Appendix B: Parkhill Interconnect Noise Impact Assessment Report

GL Garrad Hassan

PARKHILL INTERCONNECT - NOISE IMPACT ASSESSMENT

Client	NextEra Energy Canada, ULC
Contact	Ben Greenhouse
Document No	800253-CAMO-R-02
Issue	D
Status	Final
Classification	Client's Discretion
Date	2 April 2013

Author:

A. Nercessian

Checked by

S. Dokouzian, N. O'Blenes, M. Roberge

Approved by:

D. Eaton

GL Garrad Hassan Canada, Inc.

151 Slater Street, Suite 806, Ottawa, Ontario CANADA
Phone: (613) 230-3787 | Fax: (613) 230-1742
www.gl-garradhassan.com

IMPORTANT NOTICE AND DISCLAIMER

KEY TO DOCUMENT CLASSIFICATION

Strictly Confidential	For disclosure only to named individuals within the Client's organization
Private and Confidential	For disclosure only to individuals directly concerned with the subject matter of the Report within the Client's organization
Commercial in Confidence	Not to be disclosed outside the Client's organization
GL GH only	Not to be disclosed to non-GL GH staff
Client's Discretion	Distribution for information only at the discretion of the Client (subject to the above Important Notice and Disclaimer)
Published	Available for information only to the general public (subject to the above Important Notice and Disclaimer)

REVISION HISTORY

Issue	Date	Summary
A	22 February 2012	Original Version (electronic only). Issued as R-08-A under project 1008.
B	24July 2012	Change in project number. New substation configuration and transformer specifications.
C	20 September 2012	Updates requested by MOE
D	2 April 2013	Change to ground factor calculation methodology, as per MOE comments.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

NextEra Energy Canada, ULC is proposing to develop the Parkhill Interconnect Project ("Project"), which is subject to Ontario Regulation 359/09 (Renewable Energy Approvals (REA) under Part V.0.1 of the Ontario Environmental Protection Act (EPA)) [1]. NextEra Energy Canada, ULC is seeking a Renewable Energy Approval from the Ontario Ministry of the Environment (MOE).

The Parkhill Interconnect Project will consist of a substation and a switching station. The substation will consist of two main power transformers. The substation at the Point of Interconnect (POI) will be owned within a Co-Owners Agreement (Tenants-in-Common Agreement) among Bornish Wind LP, Kerwood Wind, Inc. and Jericho Wind Inc. These three companies are wholly-owned subsidiaries of NextEra Energy Canada, ULC. The parent company of NextEra Energy Canada, ULC is NextEra Energy Resources, LLC, with a current portfolio of nearly 8,500 operating wind turbines across North America.

At the request of NextEra Energy Canada, ULC (the "Client" or "NextEra"), GL Garrad Hassan Canada, Inc. (GL GH), prepared a Noise Impact Assessment (NIA) as per the requirements of the REA, Technical Guide to Renewable Energy Approvals and in accordance with Appendix A of the Ministry of the Environment's publication entitled, "Basic Comprehensive Certificates of Approval (Air) – User Guide", as amended periodically and available from the Ministry [2].

The purpose of this study is to verify compliance of the Project to current Ontario noise guidelines by calculating the noise levels generated by the Project at all Points of Reception in the vicinity of the main power transformers.

This study comprises 3 main sections: (i) a general description of the project area, noise sources and noise receptors, (ii) a description of the Project's components including noise sources and acoustic barriers, and (iii) noise impact assessment results.

2 GENERAL DESCRIPTION OF PROJECT AREA

2.1 General Characteristics

The proposed Parkhill Interconnect Project is located in south-western Ontario, in the Municipality of North Middlesex, Middlesex County, Ontario. More specifically, the Project is located south of New Ontario Road, east of Evergreen Road, north of naira Road and west of Cassidy Road. It has a total project area of approximately 43.7 ha. Project components will be installed on a privately-owned agricultural lot.

The Project consists of a switching station and a substation. The substation includes two (2) 135/225 MVA -121/525 kV LTC transformers with ONAN/ONAF/ONAF cooling rating. The switching station and substation have been strategically sited on lands that the Client holds under lease options.

The landscape in the study area is predominantly characterized by agricultural fields and associated farms punctuated with numerous hedgerows, isolated woodlands, and the occasional watercourse. Photographs included in Figure 2-1 show typical views of the land and features of the study area.

Figure 2-1: Land Features of the Parkhill Interconnect Site

2.2 Land Use Description

The site is located within two two-tiered municipal systems. The County of Middlesex makes up the upper tier of the region, while Adelaide Metcalfe, North Middlesex and Strathroy-Caradoc, along with five additional townships and municipalities, have lower tier municipal status. Agriculture is the predominant economic activity and land use throughout the County of Middlesex; however, the municipalities that comprise the study area each have features creating distinct community character. Surrounding properties and lands are characterized as low density residential while also including a number of agricultural buildings. Other land use within the study area includes rural and urban-rural, providing a foundation for manufacturing, business and tourism development. Access to the Project is provided by small paved and unpaved municipal roads that stem from larger municipal roads. The municipal zoning map is shown in Appendix A.

2.3 Baseline Ambient Noise Conditions

The MOE categorizes Points of Reception into three classes: 1, 2, and 3. Class 1 refers to an acoustic environment typical of a major population centre where the background noise is dominated by the urban hum. These areas are highly urbanized and have moderate to high noise levels throughout the day and night. Class 2 areas have an acoustic environment characterized by low ambient sound levels between 19:00 and 07:00, whereby the evening and night-time levels are defined by natural sounds, infrequent human activity and no clearly audible sounds from stationary sources (e.g. industrial and commercial facilities). Class 3 areas are typical of rural and/or small communities (i.e. with populations of less than 1000) and an acoustic environment that is dominated by natural sounds with little or no road traffic.

Within the study area, the main sources of ambient sound that currently exist include:

- Vehicular traffic noise from nearby roads;
- Vehicular traffic on the local concession and side roads, some of which are gravel roads;
- Occasional sounds stemming from agricultural activities;
- Occasional sounds due to anthropogenic domestic activities; and
- Natural sounds.

Based on these conditions, <u>all Points of Reception are considered as having a Class 3 acoustical environment,</u> which requires that the permissible sound level not exceed the following values at the PoR:

Table 2-1: Permissible sound levels for a Class 3 area

Time of Day	One Hour L_{eq} [dBA]
07:00 – 19:00	45
19:00 – 23:00	40
23:00 – 07:00	40

2.4 Points of Reception

The "Basic Comprehensive Certificates of Approval (Air) – User Guide" [2] requires a search radius of up to 1,000 m for Points of Reception (POR). This study includes Points of Reception found within 1,500 m of the proposed main power transformer locations. A total of 19 buildings were identified and provided by the Client [3], whereas 9 of the buildings within 1,500 m of the transformers were considered Points of Reception for this NIA. GL GH did not validate the Points of Reception on-site.

