turbines are visible on the wire frame drawing but not on the visual simulation.

TECHNICAL DATA

PHOTOGRAPH - VIEW POINT

Photograph Number:		PHOTO 3
Coordinates (UTM 20 NAD83) :	557328 E	5049308 N
Altitude with respect to mean sea level:		84 m
Date Photograph was taken :		November 29th, 2011
Direction :		48 degrees T.N.
Focal Length :		27 mm
View span :		67 degrees
Altitude of photograph with respect to ground :		1.8 m

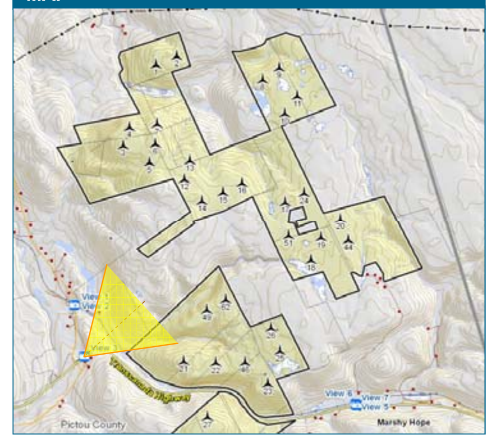
WIND TURBINES USED

Model :	GE 1.6 100
Height of nacelle—mid point :	80 m
Rotor Diameter :	100 m

SIMULATION

Visual Simulation No. :	PM08-70607GDS-PHOTO3-E557328_N5049308-L51-T01-D48-AN00.WFV
Configuration No. :	L51-70607GDS-20111202-MLR.WFL
Total number of wind turbines for the project:	62
Total number of visible wind turbines in visual simulation:	0
Closest visible wind turbine :	N/A
Furthest visible wind turbine :	N/A

MAP



Prepared for :

Shear Wind Inc.

Prepared by :

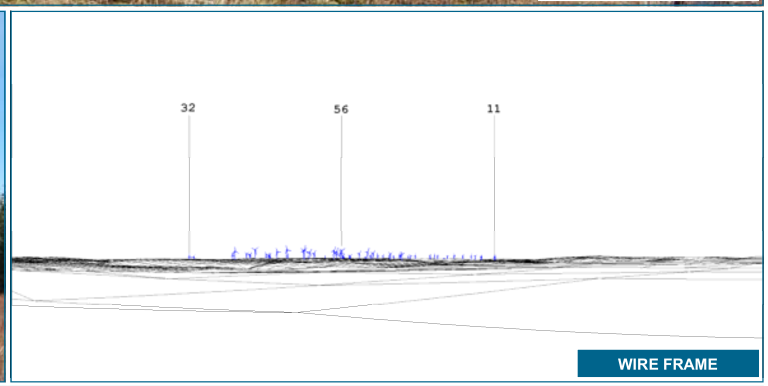
GL Garrad Hassan

Date : December 7th, 2011
Version 00

VISUAL SIMULATION

As viewed from TransCanada Highway looking NorthEast

Glen Dhu South Wind Farm



Note:
* The Wire Frame Technical drawing does not take into consideration vegetation. It is possible that wind turbines are visible on the wire frame drawing but not on the visual simulation.

TECHNICAL DATA

PHOTOGRAPH - VIEW POINT

Photograph Number:		P8003
Coordinates (UTM 20 NAD83) :	568580 E	5040273 N
Altitude with respect to mean sea level:		223 m
Date Photograph was taken :		December 5th, 2011
Direction :		320 degrees T.N.
Focal Length :		27 mm
View span :		67 degrees
Altitude of photograph with respect to ground :		1.8 m

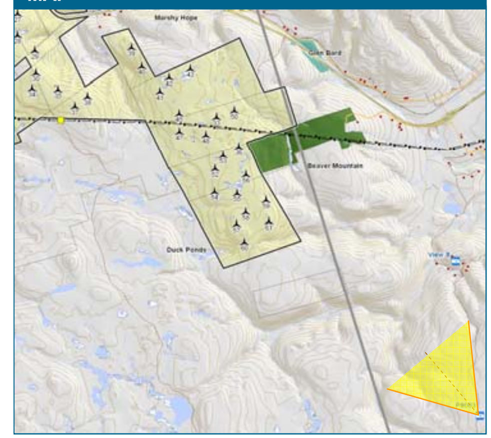
WIND TURBINES USED

Model :	GE 1.6 100
Height of nacelle—mid point :	80 m
Rotor Diameter :	100 m

SIMULATION

Visual Simulation No. :	PM07-70607GDS-P8003-E568580_N5040273-L51-T01-D320-MLR00.WFV
Configuration No. :	L51-70607GDS-20111202-MLR.WFL
Total number of wind turbines for the project:	62
Total number of visible wind turbines in visual simulation:	0
Closest visible wind turbine :	N/A
Furthest visible wind turbine :	N/A

MAP



Prepared for : Shear Wind Inc.

Prepared by : GL Garrad Hassan

Date : December 7th, 2011
Version 00

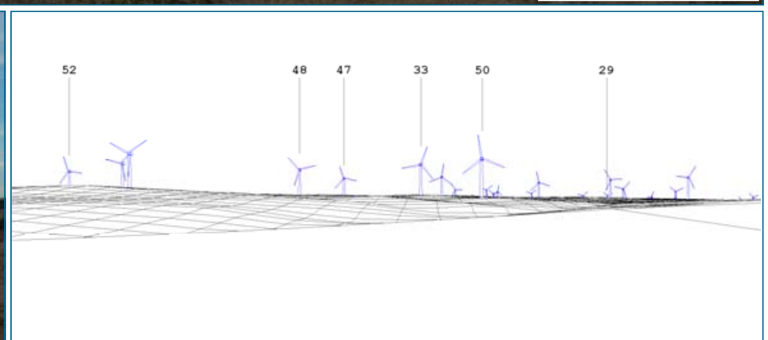
VISUAL SIMULATION

As viewed from Keppoch Road

Glen Dhu South Wind Farm


VISUAL SIMULATION


ORIGINAL PHOTO



WIRE FRAME

Note:
* The Wire Frame Technical drawing does not take into consideration vegetation. It is possible that wind turbines are visible on the wire frame drawing but not on the visual simulation.

