GL Garrad Hassan

# PARKHILL INTERCONNECT - NOISE IMPACT ASSESSMENT

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|---|---|
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## REVISION HISTORY

| Issue | Date | Summary |
|---|---|---|
| A | 22 February 2012 | Original Version (electronic only).<br>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 |

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# 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 Proponent 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. 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, all Points of Reception are considered as having a Class 3 acoustical environment, 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 Project has been evaluated using the "Basic Comprehensive Certificates of Approval (Air) – User Guide"[2], due its proximity to the wind farm being greater than 5 km, and as such requires a search radius of up to 1,000 m for Points of Reception (POR). This study includes Points of Reception found within 2,000 m of the proposed main power transformer locations. A total of 19 buildings were identified and provided by the Client and all buildings identified were considered Points of Reception for this NIA. GL GH did not validate the Points of Reception on-site.

24 vacant lots with a zoning designation that considers houses as a permitted use were also found within 2,000m 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 |
| 4 | House | 451800 | 4773370 | 4.5 |
| 5 | House | 451722 | 4773275 | 4.5 |
| 6 | House | 452249 | 4776141 | 1.5 |
| 7 | House | 452395 | 4776228 | 1.5 |
| 8 | House | 452661 | 4776120 | 4.5 |
| 9 | House | 453132 | 4775871 | 4.5 |
| 10 | House | 452995 | 4776038 | 4.5 |
| 11 | House | 454095 | 4775726 | 4.5 |
| 12 | House | 453676 | 4774131 | 1.5 |
| 13 | House | 453528 | 4773124 | 4.5 |
| 14 | House | 453943 | 4773387 | 4.5 |
| 15 | House | 453959 | 4773465 | 1.5 |
| 16 | House | 454243 | 4773436 | 1.5 |
| 17 | House | 453854 | 4774336 | 1.5 |
| 18 | House | 454243 | 4775758 | 4.5 |
| 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 |
| 27 | VLR | 454328 | 4775638 | 4.5 |
| 28 | VLR | 453895 | 4775738 | 4.5 |
| 29 | VLR | 453521 | 4775823 | 4.5 |
| 30 | VLR | 453254 | 4776020 | 4.5 |
| 31 | VLR | 453557 | 4775954 | 4.5 |
| 32 | VLR | 453928 | 4775864 | 4.5 |
| 33 | VLR | 453019 | 4775939 | 4.5 |
| 34 | VLR | 452721 | 4776005 | 4.5 |
| 35 | VLR | 451923 | 4776192 | 4.5 |
| 36 | VLR | 452067 | 4776295 | 4.5 |
| 37 | VLR | 451882 | 4776342 | 4.5 |
| 39 | VLR | 451660 | 4776255 | 4.5 |
| 40 | VLR | 451469 | 4774311 | 4.5 |
| 41 | VLR | 451970 | 4774199 | 4.5 |
| 42 | VLR | 451467 | 4774169 | 4.5 |

| | | | | |
|---|---|---|---|---|
| 43 | VLR | 451085 | 4774407 | 4.5 |
| 44 | VLR | 450886 | 4774303 | 4.5 |
| 45 | VLR | 450779 | 4774477 | 4.5 |
| 52 | VLR | 454180 | 4775776 | 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, 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 is 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 transformer in the Parkhill Interconnect substation will be operating continuously throughout the day and is assumed to emit the same amount of noise during the daytime as it does 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 LP, has not been included in the analysis since the closest proposed with turbine for this project is >5km 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 Transformer

This Project uses two (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 [3] 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. The base of each transformer has been raised to 1m above ground level to account for the 1m concrete slab they will be placed on, as requested by the Client. The vertical area sources used to represent the transformer walls were given a height of 4.5m and placed atop the concrete slab.

The Proponent 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 [5]. The proposed audible sound level of 75 dB was then converted to a PWL value of 100.8 dBA using ISO 3744:1994 [6]. 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 [7] 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 1m) was modeled on the south side of each transformer, 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 [4] provides a prediction of the equivalent continuous A-weighted sound pressure levels at a distance from one or more point sources under meteorological conditions favourable 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: 0.7 (soft ground);
- Transformer height and dimensions: see Appendix C;
- PoR height: 1.5m and 4.5 m; and
- The effect of topography was considered.