13 vacant lots with a zoning designation that considers houses as a permitted use were also found by GL GH within 1,500m of the main power transformer location, by using available Ontario base mapping, satellite imagery and parcel fabric data. In accordance with the REA requirements, "vacant lot receptors" (VLR) were placed on these vacant lots, in a location consistent with the building pattern of the area, which is typically alongside the road frontage. For the sake of consistency and given the unknown location of any future houses on these lots, VLRs were placed half-way on the front yard lot line abutting the road.

Table 2-2 below provides all PoR locations that were analyzed in this study.

Table 2-2: List of identified Points of Reception

POR ID#	Type	Coordinates (NAD83 UTM17)		Receptor Height [m]
		X	Y	
1	House	452289	4774238	4.5
2	House	452732	4773916	4.5
3	House	453143	4773794	1.5
8	House	452661	4776120	4.5
9	House	453132	4775871	4.5
10	House	452995	4776038	4.5
12	House	453676	4774131	1.5
17	House	453854	4774336	1.5
19	House	451903	4773535	1.5
22	VLR	451970	4774059	4.5
23	VLR	452484	4773944	4.5
24	VLR	453079	4773935	4.5
25	VLR	453416	4773737	4.5
26	VLR	453932	4774552	4.5
29	VLR	453521	4775823	4.5
30	VLR	453254	4776020	4.5
31	VLR	453557	4775954	4.5
33	VLR	453019	4775939	4.5
34	VLR	452721	4776005	4.5
40	VLR	451469	4774311	4.5
41	VLR	451970	4774199	4.5
42	VLR	451467	4774169	4.5

3 PROJECT DESCRIPTION

The Parkhill Interconnect substation will “step-up” the electricity conveyed via a 115 kV transmission to 500 kV and will connect via a switching station to an existing Hydro One 500 kV line that runs adjacent to the Project location. The substation equipment will include an isolation switch, a circuit breaker, a step-up transformer, transmission switch gear, instrument transformers, grounding and metering equipment. All substation and switching station grounding equipment will meet the Ontario Electrical Safety Code.

It is important to note that the 115 kV line running to the project and connecting to Hydro One’s existing 500 kV line is common to three of NextEra’s Projects, i.e. Adelaide, Bornish and Jericho Wind Energy Centre.

Based on the classification system outlined in Part II of O. Reg. 359/09, the Parkhill Interconnect Project is located in a Class 3 rural area.

Wind turbines belonging to three different projects (Adelaide, Bornish, and Jericho) will convert wind into Alternating Current (AC) electricity. The local transformers of each project will raise the voltage to 115 kV. The combined power of the three projects will then be directed to the Parkhill Interconnect substation that will elevate the voltage to 500 kV. The Project will be made up of the following key facilities, equipment and technologies:

- Collector system and two (2) 3-phase 225 MVA transformers at the substation; and
- Access roads and maintenance building.

A scaled location map, indicating the topography, nature of the neighborhood surrounding the facility, location of adjacent buildings, structures and receptors has been attached as Appendix B.

3.1 Life of the Project

The expected life of the Project will be a minimum of 20 years (the length of the power purchase agreement), but may continue to operate or be repowered once the power purchase agreement expires. At the end of the Project life the Project will be decommissioned in accordance with the Decommissioning Plan Report.

3.2 Operating Hours

The main transformers in the Parkhill Interconnect substation will be operating continuously throughout the day and are assumed to emit the same amount of noise during the daytime as during night time. Therefore, no changes will be made to the sound power level of the main transformers when running the model to account for time of day. The sound pressure level that will be compared to the permissible noise levels in Table 2-1 will be the same for daytime operation and night time operation.

3.3 Noise Sources

3.3.1 Approach to the Study

The sound pressure level at each Point of Reception for the Parkhill Interconnect Project was calculated based on the ISO 9613-2 method [4]. This is a widely used and generally accepted standard for the evaluation of noise impact in environmental assessments. The desired sound pressure level of the proposed main power transformers was obtained from the Client and can be found in Appendix C, while the transformer sound power level (PWL) was estimated on the basis of the technical specifications and dimensions. The software package CadnaA, which implements ISO-9613-2, was used to predict the sound pressure levels at the PoRs.

3.3.2 Noise Sources Summary

The primary noise sources of the current Project design are the main power transformers located in the central portion of the Project area.

The cumulative noise impact from the nearby proposed wind farm project, Bornish Wind Energy Centre, has not been included in the analysis since the closest proposed with turbine for this project is >5 km away.

No other equipment at the substation and at the switching station has been included in the present NIA. Any ancillary equipment installed is considered to have a significantly lower acoustical level compared to the main power transformers.

3.3.3 Main Transformers

This Project uses one (2) main step-up transformers located at the Project's substation. The electrical and physical specifications for the substation's transformers were provided by the Client [5] and are shown in Appendix C. Details are presented in Table 3-1 below. This study assumes that the 225-MVA / 525 kV main transformers at the substation are fluid-immersed devices with forced air cooling (rated ONAN/ONAF/ONAF).

The transformer walls were modeled as vertical area sources and the transformer top was modeled as a horizontal area source. GL GH considers that given the relatively large size of the transformers and barriers, modeling the transformers as an area source is a more realistic approach than assuming a point source, in this case. Not only does the transformer not behave like a point source, but it also yields a less conservative sound pressure level at the nearest PoR. Refer to Section 4.2 for a comparison of results at most impacted dwelling.

The base of each transformer has been raised to 1 m above ground level, as requested by the Client. The vertical area sources used to represent the transformer walls were given a height of 4.5 m and placed 1 m above ground.

The Client is currently in talks with the manufacturer to ensure that the broadband Sound Pressure Level (SPL) value of the transformer will not exceed 75 dBA when measured according to IEEE Std C57.12.90-2006 [7]. The proposed audible sound level of 75 dB was then converted to a PWL value of 100.8 dBA using IEEE Std C57.12.90-2006. A 5 dBA penalty for tonality, as per Publication NPC-104 (Sound Level Adjustments) was applied for a resulting PWL of 105.8 dBA. A typical transformer octave band sound distribution for a large transformer from the Handbook of Acoustics [8] was used and fitted to match the broadband value of 105.8 dBA.

Details on each noise source are presented in Table 3-1 below.

Coordinates of the transformers and a table with the derived octave band spectra are listed in Appendix C.

3.3.4 Sound Barrier

In order to achieve compliance with the current noise propagation model, both transformers will require a noise barrier. The type of barrier used in this noise study is one that can be described as of absorptive type with an Absorptive Coefficient of 0.85. The acoustic barriers should have a surface density of at least 20 kg/m^2 and have a closed surface free of gaps and cracks, such as Armtec's Durisol. A 5.5 m tall barrier (equal to the height of the transformer raised by 1 m) was modeled on the south side of each transformer, approximately 6 m away from the southern edge of the transformer. The barriers are illustrated on the noise map in Appendix D. The coordinates of the barrier can be found in Table 3-2.