TECHNICAL DATA

PHOTOGRAPH - VIEW POINT

Photograph Number:		P8052
Coordinates (UTM 20 NAD83) :	565004 E	5046284 N
Altitude with respect to mean sea level:		197 m
Date Photograph was taken :		December 5th, 2011
Direction :		267 degrees T.N.
Focal Length :		27 mm
View span :		67 degrees
Altitude of photograph with respect to ground :		1.8 m

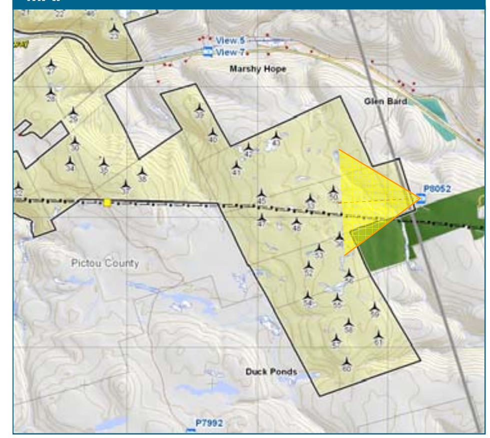
WIND TURBINES USED

Model :	GE 1.6 100
Height of nacelle—mid point :	80 m
Rotor Diameter :	100 m

SIMULATION

Visual Simulation No. :	PM06-70607GDS-P8052-E656004_N5046284-L51-T01-D267-MLR00.WFV
Configuration No. :	L51-70607GDS-20111202-MLR.WFL
Total number of wind turbines for the project:	62
Total number of visible wind turbines in visual simulation:	20
Closest visible wind turbine :	No 50 at 1.3 km
Furthest visible wind turbine :	No 28 at 5.9 km

MAP



Prepared for : Shear Wind Inc.

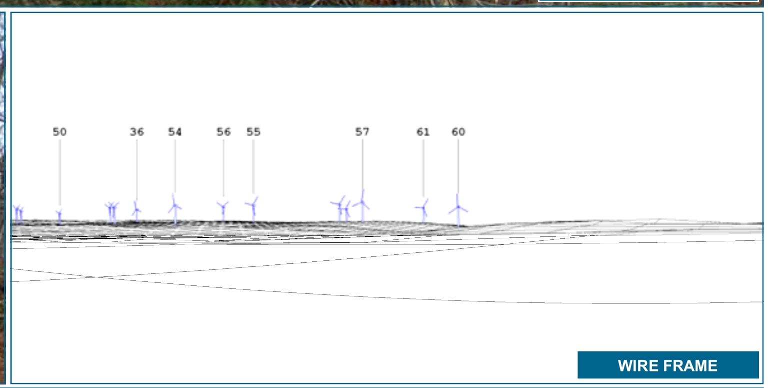
Prepared by : GL Garrad Hassan

Date : December 6th, 2011
Version 00

VISUAL SIMULATION

As viewed from Beaver Mountain Provincial Park

Glen Dhu South Wind Farm



Note:
* The Wire Frame Technical drawing does not take into consideration vegetation. It is possible that wind turbines are visible on the wire frame drawing but not on the visual simulation.

TECHNICAL DATA

PHOTOGRAPH - VIEW POINT

Photograph Number:		P7992
Coordinates (UTM 20 NAD83) :	561484 E	5042676 N
Altitude with respect to mean sea level:		239 m
Date Photograph was taken :		December 5th, 2011
Direction :		60 degrees T.N.
Focal Length :		27 mm
View span :		67 degrees
Altitude of photograph with respect to ground :		1.8 m

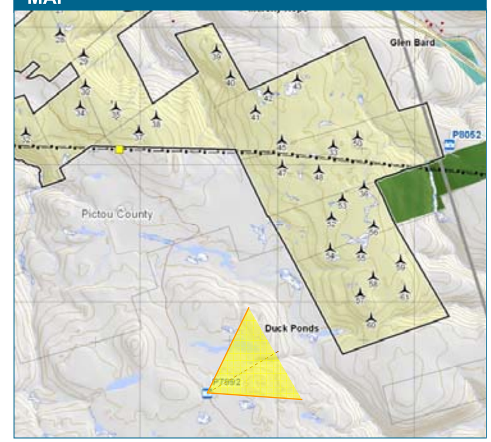
WIND TURBINES USED

Model :	GE 1.6 100
Height of nacelle—mid point :	80 m
Rotor Diameter :	100 m

SIMULATION

Visual Simulation No. :	PM05-70607GDS-P7992-E561484_N5042676-L51-T01-D60-AN00.WFV
Configuration No. :	L51-70607GDS-20111202-MLR.WFL
Total number of wind turbines for the project:	62
Total number of visible wind turbines in visual simulation:	1
Closest visible wind turbine :	57 at 2.7 km
Furthest visible wind turbine :	57 at 2.7 km

MAP



Prepared for : Shear Wind Inc.

Prepared by : GL Garrad Hassan

Date : December 6th, 2011
Version 00

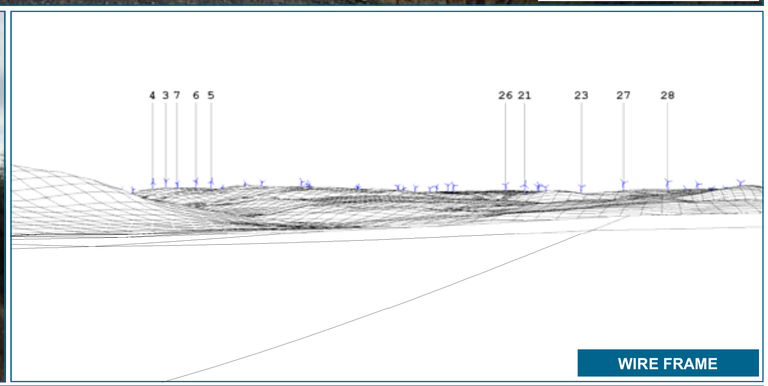
VISUAL SIMULATION

As viewed from Weave's Mountain Road near Duck Ponds

Glen Dhu South Wind Farm


VISUAL SIMULATION


ORIGINAL PHOTO



WIRE FRAME

Note:
* The Wire Frame Technical drawing does not take into consideration vegetation. It is possible that wind turbines are visible on the wire frame drawing but not on the visual simulation.