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. However, due to the several conservative assumptions made during modeling, as described above (and in section 3.3.4), the likelihood of obtaining results greater than the predicted values is significantly reduced.

First order acoustic reflections were not included in the study since it is assumed that the sound reflection coefficient is lower than 0.2 [4].

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 2,000 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 4-1.

## 4.1 Results

Table 4-1 presents the sound pressure level at each point of reception within 2,000 m of the Main Power Transformer, 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 Transformer and a house is approximately 610 m (PoR #1 and T1). This distance was calculated starting from the center of the 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 4-1: 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 | 37.5 | NO | 40/45 | YES |
| 2 | House | 33.6 | NO | 40/45 | YES |
| 3 | House | 32.1 | NO | 40/45 | YES |
| 4 | House | 27.3 | NO | 40/45 | YES |
| 5 | House | 26.4 | NO | 40/45 | YES |
| 6 | House | 28.0 | NO | 40/45 | YES |
| 7 | House | 27.9 | NO | 40/45 | YES |
| 8 | House | 31.5 | NO | 40/45 | YES |
| 9 | House | 33.2 | NO | 40/45 | YES |
| 10 | House | 32.1 | NO | 40/45 | YES |
| 11 | House | 29.7 | NO | 40/45 | YES |
| 12 | House | 32.7 | NO | 40/45 | YES |
| 13 | House | 27.1 | NO | 40/45 | YES |
| 14 | House | 28.3 | NO | 40/45 | YES |
| 15 | House | 25.7 | NO | 40/45 | YES |
| 16 | House | 25.4 | NO | 40/45 | YES |
| 17 | House | 31.6 | NO | 40/45 | YES |
| 18 | House | 28.8 | NO | 40/45 | YES |
| 19 | House | 26.3 | NO | 40/45 | YES |
| 22 | VLR | 33.4 | NO | 40/45 | YES |
| 23 | VLR | 33.3 | NO | 40/45 | YES |
| 24 | VLR | 35.5 | NO | 40/45 | YES |
| 25 | VLR | 32.5 | NO | 40/45 | YES |
| 26 | VLR | 34.0 | NO | 40/45 | YES |
| 27 | VLR | 28.8 | NO | 40/45 | YES |
| 28 | VLR | 30.8 | NO | 40/45 | YES |
| 29 | VLR | 32.1 | NO | 40/45 | YES |
| 30 | VLR | 31.7 | NO | 40/45 | YES |
| 31 | VLR | 31.1 | NO | 40/45 | YES |

| | | | | | |
|---|---|---|---|---|---|
| 32 | VLR | 29.9 | NO | 40/45 | YES |
| 33 | VLR | 32.8 | NO | 40/45 | YES |
| 34 | VLR | 32.5 | NO | 40/45 | YES |
| 35 | VLR | 28.0 | NO | 40/45 | YES |
| 36 | VLR | 28.5 | NO | 40/45 | YES |
| 37 | VLR | 26.0 | NO | 40/45 | YES |
| 39 | VLR | 26.6 | NO | 40/45 | YES |
| 40 | VLR | 29.5 | NO | 40/45 | YES |
| 41 | VLR | 34.9 | NO | 40/45 | YES |
| 42 | VLR | 29.5 | NO | 40/45 | YES |
| 43 | VLR | 26.9 | NO | 40/45 | YES |
| 44 | VLR | 25.4 | NO | 40/45 | YES |
| 45 | VLR | 25.5 | NO | 40/45 | YES |
| 52 | VLR | 29.1 | NO | 40/45 | YES |

## 4.2 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 additional mitigation measures to the proposed noise barrier are 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] Email sent by Gabe Henehan to GL GH, July 20 2012.