3.3.5 Summary Tables

Table 3-1: Noise Source Summary Table

Source ID	Source Description	Sound Power Level [dBA][1]	Source Location	Sound Characteristics	Noise Control Measures
T1	Main Transformer	105.8	O	S-T	B
T2	Main Transformer	105.8	O	S-T	B

1. 5 dBA tonal penalty included

Source location: (O): Outside building
Sound Characteristics: (S): Steady; (T): Tonal
Noise Control: (B): Barrier

Table 3-2: Coordinates of Barrier Edges. UTM 17 NAD83

ID	Description	Easting	Northing
B1a	Barrier 1, point a	452720	4774653
B1b	Barrier 1, point b	452747	4774646
B2a	Barrier 2, point a	452761	4774643
B2b	Barrier 2, point b	452788	4774637

4 NOISE IMPACT ASSESSMENT

As stated in MOE's publication NPC 232, the sound level limit at a point of reception must be established based on the principle of "predictable worst case" noise impact.

The sound pressure level at each Point of Reception for the aggregate of all noise sources associated with the Parkhill Interconnect Project was calculated based on the ISO 9613-2 method.

The ISO 9613 standard [6] provides a prediction of the equivalent continuous A-weighted sound pressure levels at a distance from one or more point sources under meteorological conditions favorable to propagation of sound emissions.

The method consists of octave-band algorithms (i.e. with nominal mid-band 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; and
- Ground effect – attenuation due to the acoustic properties of the ground.

ISO-9613-2 parameters were set as follows:

- Ambient air temperature: 10ºC;
- Ambient barometric pressure: 101.32 kPa;
- Humidity: 70%;
- Ground factor: A detailed map of Hard Ground (0) and Porous Ground (1.0) was used to model the ground attenuation.;
- Transformer height and dimensions: see Appendix C;
- PoR height: 1.5m and 4.5 m; and
- The effect of topography was considered.

A discussion of the Ground Factor methodology can be found in section 4.1.

Additional calculations concerning attenuation from foliage were not performed in this report, 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 noise source and a Point of Reception. The estimated accuracy of the ISO 9613 method, as stated in ISO 9613-2, is ± 3 dB.

First order acoustic reflections were not included in the study since it is assumed that the sound reflection coefficient is lower than 0.2 [6].

The transformer noise emission ratings used for each octave band are specified in Appendix C. The noise impact was calculated for each Point of Reception located within 1,500 m of a source of sound from the Project, and the calculated noise level was then compared with the applicable permissible sound level for each receptor, as presented in Table 4-2.

4.1 Ground Factor Methodology

GL GH has previously assumed a global ground factor of 0.7 to model the ground factor attenuation. However, as per recent requirements, GL GH has undertaken a refined estimate of the ground factor attenuation around the project interconnection substation. This section presents a detailed ground factor calculation for the area expected to be most sensitive to ground factor assumptions. For the transformers-to-PoR 1 case, ground factors for the source, middle, and receiver regions have been calculated based on ISO 9613-2. The distance from the transformer to Receptor ID 1 is 610 m. Figure 4-1 below shows the regions and ground cover, including the gravel area around the substation.

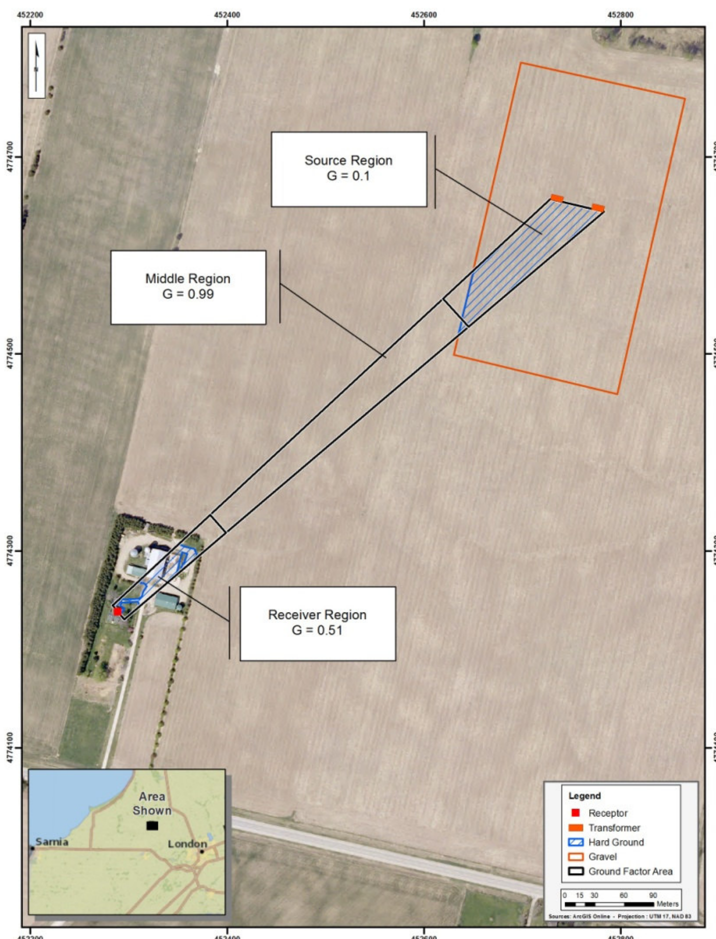


Figure 4-1: Ground factor coverage near Parkhill substation

Source region ground factor G_S

As defined by ISO 9613-2, the source region extends over a distance of $30h_S$ from the source towards the receiver, where h_S is the source uppermost height of 4.5 m. The source region length is therefore 135 m. NextEra has supplied site plans indicating that the area that will be covered with gravel. A geometric analysis has indicated that 90% of the source region is covered with gravel. Based on aerial photography, the remaining area is covered with porous ground. The source region ground factor G_S is then **0.1**, as per ISO 9613-2.

GL Garrad Hassan

Receiver region ground factor G_R
As defined by ISO 9613-2, the receiver region extends over a distance of $30h_R$ from the receiver towards the source, where h_R is the receiver height of 4.5 m. The receiver region length is 135 m. Based on aerial photography, 49% of the receiver region is covered by hard ground. The receiver region ground factor G_R is then **0.51**, as per ISO 9613-2.

Middle region ground factor G_M
As defined by ISO 9613-2, the middle region stretches over the distance between the source and receiver regions. Based on aerial photography, 0.6% of the receiver region is covered by hard ground. The middle region ground factor G_M is then **0.99**, as per ISO 9613-2.

CadnaA Calculations
Two sets of CadnaA calculations have been carried out. The first uses the three ground factors calculated as described above:

$G_S = 0.1$
$G_M = 0.99$
$G_R = 0.51$

The second CadnaA calculation uses a global ground factor of 0.7 for all three regions.

When using the three ground factors, the estimated sound pressure level at PoR1 is below the 40 dBA limit, but higher when compared to using a global factor of 0.7.

Given this result, for this specific project, a different a more detailed approach for considering ground factor is thus implemented and explained below.