TECHNICAL DATA

PHOTOGRAPH - VIEW POINT

Photograph Number:		P7973
Coordinates (UTM 20 NAD83) :	553055 E	5047945 N
Altitude with respect to mean sea level:		114 m
Date Photograph was taken :		December 5th, 2011
Direction :		65 degrees T.N.
Focal Length :		27 mm
View span :		67 degrees
Altitude of photograph with respect to ground :		1.8 m

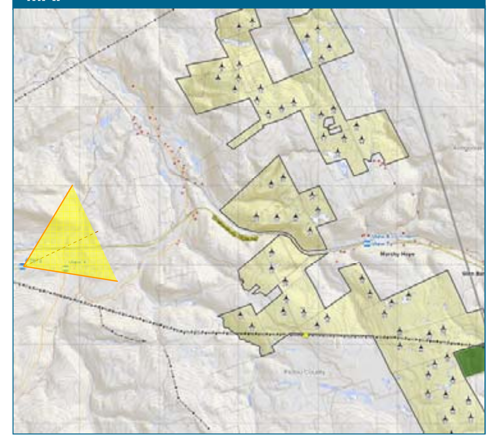
WIND TURBINES USED

Model :	GE 1.6 100
Height of nacelle—mid point :	80 m
Rotor Diameter :	100 m

SIMULATION

Visual Simulation No. :	PM04-70607GDS-P7973-E553055_N5047945-L51-T01-D65-MLR00.WFV
Configuration No. :	L51-70607GDS-20111202-MLR.WFL
Total number of wind turbines for the project:	62
Total number of visible wind turbines in visual simulation:	19
Closest visible wind turbine :	21 at 6.0 km
Furthest visible wind turbine :	20 at 9.2 km

MAP



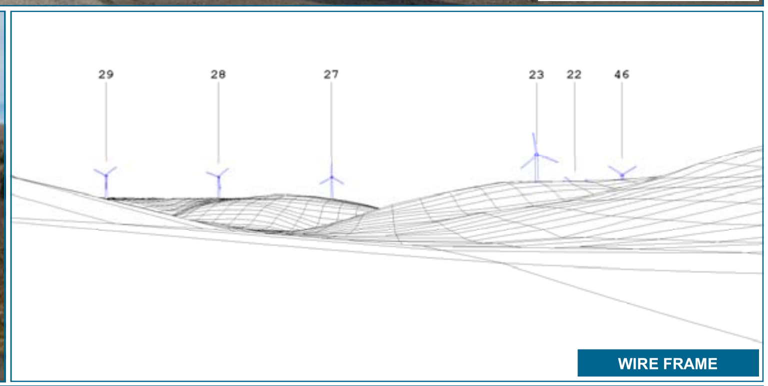
Prepared for : Shear Wind Inc.

Prepared by : GL Garrad Hassan
Date : December 6th, 2011
Version 00

VISUAL SIMULATION

As viewed from Road 4, west of Kenzieville

Glen Dhu South Wind Farm



Note:
* The Wire Frame Technical drawing does not take into consideration vegetation. It is possible that wind turbines are visible on the wire frame drawing but not on the visual simulation.

TECHNICAL DATA

PHOTOGRAPH - VIEW POINT

Photograph Number:		PHOTO 7
Coordinates (UTM 20 NAD83) :	561745 E	5048542 N
Altitude with respect to mean sea level:		126 m
Date Photograph was taken :		November 29th, 2011
Direction :		270 degrees T.N.
Focal Length :		27 mm
View span :		67 degrees
Altitude of photograph with respect to ground :		1.8 m

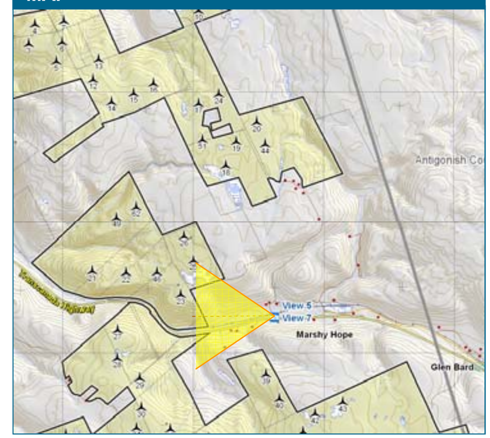
WIND TURBINES USED

Model :	GE 1.6 100
Height of nacelle—mid point :	80 m
Rotor Diameter :	100 m

SIMULATION

Visual Simulation No. :	PM03-70607GDS-PHOTO7-E561745_N5048542-L51-T01-D270-MLR00.WFV
Configuration No. :	L51-70607GDS-20111202-MLR.WFL
Total number of wind turbines for the project:	62
Total number of visible wind turbines in visual simulation:	5
Closest visible wind turbine :	No 23 at 1.5 km
Furthest visible wind turbine :	No 28 at 2.5 km

MAP



Prepared for :

Shear Wind Inc.

Prepared by :

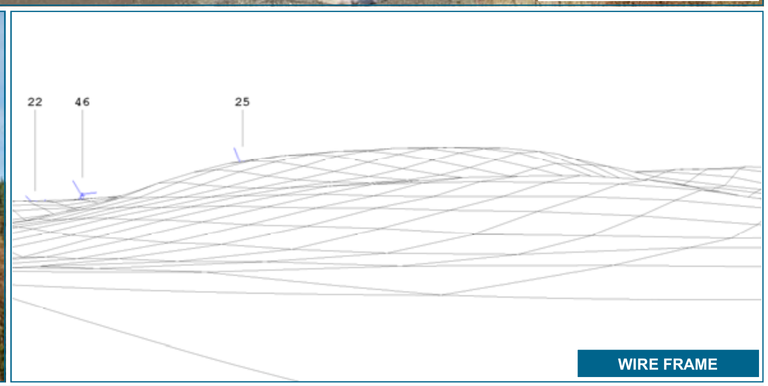
GL Garrad Hassan

Date : December 6th, 2011
Version 00

VISUAL SIMULATION

As viewed from John Munroe Road at Highway 104 (Marshy Hope)

Glen Dhu South Wind Farm



Note:
* The Wire Frame Technical drawing does not take into consideration vegetation. It is possible that wind turbines are visible on the wire frame drawing but not on the visual simulation.