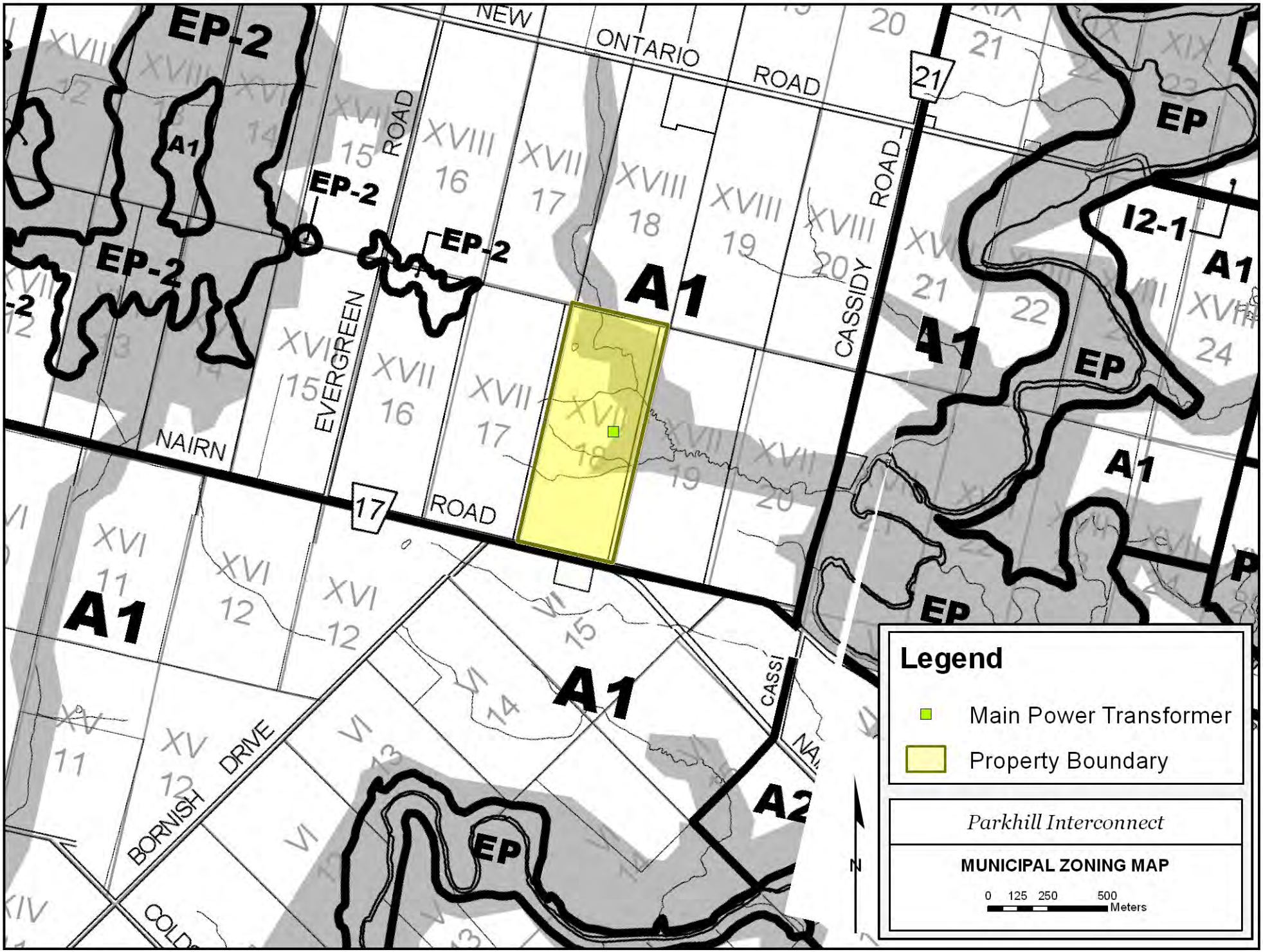
[4] ISO 9613-2 (1996), Acoustics – Attenuation of sound during propagation outdoors.

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

[6] ISO3744 (1994), Acoustics – Determination of sound power levels of noise sources using sound pressure – Engineering method in an essentially free field over a reflecting plane.