4.1.1 Site-specific ground factor approach

Geospatial imagery was used to produce a detailed shape file identifying hard ground. The shape file covers an area of at least 1.5 km around the substations transformers. All areas identified as having hard ground have been assigned a ground absorption of 0. All other areas, which are covered by farming area, brush, grass, etc. have been considered as porous ground and assigned a ground absorption value of 1.0, as detailed in ISO 9613-2.

Figure 4-2 below shows the regions and ground cover.

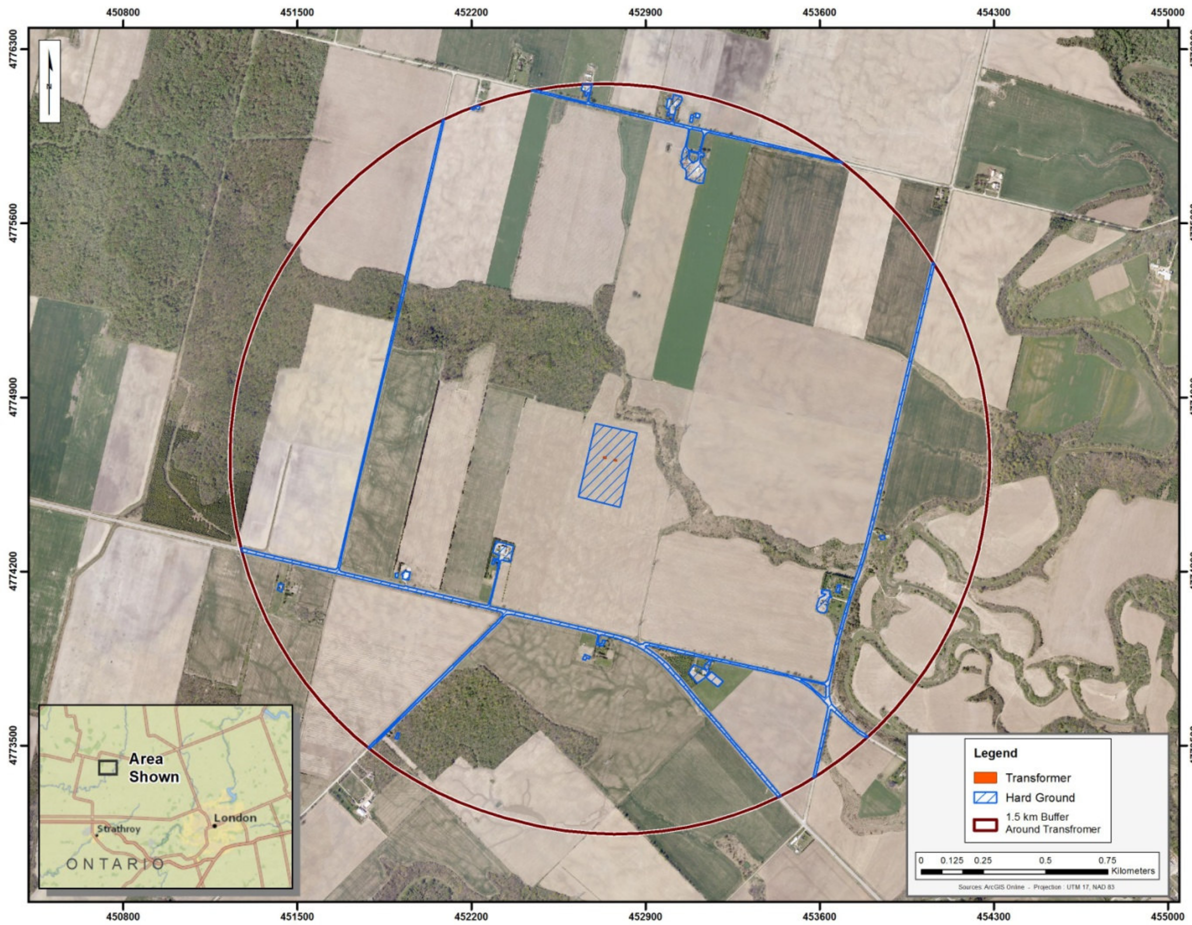


Figure 4-2 : Ground factor coverage for the entire Parkhill substation area

The worst case result at the most impacted receptor, PoR 1, is 38.8 dBA. This level is higher than results utilizing a global ground factor of 0.7, or three regional ground factors. The detailed site-specific methodology is therefore the most conservative of the three approaches for the most impacted receptor, and has been utilized in this assessment. The results are shown in Table 4-1 below.

Table 4-1: Comparison of three ground factor cases

Case	Case 1, Global G = 0.7	Case 2, Three G values	Case 3 Detailed map of hard ground and porous ground for entire project
Sound Pressure Level at PoR1 [dBA]	37.5	38.4	38.8

GL Garrad Hassan

4.2 Results

Table 4-2 presents the sound pressure level at each point of reception within 1,500 m of the Main Power Transformers, and all are found to be compliant with daytime and night-time permissible sound levels per the MOE guidelines. The simulated noise iso-contour map is presented in Appendix D.

The shortest distance between a Main Power Transformers and a house is approximately 610 m (PoR 1 and T1). This distance was calculated starting from the center of a transformer. The shortest distance between a noise source at the Project and a vacant lot receptor is approximately 760 m (PoR 23 and T2).

Table 4-2: Acoustic assessment summary

Point of Reception ID	Description	Sound Level at PoR Level Lr [dBA]	Verified by Acoustic Audit	Performance Limit, Night/Day [dBA]	Compliance with Performance Limit
1	House	38.8	NO	40/45	YES
2	House	34.1	NO	40/45	YES
3	House	32.4	NO	40/45	YES
8	House	31.9	NO	40/45	YES
9	House	34.6	NO	40/45	YES
10	House	32.5	NO	40/45	YES
12	House	32.3	NO	40/45	YES
17	House	31.5	NO	40/45	YES
19	House	26.4	NO	40/45	YES
22	VLR	33.6	NO	40/45	YES
23	VLR	33.7	NO	40/45	YES
24	VLR	35.4	NO	40/45	YES
25	VLR	32.4	NO	40/45	YES
26	VLR	34.0	NO	40/45	YES
29	VLR	32.4	NO	40/45	YES
30	VLR	32.0	NO	40/45	YES
31	VLR	31.5	NO	40/45	YES
33	VLR	33.1	NO	40/45	YES
34	VLR	32.7	NO	40/45	YES
40	VLR	29.1	NO	40/45	YES
41	VLR	34.9	NO	40/45	YES
42	VLR	29.3	NO	40/45	YES

As discussed in section 3.3.3, GL GH has modeled the transformers as area sources. For comparison, if the transformers are modeled as point sources, at a conservative height of 4.75 m, with all other parameters kept constant, PoR 1 yields a sound pressure level of 37.6 dBA, whereas the area source approach yields a sound pressure level of 38.8 dBA, as illustrated in Table 4-2.