TECHNICAL DATA

PHOTOGRAPH - VIEW POINT

Photograph Number:		PHOTO 5
Coordinates (UTM 20 NAD83) :	561745 E	5048542 N
Altitude with respect to mean sea level:		126 m
Date Photograph was taken :		November 29th, 2011
Direction :		317 degrees T.N.
Focal Length :		27 mm
View span :		67 degrees
Altitude of photograph with respect to ground :		1.8 m

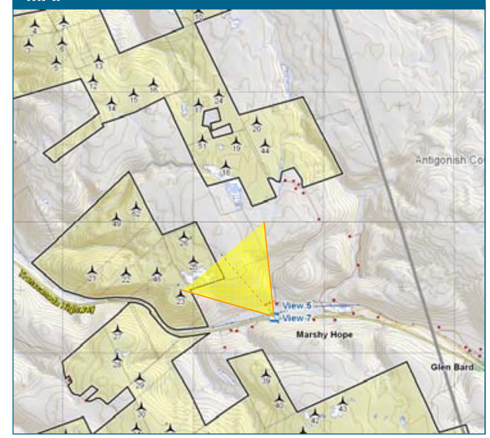
WIND TURBINES USED

Model :	GE 1.6 100
Height of nacelle—mid point :	80 m
Rotor Diameter :	100 m

SIMULATION

Visual Simulation No. :	PM02-70607GDS-PHOTO5-E561745_N5048542-L51-T01-D317-MLR00.WFV
Configuration No. :	L51-70607GDS-20111202-MLR.WFL
Total number of wind turbines for the project:	62
Total number of visible wind turbines in visual simulation:	2
Closest visible wind turbine :	No 25 at 1.5 km
Furthest visible wind turbine :	No 46 at 1.9 km

MAP



Prepared for : Shear Wind Inc.

Prepared by : GL Garrad Hassan

Date : December 6th, 2011
Version 00

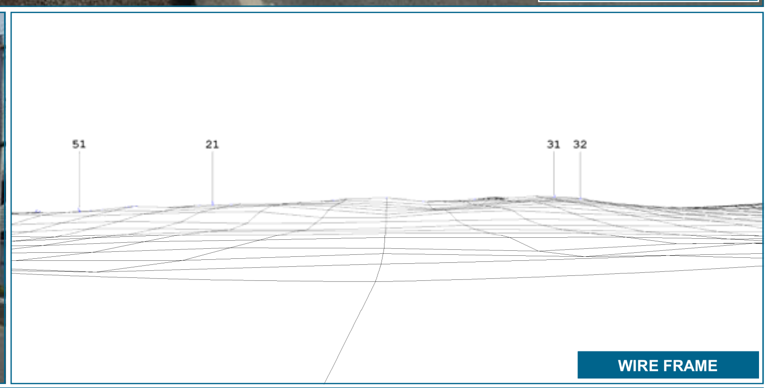
VISUAL SIMULATION

As viewed from John Munroe Road at Highway 104 (Marshy Hope)

Glen Dhu South Wind Farm


VISUAL SIMULATION


ORIGINAL PHOTO



WIRE FRAME

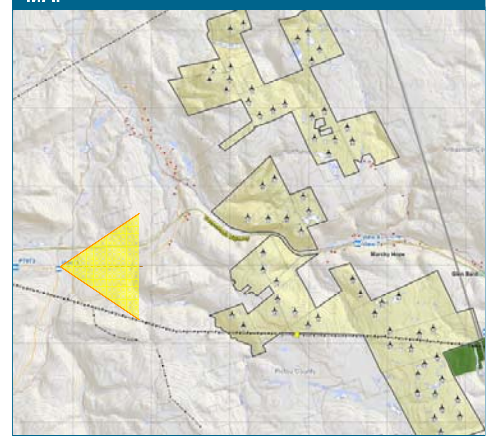
Note:
* The Wire Frame Technical drawing does not take into consideration vegetation. It is possible that wind turbines are visible on the wire frame drawing but not on the visual simulation.

TECHNICAL DATA

PHOTOGRAPH - VIEW POINT

Photograph Number:		PHOTO 4
Coordinates (UTM 20 NAD83) :	554145 E	5047899 N
Altitude with respect to mean sea level:		75 m
Date Photograph was taken :		November 29th, 2011
Direction :		90 degrees T.N.
Focal Length :		27 mm
View span :		67 degrees
Altitude of photograph with respect to ground :		1.8 m
WIND TURBINES USED		
Model :		GE 1.6 100
Height of nacelle—mid point :		80 m
Rotor Diameter :		100 m
SIMULATION		
Visual Simulation No. :		PM01-70607GDS-PHOTO4-E554145_N5047899-L51-T01-D90-MLR00.WFV
Configuration No. :		L51-70607GDS-20111202-MLR.WFL
Total number of wind turbines for the project:		62
Total number of visible wind turbines in visual simulation:		0
Closest visible wind turbine :		N/A
Furthest visible wind turbine :		N/A

MAP



Prepared for :

Shear Wind Inc.

Prepared by :