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

# APPENDIX A MUNICIPALITY OF NORTH MIDDLESEX LAND USE MAP


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

# APPENDIX B PROPOSED LOCATION AND TOPOGRAPHIC MAP

451000 451500 452000 452500 453000 453500 454000 454500

4776000 4775500 4775000 4774500 4774000 4773500 4773000

NEW ONTARIO ROAD
EVERGREEN ROAD
CASSIDY ROAD
NAIRN ROAD
QUEEN STREET
BORNISH DRIVE
QUEENS AVENUE
EAST WILLIAMS STREET
ALMA STREET
Nairn


## 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**

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1008-35-20012-RG

July 20, 2012

Projection: UTM Zone 17, NAD83

Sources: NextEra Energy Resources, Ontario Base Mapping, Ontario Road Network, Land Information Ontario, Geobase, CanVec.

# 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
Effective Height: 4.75 m
Top Area: 145 $m^2$
Estimated Total Surface Area (S): 378.5 $m^2$
Estimated Sound Power Level (without penalty): 100.8 dBA

**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 [7] [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<br>PARKHILL T.S.<br>DETAIL REQUIREMENTS | Spec. No. Exhibit 1<br>Rev. No. 0<br>Date 7/20/12<br>Page 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 Level dBA |
| Frequency | 60 | Class | 525 kV | | 121 kV | | | | | | |
| Cooling medium | Oil | Connection | Wye | | Delta | | | | | | |
| 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**

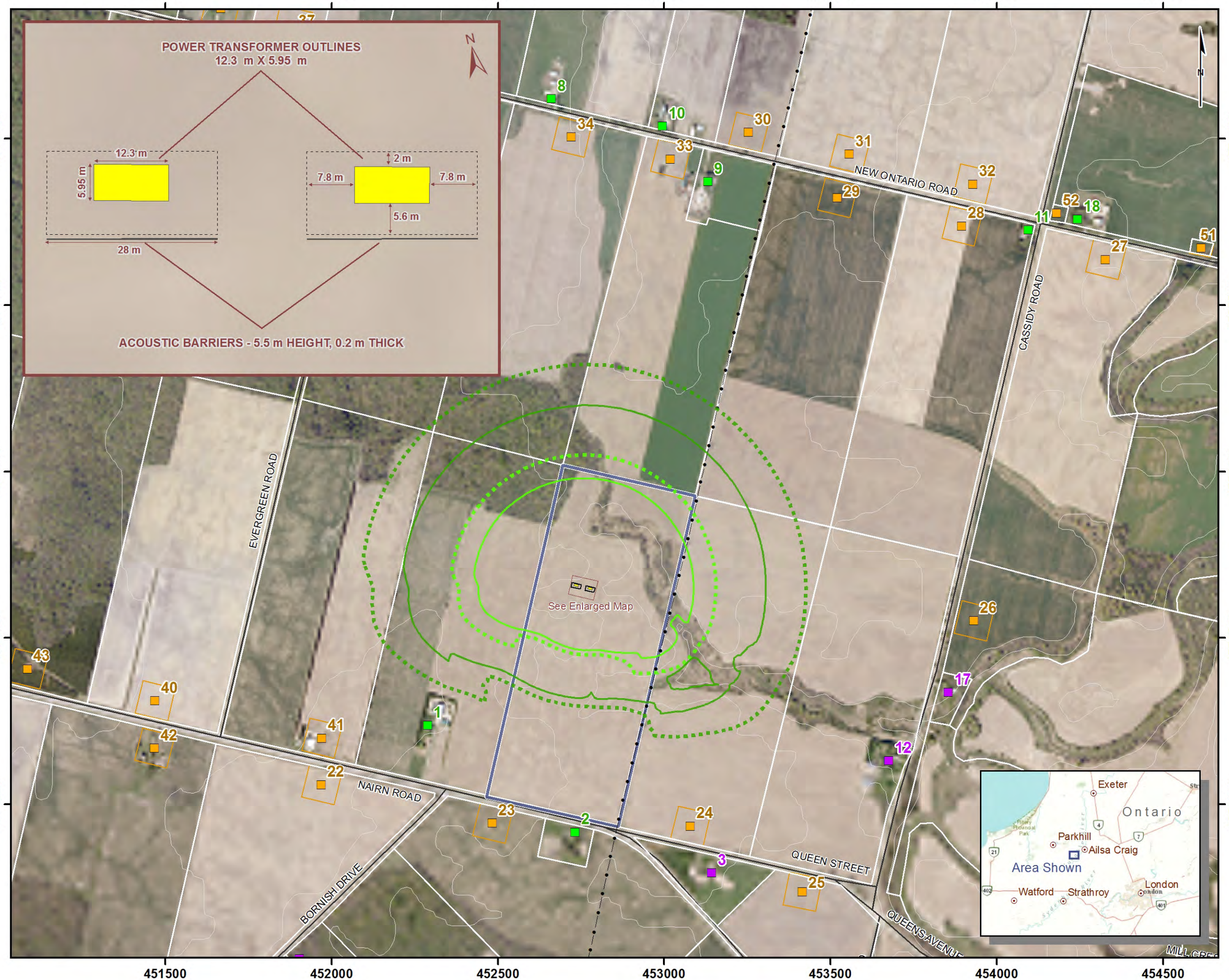
| | Winding | | | | Bushing | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Terminal | MVA | Voltage (kV) | BIL (kV) | Ampere (A) | Class (kV) | BIL (kV) | Ampere (A) | Min Strike Dist Ph to Ph | Min Strike Dist Ph to Gnd | Ext. Creep |
| HV Line | 225 | 525 | 1550 | | 525 | 1675 | | | |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