4.3 Mitigation Measures

The overall predicted noise levels for all identified Points of Reception, based on site operations, comply with performance limits for daytime and night-time operations. As a result, no mitigation is deemed required to ensure compliance with MOE guidelines.

5 CONCLUSION

GL GH calculated the predicted noise levels generated by the Parkhill Interconnect Project based on the ISO 9613-2 model using CadnaA software. Based on the approach presented in this study and a set of assumptions related to noise sources of the Project and noise receptors, the Project is considered to be compliant with the daytime and night-time MOE permissible sound limits for Class 3 areas.

6 REFERENCES

[1] Ontario Regulation 359/09 (Renewable Energy Approvals (REA) [1] under Part V.0.1 of the Ontario Environmental Protection Act (EPA)).

[2] Ministry of the (MOE). 2011. Basic Comprehensive Certificates of Approval (Air) – User Guide (Appendix A). Environmental Assessment and Approval Branch

[3] File "CAN_ON_Parkhill_Substation_Receptors_2012-01-30.zip", email sent by Brian Torborg, NextEra, to GL GH, 30 January 2012.

[4] ISO 9613-2 (1996), Acoustics – Attenuation of sound during propagation outdoors.

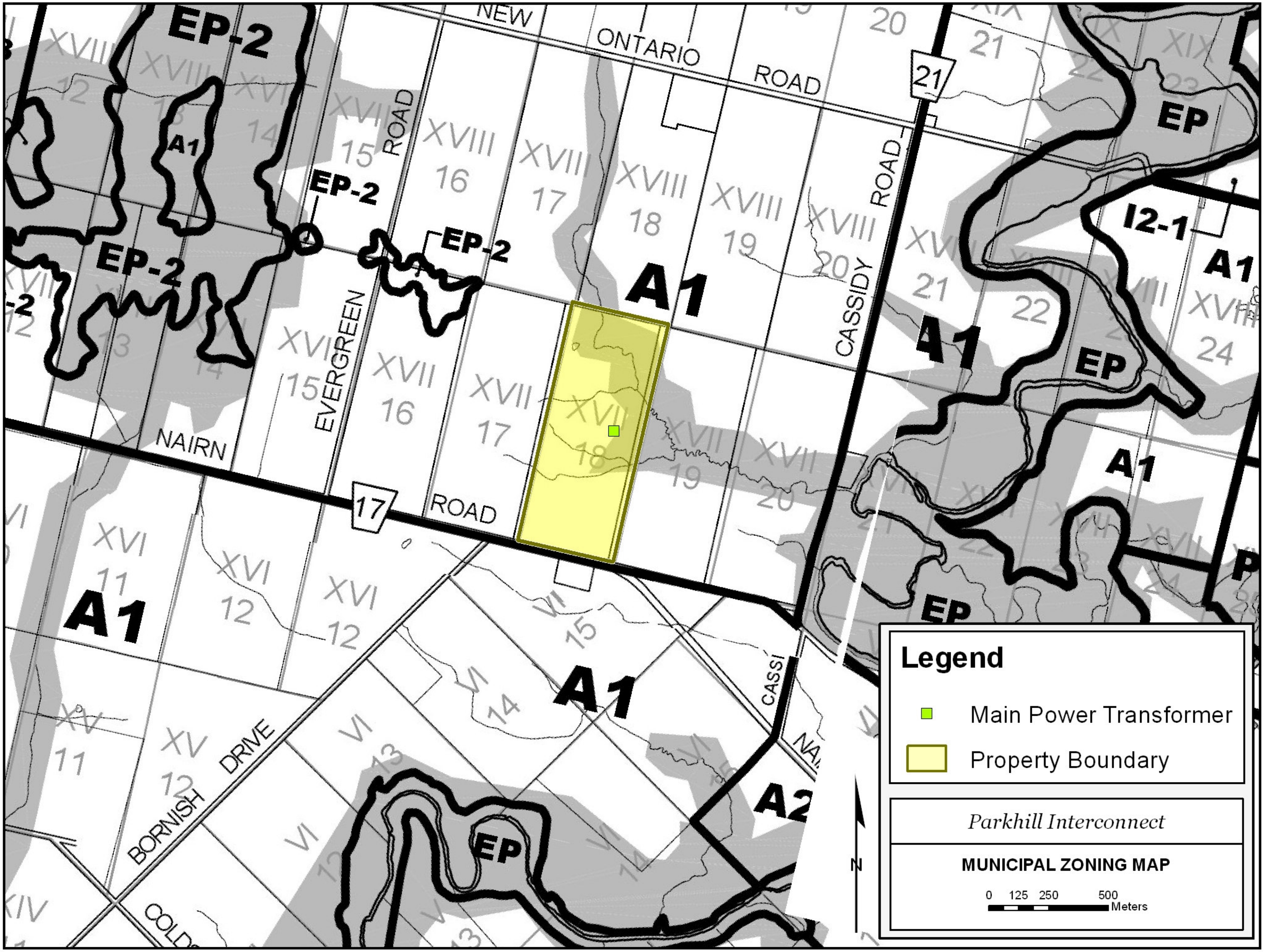
[5] Email sent by Gabe Henehan, NextEra to GL GH, 20 July 2012.

[6]

[7] C57.12.90-2006 IEEE Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers.