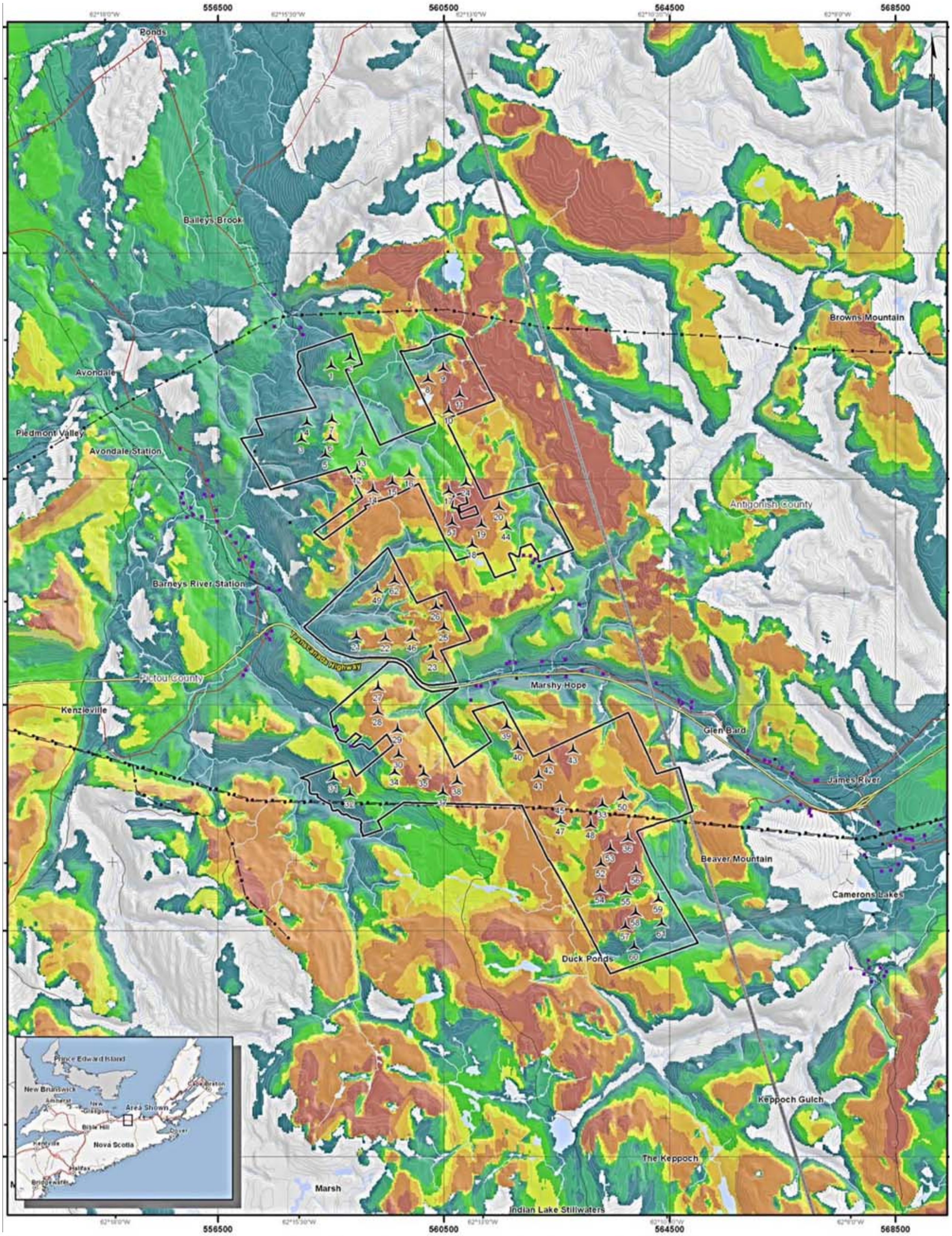
GL Garrad Hassan

Date : December 6th, 2011
Version 00

VISUAL SIMULATION

As viewed from Kenzieville Highway

Glen Dhu South Wind Farm



Legend

Project Components
- Wind Turbine (62)
- Project Area

Other Components
- Dwelling
- Other Building
- Powerline
- Transcanada Highway
- Local Highway
- Other Road
- Railroad
- Watercourse
- Contours (interval: 5m)
- County Boundary
- Waterbody

Turbine Visibility
Without considering the effect of vegetation
- [0 - 10]
- [10 - 20]
- [20 - 30]
- [30 - 40]
- [40 - 50]
- [50 - 60]
- [60 - 62]

0 1 2 4 6 kilometres

Shear Wind Inc.
Glen Dhu Wind Project

ZONE OF VISUAL INFLUENCE
LAYOUT 51 (62 WIND TURBINES)

GL Garrad Hassan

December 2, 2011

Projection: UTM Zone 20, NAD83

Sources: CanVec 50k, Nova Scotia Forest Inventory, Nortek Resource Solutions, Beaver Mountain Provincial Park, RABC/CanWEA, Significant Species and Habitats Database, Restricted and Limited Use Land Database and Industry Canada, LIDAR.

Appendix XIV. SHADOW FLICKER ASSESSMENT

GL Garrad Hassan

SHADOW FLICKER ASSESSMENT

GLEN DHU SOUTH WIND FARM, PICTOU COUNTY, NOVA SCOTIA

Client	Shear Wind Inc.
Contact	Ian Tillard
Document No.	706-07-CAMO-R-02
Issue	A
Status	Final
Classification	Client's Discretion
Date	16 January 2012

Author:

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Checked by:

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REVISION HISTORY

Issue	Issue Date	Summary
A	16 January 2012	Original issue

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LIST OF FIGURES

1 INTRODUCTION

GL Garrad Hassan Canada, Inc. ("GL GH"), a member of the GL Group and part of the GL Garrad Hassan brand, has been commissioned by Shear Wind Inc. ("Client") to independently assess the impact of the shadow flicker effects in the vicinity of the proposed Glen Dhu South Wind Farm (the "Project"). The proposed Glen Dhu South Wind Farm is located in Pictou county, Nova Scotia. The wind farm consists of 62 GE 1.6-100 with a maximum blade tip height of 130 m, a hub height of 80 m and a rotor diameter of 100 m. These turbines can have an influence on the shadow flicker events experienced at sensitive locations in the vicinity of the Project. The ID and coordinates of the layout and the list of dwellings are the same as those used in the Noise Impact Assessment already issued in December 2011.

Shadow flicker is defined as the modulation of light levels resulting from the periodic passage of a rotating wind turbine blade between the sun and a viewer. The duration of shadow flicker experienced at a specific location can be determined using a purely geometric analysis which takes into account the relative positions of the sun throughout the year, the wind turbines at the site, and the viewer. This method has been used to determine the duration of shadow flicker events at sensitive locations in vicinity of the Project.

It should be noted, however, that this analysis method tends to be conservative (see Section 3.3) and therefore typically results in an over-estimation of the number of hours of shadow flicker experienced at a given dwelling.

This report includes a brief presentation of the Project site, a description of the shadow flicker assessment methodology, results of the analysis including a map illustrating areas prone to shadow flicker, and concluding comments.

2 DESCRIPTION OF THE WIND FARM SITE

2.1 Site Description

The Project is located in the county of Pictou, Nova Scotia, and has a projected nameplate capacity of 100 MW. The layout consists of 62 GE 1.6-100 wind turbine generators (WTG). More specifically, the Project is located approximately in an area 8 km to 20 km south of the Northumberland Straight and some 30 km east of the city of New Glasgow.