| UNUSUAL SERVICE CONDITIONS<br>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<br>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**

# APPENDIX D SIMULATED NOISE ISO-CONTOURS




## 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

1008-02-200712-RG

July 20, 2012

Projection: UTM Zone 17, NAD83

Sources: NextEra Energy Resources, Ontario Base Mapping, Ontario Road Network, Land Information Ontario, Geobase, CanVec.

# APPENDIX E POINT OF RECEPTION NOISE IMPACT TABLE

The following table represents the contribution of every noise source on the noisiest 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 (Lr) [dBA] [1]** | **Distance to PoR 24 [m]** | **Sound Level at PoR 24 (Lr) [dBA] Day[1]** |
| T1 | 610 | 35.6 | 800 | 31.0 |
| T2 | 635 | 33.0 | 775 | 33.5 |
| **TOTAL** | | **37.5** | | **35.5** |

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

## Calculation Protocol

CadnaA-Berechnung
Version 4.2.141 (32 Bit)
Start: 20.07.12 18:08:57
Berechnungsparameter:

General
"Country" International
"Max. Error (dB)" 0.00
"Max. Search Radius (m)" 5000.00
"Min. Dist Src to Rcvr" 0.00
Partition
"Raster Factor" 0.001
"Max. Length of Section (m)" 1000.00
"Min. Length of Section (m)" 0.00
"Min. Length of Section (%)" 0.00
"Proj. Line Sources" On
"Proj. Area Sources" On
Ref. Time
"Reference Time Day (min)" 960.00
"Reference Time Night (min)" 480.00
"Daytime Penalty (dB)" 0.00
"Recr. Time Penalty (dB)" 6.00
"Night-time Penalty (dB)" 10.00
DTM
"Standard Height (m)" 0.00
"Model of Terrain" Triangulation
Reflection
"max. Order of Reflection" 0
"Search Radius Src" 100.00
"Search Radius Rcvr" 100.00
"Max. Distance Source - Rcvr" 1000.00 1000.00
"Min. Distance Rvcr - Reflector" 1.00 1.00
"Min. Distance Source - Reflector" 0.10
Industrial (ISO 9613)
"Lateral Diffraction" some Obj
"Obst. within Area Src do not shield" On
"Screening" Excl. Ground Att. over Barrier
" " Dz with limit (20/25)
"Barrier Coefficients C1,2,3" 3.0 20.0 0.0
"Temperature (°C)" 10
"rel. Humidity (%)" 70
"Ground Absorption G" 0.70
"Wind Speed for Dir. (m/s)" 3.0