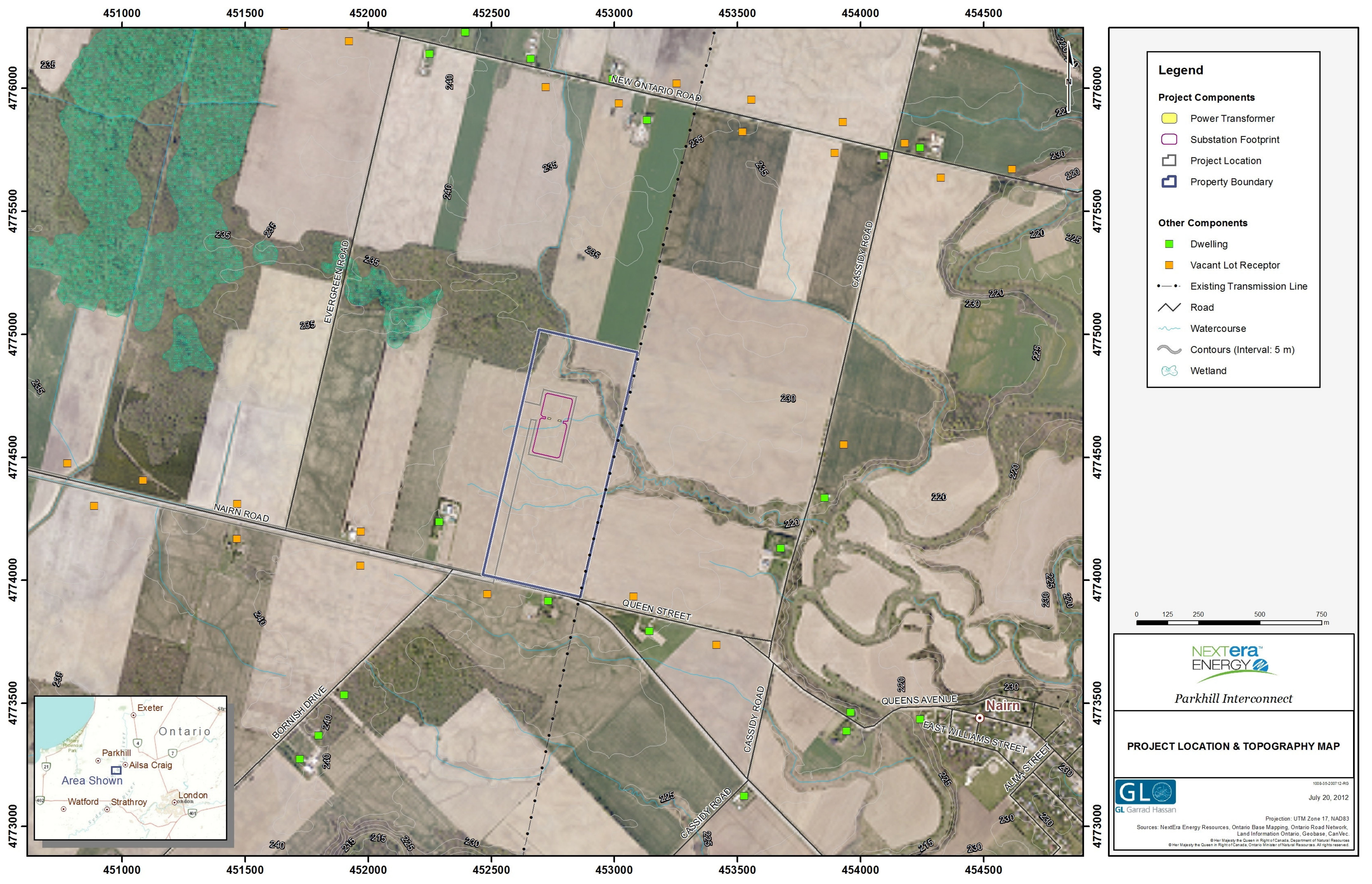
[8] Handbook of Acoustics – Edited by Malcolm J. Crocker, 1998.

APPENDIX A MUNICIPALITY OF NORTH MIDDLESEX LAND USE MAP



Legend
Main Power Transformer
Property Boundary
Parkhill Interconnect
MUNICIPAL ZONING MAP
0 125 250 500 Meters
N
NEW ONTARIO ROAD
NAIRN ROAD
EVERGREEN ROAD
CASSIDY ROAD
BORNISH DRIVE
17
21
EP-2
EP
A1
A2
I2-1

APPENDIX B PROPOSED LOCATION AND TOPOGRAPHIC MAP


NEW ONTARIO ROAD
NAIRN ROAD
EVERGREEN ROAD
CASSIDY ROAD
QUEEN STREET
BORNISH DRIVE
QUEENS AVENUE
EAST WILLIAMS STREET
ALMA STREET
Nairn
Exeter
Ontario
Parkhill
Ailsa Craig
Area Shown
Watford
Strathroy
London
Legend
Project Components
Power Transformer
Substation Footprint
Project Location
Property Boundary
Other Components
Dwelling
Vacant Lot Receptor
Existing Transmission Line
Road
Watercourse
Contours (Interval: 5 m)
Wetland
0 125 250 500 750 m
NEXTera ENERGY
Parkhill Interconnect
PROJECT LOCATION & TOPOGRAPHY MAP
GL Garrad Hassan
1008-35-200712-RG
July 20, 2012
Projection: UTM Zone 17, NAD83
Sources: NextEra Energy Resources, Ontario Base Mapping, Ontario Road Network, Land Information Ontario, Geobase, CanVec.
© Her Majesty the Queen in Right of Canada, Department of Natural Resources
© Her Majesty the Queen in Right of Canada, Ontario Minister of Natural Resources. All rights reserved.

APPENDIX C NOISE SOURCES

Noise Sources

Source ID	Description	Sound Power Level1 [dBA]	Coordinates (NAD83-UTM17)	
			X	Y
T1	Main Transformer	105.8	452735	4774658
T2	Main Transformer	105.8	452777	4774648

Includes 5dBA Tonal Penalty

Specifications of Noise Sources

225 MVA Main Power Transformer

Maximum Audible Sound Level: 75 dBA,
as per manufacturer documentation
Total Perimeter: 49.1 m
(12.3 m wide by 5.95 m deep, including 2 m offset from three fan-cooled surfaces)
Effective Height: 4.75 m without cooling tank
Top Area: 145.3 m^2
Estimated Total Surface Area (S): 378.5 m^2
Estimated Sound Power Level (without penalty): 100.8 dBA as per [7]

225 MVA substation main transformer octave band spectrum (including 5 dB penalty) [1]

31.5	63	125	250	500	1000	2000	4000	8000	Overall Sound Power Level [dBA]
63.0	82.2	94.3	96.8	102.2	99.4	95.6	90.4	81.3	**105.8**

1 Generic octave band for similar size transformer. Scaled to 105.8 dBA

Transformer Octave Band Calculation Details

31.5	63	125	250	500	1000	2000	4000	8000	
-1	5	7	2	2	-4	-9	-14	-21	**Typical Outdoor Transformer Octave band relative distribution [8] [dB Lin]**
-39.4	-26.2	-16.1	-8.6	-3.2	0	1.2	1	-1.1	**dB Lin to dBA Conversion Scale**
-40.4	-21.2	-9.1	-6.6	-1.2	-4	-7.8	-13	-22.1	**Typical Outdoor Transformer Octave band relative distribution [dBA]**
63.0	82.2	94.3	96.8	102.2	99.4	95.6	90.4	81.3	**Scaled to 105.8 dBA for 225 MVA Transformer**

NEXTera ENERGY	TRANSFORMER SPECIFICATION PARKHILL T.S. DETAIL REQUIREMENTS	Spec. No. Rev. No. Date Page	Exhibit 1 0 7/20/12 1 of 3

TRANSFORMER RATINGS

Application: (Wind Farm / Solar) Generator Step-Up (GSU)

Phase	3	Cooling	HV Volts		XV Volts		YV Volts		ZV(TV) Volts		Sound
Frequency	60	Class	525 kV		121 kV						Level
Cooling medium	Oil	Connection	Wye		Delta						dBA
Phasor Diagram	YND1	ONAN	135	MVA	135	MVA		MVA		MVA	75@
Oil preservation	Conservator	ONAF	180	MVA	180	MVA		MVA		MVA	Top
	/diaphragm	ONAF	225	MVA	225	MVA		MVA		MVA	ONAF

ADDITIONAL TAP VOLTAGES

Terminal	Style	Taps or kV	Capacity
HV	MR	± 10 % HV Line Voltage (33 Taps ULTC)	Full Capacity ULTC
XV	N/A	N/A	