The turbines are located on a plateau where the elevation ranges between 190 m and 275 m asl with the average elevation being 230 m asl. The land use of the site is predominantly characterized by forested areas.

2.2 Wind Farm Layout

The proposed turbine layout is comprised of 62 GE 1.6-100 wind turbine generators. The coordinates of each turbine are presented in Appendix A [1].

2.3 Receptors Locations

A list of validated receptors has been provided by the client [2]. This list includes 24 receptors within 1,500 m of a turbine, but only the 20 receptors within a study zone of 1,300 m of a turbine, a distance calculated on the basis of the turbine's tip height x 10 (see methodology section below), have been considered in this analysis. Coordinates of the receptors considered in this study are presented in Appendix B.

2.4 Applicable Regulations

There are no applicable local or state requirements with regard to shadow flicker in the jurisdictions associated with this Project. However, GL GH considers maximum levels of 30 hours/year and 30 minutes/day of flicker at inhabited residences (taking into account cloud cover for the maximum hour per year) as best practices that should ideally be applied to wind farms.

3 SHADOW FLICKER ASSESSMENT

3.1 Overview

Shadow flicker may occur under certain combinations of circumstances with regards to the sun's position and wind direction; when the sun passes behind the rotating blades of a wind turbine, a moving shadow is cast in front of or behind the turbine. When viewed from a stationary position, the moving shadows cause periodic flickering of the sunlight, otherwise known as the "shadow flicker" phenomenon.

The effect is most noticeable inside buildings, where the flicker appears through a window opening. The likelihood and duration of the effect depends on a number of variables, namely:

- Orientation of the building relative to the turbine;
- Wind direction: the shape and intensity of the shadow are determined by the position of the sun relative to the blades (the turbine rotor continuously yaws to face the wind so the rotor plane will always be perpendicular to the wind direction;
- Distance from turbine: the farther the observer from the turbine, the less pronounced the effect;
- Turbine height and rotor diameter: a larger turbine rotor diameter will cast a larger shadow, meaning a larger area will be prone to incidences of shadow flicker;
- Time of year and day: position of sun relative to the horizon;
- Weather conditions: cloud cover reduces the occurrence of shadow flicker;
- Vegetation and other obstacles that help to mask shadows;
- Operational status of turbines.

3.2 Assessment Methodology

The number of hours of shadow flicker experienced annually at a given location can be calculated using a geometrical model which takes into account the sun's position, topography of the wind farm site and wind turbine specifications such as rotor diameter and hub height.

The wind turbine has been modeled assuming all wind turbines are disc objects oriented perpendicular to the sun-turbine vector, representing the maximum duration for which there is potential for shadow flicker to occur.

Shadow flicker has been calculated at the subject receptors (i.e. dwellings) at a height of 2 m to represent ground floor windows. Rather than facing a particular direction, shadow flicker receptors (windows) are simulated as horizontal planes, meaning they experience shadow flicker over 360°; this assumption therefore represents a worst case scenario. Simulations have been carried out with a resolution of 1 minute; if shadow flicker occurs in any 1-minute period, the model registers this as 1 minute of shadow flicker.

It is generally accepted that shadow flicker from wind turbines does not occur beyond a distance, D, from a given wind turbine. The UK wind industry considers this distance to be equivalent to 10 rotor diameters [3], while the Danish wind industry suggests a value of between 500 and 1000 m [4]. GL GH has adopted a conservative approach and has assumed the length, D, that a shadow can be cast on the basis of the following formula:

D = 10 x (hub height + rotor radius)

Beyond this distance, a viewer does not perceive the turbine blade to be chopping the light, but rather as an object passing in front of the sun.

Shadow flicker calculations can be adjusted using an annual cloud coverage figure which is based on historical meteorological data and statistics. According to data gathered from meteorological stations, an annual cloud cover can be estimated and applied as a percentage. Further, using the site-specific wind rose to consider the probability of the turbines being oriented in a given direction could lead to significant further reduction in the annual shadow flicker occurrence.

No attempt has been made to account for vegetation or other shielding effects around each shadow receptor in the calculations of shadow flicker duration. Similarly, turbine shut-down has not been considered.

3.3 Conservative Assumptions

Shadow flicker duration calculated in the manner described above typically over-estimates the annual number of hours of shadow flicker experienced at a specified location for several reasons, namely:

1. The modeling of the wind turbine blades as discs rather than individual blades results in an overestimate of shadow flicker duration.

   Turbine blades are of non-uniform thickness with the thickest part of the blade (maximum chord) close to the hub and the thinnest part (minimum chord) at the tip. Diffusion of sunlight, as discussed above, results in a limit to the maximum distance that a shadow can be perceived. This maximum distance will also be dependent on the thickness of the turbine blade and the human threshold for perception of light intensity variation. As such, a shadow cast by the blade tip will be shorter than the shadow cast by the thickest part of the blade [5].

2. The wind turbine will not always be yawed such that its rotor is perpendicular to the sun-turbine vector). Any other rotor orientation will reduce the area of the projected shadow, and thus the incidence of shadow flicker. Additionally, the orientation of windows on a given house has not been taken into account, i.e. the model assumes that a window is always facing the turbine(s).

   The wind speed frequency distribution, or wind rose, at the site can be used to determine probable turbine orientation in order to calculate the resulting reduction in shadow flicker duration; however this has not been done in this study.

3. Aerosols (moisture, dust, smoke, etc.) in the atmosphere have the ability to influence shadows cast by a wind turbine.

   The length of the shadow cast by a wind turbine is dependent on the degree that direct sunlight is diffused, which in turn is dependent on the amount of dispersants (humidity, smoke and other aerosols) in the path between the light source (sun) and the receiver [5].

4 Modeling the sun as a point light source rather than a disc results in an overestimate of the shadow flicker duration. The fact that the light source is a disc results in a shadow which is less well defined and of lower intensity as compared to a point light source.

The occurrence of cloud cover has the potential to significantly reduce the number of hours of shadow flicker.

Cloud cover measurements recorded at nearby meteorological stations may be used to estimate probable levels of cloud cover, and to provide an indication of the resulting reduction in shadow flicker duration (see Section 3.2).