PERCENT IMPEDANCE VOLTS

%	Windings	At MVA
10.0	H - X	135 MVA
	H - Y	
	X - Y	

TEMPERATURE RISES	°C	MVA
Winding	≤65	Top ONAF
Metallic Part	≤100	Top ONAF
Metallic Part in contact with paper	≤80	Top ONAF
Top Oil	≤65	Top ONAF

PD = <300 pC
RIV = < 100 uV

Winding and Bushing Ratings

	Winding				Bushing					
Terminal	MVA	Voltage (kV)	BIL (kV)	Ampere (A)	Class (kV)	BIL (kV)	Ampere (A)	Min Strike Dist Ph to Ph	Min Strike Dist Ph to Gnd	Ext. Creep
HV Line	225	525	1550		525	1675				
HV Neutral			200		36	200				
XV Line	225	121	550		145	650				
XV Neutral										
YV Line										
YV Neutral										

UNUSUAL SERVICE CONDITIONS
Yes x No (Check one) – Conform to CSA-C88-M90

Ambient Temp. in ºC (Max, Avg, Min)	38, 20, -30
Elevation/Wind Speed	See Exhibit 2
Seismic Zone Designation (see Appendix H)	See Exhibit 2
Snow/Ice Accumulation (under energized, but no load)	See Exhibit 2
Short-time emergency Overloading (except GSU)	See IEEE C57.91-1995 Table 8
Long-time emergency Overloading (except GSU)	
Abnormal harmonic currents solid-state short circuits	no
Geomagnetically Induced Current (GIC) location	yes
High-current isolated-phase bus duct connection	no
Parallel operation	yes
Neutral grounding resistor	no

FOUNDATION
Specific Details and Measurements

Foundation Type:	
Distance from Center of Foundation:	
To Segment 1	
To Segment 2	
To Segment 3	
To Segment 4	**LOSS EVALUATION**
No Load losses per kW will be evaluated at	See Appendix F
Load losses per kW will be evaluated at	See Appendix F
Auxiliary losses per kW will be evaluated at	See Appendix F

Exhibit 1 **NEXTERA ENERGY Transformer Detailed Requirements**

Prolec GE is providing the attached proposal drawing and mechanical data for a 135//225MVA-525kV-121kV transformer. Note that this drawing is not for construction.

Jim Roomy

Account Manager – GE Digital Energy

(954) 478-4694 phone

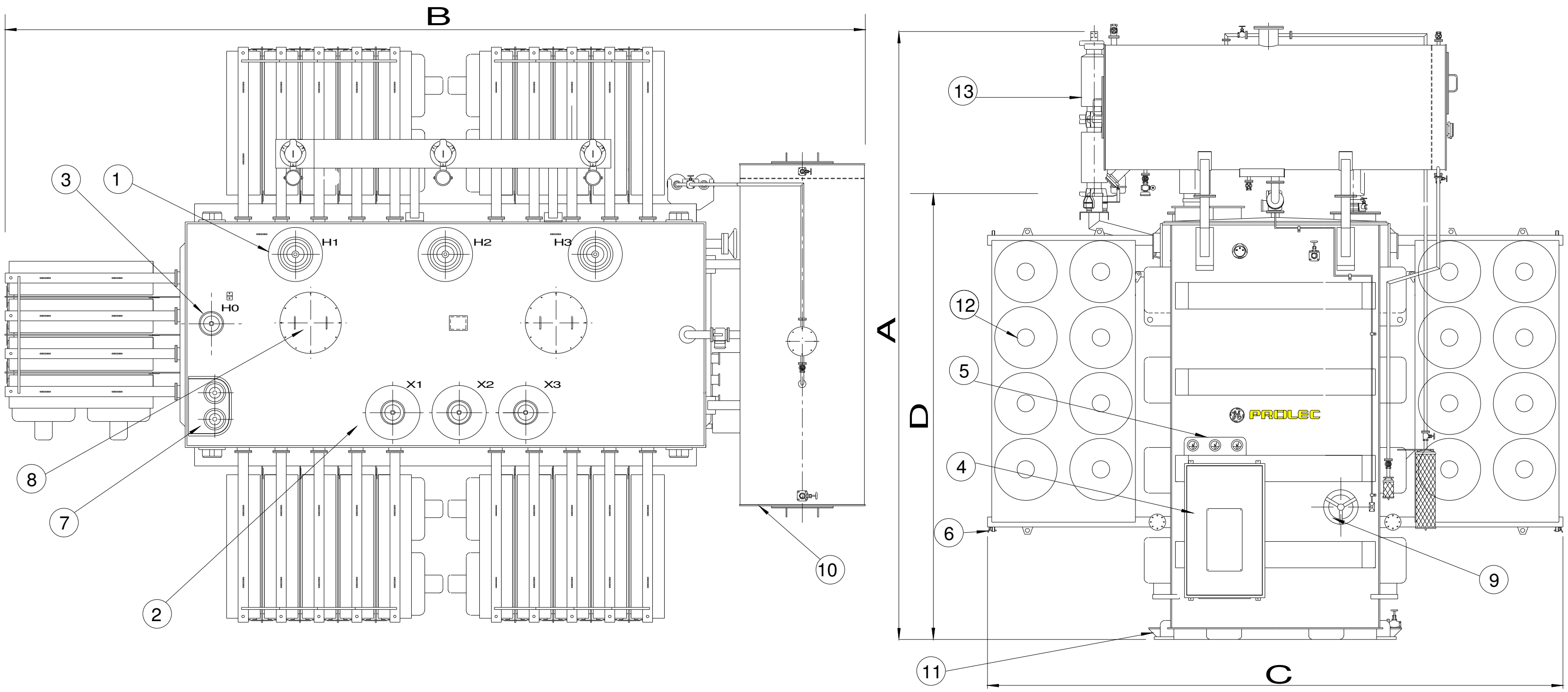
jim.roomy@ge.com

<<Parkhill Transformer - Outline Drawing - BB15.doc>>

MECHANICAL DATA

Not for Construction Purposes

Dimensions (Approximate)		Ft. (Mts.)
Height	(A)	26.9 (8.20)
Width	(B)	40.4 (12.30)
Depth	(C)	19.4 (5.95)
Height over Cover	(D)	14.6 (4.45)
Untanking (Plus slings)	(E)	27.4 (8.35)
Shipping Dimensions:Ft	W x D x H	28.1 x 12.5 x 14.6
Masses (Approximate)		pounds (Kg)