5 The presence of vegetation or other physical barriers around a shadow receptor location may shield the view of the wind turbine, and therefore reduce the incidence of shadow flicker.

6 Periods where the wind turbine is not in operation due to low winds, high winds, or for operational and maintenance reasons will also reduce shadow flicker occurrence.

In light of the reasons listed above, it is likely that the shadow flicker durations presented in Section 4 can be regarded as conservative.

3.4 Current Analysis

The shadow flicker assessment for the proposed Project has been conducted for the 62 GE 1.6-100 turbines using the method described in Section 3.2 above. All receptors in located at a distance D from the turbines, defined in Section 3.2, have been included in the study. For the GE 1.6-100 wind turbine generator this equates to 1,300 m.

In order to render more realistically the shadow flicker results, an annual cloud cover figure has been considered based on data gathered from Halifax and Sydney Airports meteorological stations. It has been estimated that the cloud cover is sufficient to nullify shadow flicker occurrence 69.6 % of the time over the course of a year. Results both with and without consideration of cloud cover are presented in Section 4 and Appendix B.

The model does not take into account any obstacles like for example; vegetation, mountains, or other shielding effects, around each shadow receptor in calculating the shadow flicker duration. Similarly, turbine shut-down has not been considered. For these reasons and the other conservative assumptions listed in Section 3.3 above, and the consideration of cloud cover, it is likely that the adjusted shadow flicker durations presented here can still be regarded as conservative.

4 RESULTS

A map illustrating predicted shadow flicker duration at receptors lying within 1,300 m of the Glen Dhu South Wind Farm is presented in Figure 4-1. This map takes into account average annual cloud cover. For illustrative purposes shadow flicker is shown when occurring 30 hours or more per year.

The results of the shadow flicker assessment are presented for all receptors locations provided by the Client and within the study zone (in terms of maximum minutes per day and total hours per year) in tabular format in Appendix B.

As per the predicted levels from this analysis, no dwellings are predicted to experience more than 30 hours of shadow flicker per year; however three (3) dwellings are predicted to experience at least one day with more than 30 minutes of shadow flicker during that given day. Results in hours per year take into account the cloud cover from the Environment Canada meteorological stations at Halifax and Sydney Airports but, as described in Section 3.3, these results are still considered to be overestimated.

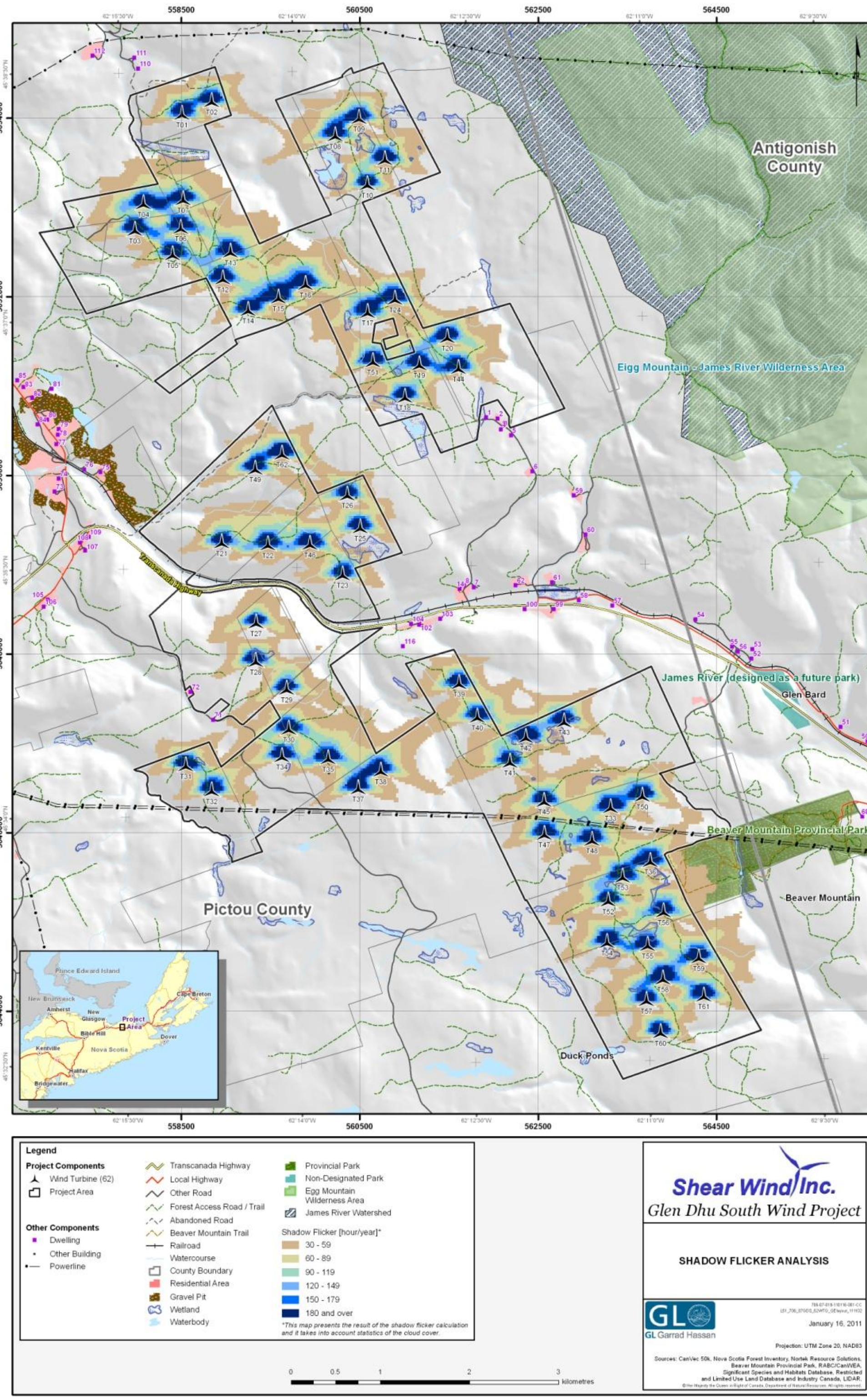

Figure 4-1: Modeled hours of shadow flicker at Glen Dhu South Wind Farm

5 CONCLUSION

An analysis has been conducted to determine the duration of shadow flicker likely to be experienced at receptors in the vicinity of the Glen Dhu South Wind Farm Wind Farm in County, Pictou county, Nova Scotia. This analysis was realized specifically for the GE 1.6-100 wind turbine with a blade tip height of 130 m.