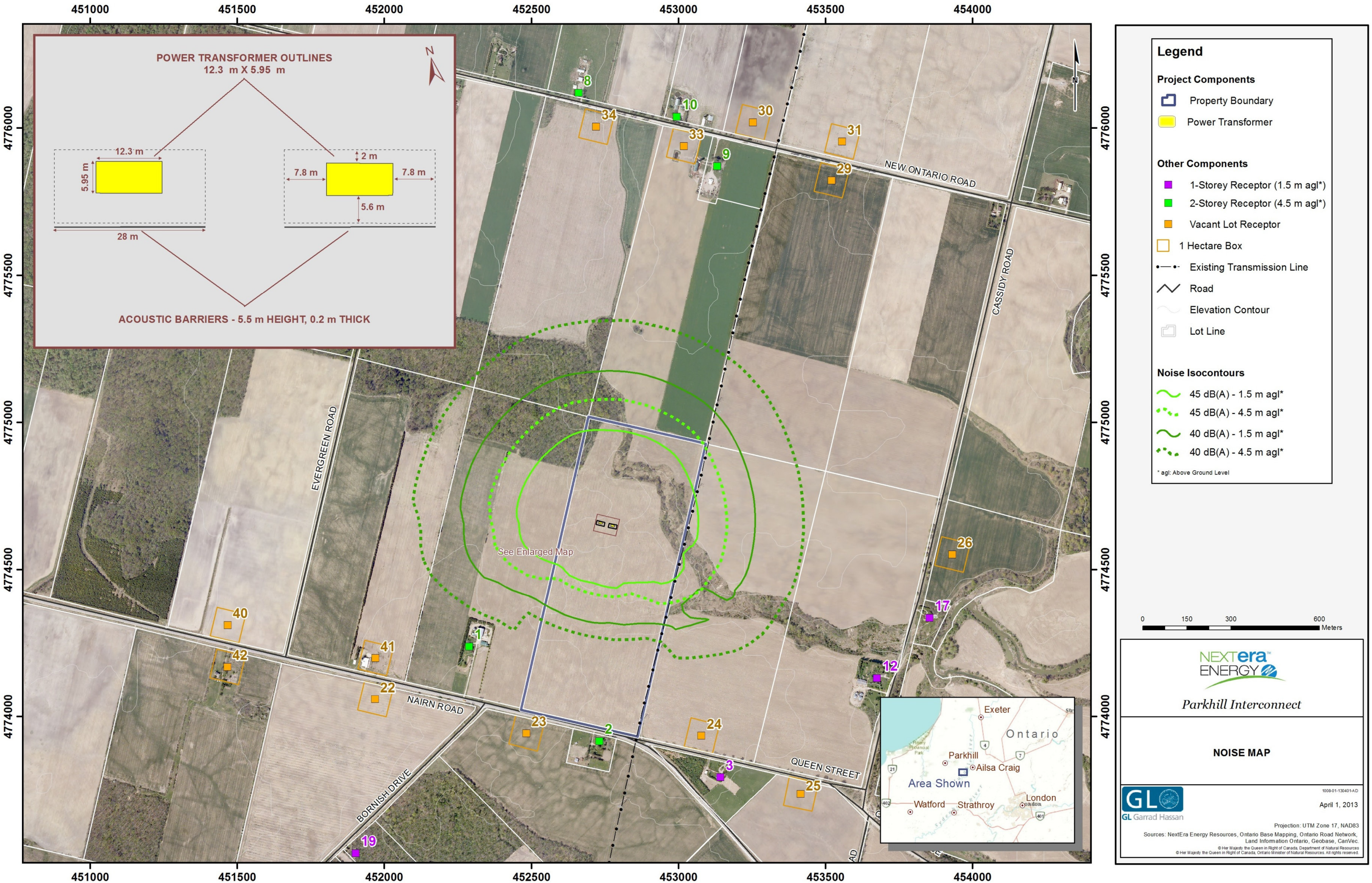
1.- H. V. BUSHINGS "H"
2.- L. V. BUSHINGS "X"
3.- NEUTRAL BUSHING
4.- CONTROL CABINET
5.- INSTRUMENTS
6.- RADIATORS
7.- MECHANICAL PRESSURE DEVICE
8.- MANHOLE
9.- NO LOAD TAP CHANGER
10.- CONSERVATOR TANK
11.- BASE
12.- FANS (IF SUPPLIED)
13.- H.V. SURGE ARRESTERS (IF SUPPLIED)

NOTE: THIS DRAWING IS A PRELIMINARY PROPOSAL AND DOES NOT INDICATE THE EXACT DETAILS OF CONSTRUCTION, ARRANGEMENT OF ACCESSORIES OR THE FINAL DIMENSIONS OF THE TRANSFORMER. THIS INFORMATION SHOULD NOT BE USED FOR FINAL CONSTRUCTION ARRANGEMENTS OR FOR THE FOUNDATION UNLESS SPECIFICALLY APPROVED BY THE FACTORY. ALL DIMENSIONS AND WEIGHTS ARE APPROXIMATE

PROLEC

Drawing: No. BB15

APPENDIX D SIMULATED NOISE ISO-CONTOURS



POWER TRANSFORMER OUTLINES
12.3 m X 5.95 m
12.3 m
5.95 m
28 m
2 m
7.8 m
7.8 m
5.6 m
ACOUSTIC BARRIERS - 5.5 m HEIGHT, 0.2 m THICK
N
See Enlarged Map
NEW ONTARIO ROAD
CASSIDY ROAD
EVERGREEN ROAD
NAIRN ROAD
QUEEN STREET
BORNISH DRIVE
1
2
3
8
9
10
12
17
19
22
23
24
25
26
29
30
31
33
34
40
41
42
451000
451500
452000
452500
453000
453500
454000
4776000
4775500
4775000
4774500
4774000
Exeter
Ontario
Parkhill
Ailsa Craig
Area Shown
Watford
Strathroy
London
Legend
Project Components
Property Boundary
Power Transformer
Other Components
1-Storey Receptor (1.5 m agl*)
2-Storey Receptor (4.5 m agl*)
Vacant Lot Receptor
1 Hectare Box
Existing Transmission Line
Road
Elevation Contour
Lot Line
Noise Isocontours
45 dB(A) - 1.5 m agl*
45 dB(A) - 4.5 m agl*
40 dB(A) - 1.5 m agl*
40 dB(A) - 4.5 m agl*
* agl: Above Ground Level
0 150 300 600 Meters
NEXTera ENERGY
Parkhill Interconnect
NOISE MAP
GL Garrad Hassan
1008-01-130401-AD
April 1, 2013
Projection: UTM Zone 17, NAD83
Sources: NextEra Energy Resources, Ontario Base Mapping, Ontario Road Network, Land Information Ontario, Geobase, CanVec.

APPENDIX E POINT OF RECEPTION NOISE IMPACT TABLE

The following table represents the contribution of every noise source on the most-impacted PoR and VLR as per [2].

Source ID	Point of Reception 1		Point of Reception 24	
	Distance to PoR 1 [m]	**Sound Level at PoR 1 [dBA] [1]**	**Distance to PoR 24 [m]**	**Sound Level at PoR 24 [dBA] Day[1]**
T1	610	36.7	800	31.4
T2	635	34.7	775	33.2
TOTAL		**38.8**		**35.4**

1- 5 dBA tonal penalty included.
2- Effect of Sound Barrier included