None of the 20 dwellings located within 1,300 m of the Project are predicted to experience more than 30 hours of shadow flicker per year; however three (3) dwellings are predicted to experience at least one day with more than 30 minutes of shadow flicker during that given day. The maximum of shadow flicker for those three dwellings is 34 minutes per day. Detailed results can be found in Appendix B. Results in hours per year take into account the cloud cover from the Environment Canada meteorological stations at Halifax and Sydney Airports but, as described in Section 3.3, these results are still considered to be overestimated.

6 REFERENCES

[1] Turbine layout of the 62 locations of the GE1.6-100, optimized by GL GH.

[2] Dwellings locations sent by email, by Ian Tillard, Shear Wind, to Pierre Héraud, GL GH, July 2011, "Glen Dhu south house data July 2011.xls.". This file was updated by GL GH according to the information provided by the client after each site visit.

[3] Danish Wind Industry Association, "Shadow variations from Wind turbines", http://guidedtour.windpower.org/en/tour/env/shadow/shadow2.htm, viewed 22 July 2010.

[4] Department for Business Enterprise & Regulatory Reform, UK, "Onshore Wind: Shadow Flicker", http://www.berr.gov.uk/whatwedo/energy/sources/renewables/planning/onshore-wind/shadow-flicker/page18736.html , viewed 23 July 2010.

[5] Freud H-D, Kiel F.H., "Influences of the opaqueness of the atmosphere, the extension of the sun and rotor blade profile on the shadow impact of wind turbine", DEWI Magazine No. 20 pp 43-51, Feb 2002.

APPENDIX A TURBINE LAYOUT

Coordinates of turbines

Turbine ID	Easting [m]	Northing [m]
1	558509	5054031
2	558842	5054174
3	557979	5052731
4	558077	5053028
5	558403	5052457
6	558493	5052756
7	558521	5053075
8	560226	5053790
9	560492	5053985
10	560586	5053242
11	560783	5053525
12	558966	5052187
13	559050	5052488
14	559250	5051836
15	559589	5051973
16	559893	5052125
17	560588	5051813
18	561006	5050864
19	561167	5051226
20	561480	5051531
21	558953	5049233
22	559471	5049211
23	560309	5048875
24	560894	5051960
25	560504	5049401
26	560359	5049769
27	559339	5048336
28	559335	5047905
29	559682	5047595
30	559703	5047148
31	558550	5046738
32	558840	5046456
33	563313	5046268
34	559628	5046841
35	560146	5046817
36	563758	5045667

Turbine ID	Easting [m]	Northing [m]
37	560483	5046482
38	560737	5046678
39	561613	5047656
40	561819	5047281
41	562183	5046777
42	562363	5047054
43	562791	5047230
44	561607	5051186
45	562565	5046340
46	559943	5049217
47	562570	5045970
48	563103	5045905
49	559327	5050059
50	563668	5046397
51	560646	5051260
52	563286	5045224
53	563448	5045492
54	563273	5044759
55	563727	5044725
56	563904	5045101
57	563713	5044109
58	563899	5044352
59	564301	5044588
60	563872	5043750
61	564357	5044160
62	559629	5050227

1. Coordinate system is UTM Zone 20N, NAD83 datum.

APPENDIX B HOUSE LOCATIONS AND ASSOCIATED SHADOW FLICKER

Shadow flicker at dwellings

Receptors		UTM Coordinates		Entity	No. of Days per Year	Worst Day	Max Minutes per Day [min/day]	Total Hours in Year [hrs/yr]		Turbine ID Contributing to Events	Nearest Turbine	
#	ID	Easting [m]	Northing [m]					without Cloud Cover	with Cloud Cover		Distance [m]	ID
72	14	558603	5047574	Dwelling	176	30-May	31	60	18	28 29 30 34	803	28
110	21	558015	5054552	Dwelling	121	14-Jan	34	51	15	1 2	718	1
71	13	558858	5047263	Dwelling	135	6-Feb	28	45	14	29 30 34	609	31
111	22	557975	5054675	Dwelling	94	2-Jan	30	36	11	1 2	837	1
116	24	560983	5048086	Dwelling	94	31-Jan	32	33	10	39 40	763	39
103	18	561404	5048391	Dwelling	66	2-Jun	22	20	6	23	764	39
104	19	561078	5048338	Dwelling	48	17-Dec	28	18	5	39	867	39
1	1	561918	5050647	Dwelling	38	26-Apr	26	11	3	18	622	44
102	17	561166	5048328	Dwelling	32	22-Dec	23	10	3	39	807	39
100	16	562348	5048501	Dwelling	34	15-Dec	19	9	3	39	1120	39
112	23	557505	5054696	Dwelling	33	31-Jan	21	9	3	1	1204	1
4	4	562082	5050514	Dwelling	35	6-May	20	8	2	18	823	44
2	2	562046	5050636	Dwelling	31	23-Apr	22	8	2	18	704	44
3	3	562129	5050583	Dwelling	30	14-Aug	19	6	2	18	798	44
5	5	562196	5050448	Dwelling	31	8-May	18	6	2	18	944	44
7	7	561777	5048744	Dwelling	0	-	0	0	0		1100	39
8	8	561670	5048764	Dwelling	0	-	0	0	0		1109	39
14	9	561620	5048730	Dwelling	0	-	0	0	0		1074	39
62	12	562245	5048769	Dwelling	0	-	0	0	0		1280	39
99	15	562676	5048502	Dwelling	0	-	0	0	0		1277	43

2. Coordinate system is UTM Zone 20N, NAD83 datum.

Shear Wind Inc.

January 17, 2011

To Whom It May Concern:

Re: Letter of Acceptance
Glen Dhu South Wind Power Project
Environmental Registration Document

The undersigned approves and accepts the contents of the Environmental Assessment Registration Document, dated January 17, 2011 submitted to the Nova Scotia Department of Environment for the Glen Dhu South Wind Power Project, located near Barney's River, Nova Scotia.

Sincerely,

Mike Magnus
President and CEO