



- **Future Solar Developments Inc.**

Acoustic Assessment Report

Type of Document
Final

Project Name
Acoustic Assessment Report LP#8

Project Location
419 Penetanguishene Road, Oro-Medonte, ON

Project Number
WSL-00002250-A0

Prepared By:

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Acoustic Assessment Report, LP# 8
419 Penetanguishene Road, Oro-Medonte, ON


Prepared for
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3 Copies – Future Solar Developments Inc., Scarborough, ON

February 2012



Version Control

Version	Date	Revision Description	Author Initials	Reviewer Initials
1.0	February 16, 2012	Original Report	ERT	R.O.

Executive Summary

Exp services Inc. (**exp**) was retained by Future Solar Developments Inc. to conduct an acoustic assessment for a proposed solar facility that will be installed on the site located at 419 Penetanguishene Road in the Township of Oro-Medonte (herein referred to as the “Site”). The assessment was required for a Type 3 solar panel project under O.Reg. 359/09, Renewable Energy Approvals Under Part V.0.1 of the Act as amended by O.Reg. 521/10 and O.Reg. 231/11.

The proposed facility would comprise of a solar panel array, ground mounts for the array, twenty (20) Aurora PV Inverters (model PVI-5000-OUTD-US) to convert Direct Current (DC) energy harvested by the panels to Alternating Current (AC), and one (1) transformer to step-up the power to enable feed into the Hydro One distribution system. The solar equipment is to be located to the west of existing property buildings (see Site plans in Appendix A).

The noise assessment conducted and reported below was based on MOE guidance documentation (“Basic Comprehensive Certificates of Approval (Air) – User Guide”, MOE, 2004). The following summary presents results, conclusions, and recommendations:

Equipment to be operated at the site that has the potential to give rise to environmental noise is limited to twenty (20) inverters and one (1) transformer. The operation of solar panels does not give rise to environmental noise.

The critical noise receptors have been identified as permanent residences. Point of Reception 1 (POR1) is located approximately 320 m west of the Site on the east side of Penetanguishene Road, POR2 is located approximately 360 m to the southwest of the Site on the east side of Penetanguishene Road and POR3 is located approximately 200 m north of the Site on the east side of Penetanguishene Road. Reported distances are between noise sources and the closest point 30 m from the POR dwelling as defined in Section 7 of NPC-232.

Potential noise impact from operation of the solar facility on the critical receptors was calculated and assessed versus criteria detailed in MOE NPC-232.

Solar facilities operate during daylight hours, the earliest sunrise at the Site is approximately 5:35 am and the latest sunset is approximately 9:10 pm. As such, it is appropriate to evaluate the project against MOE daytime (07:00 – 19:00), evening (19:00 – 23:00) and nighttime (23:00 – 07:00) hours.

Simultaneous operation of stationary sources results in a calculated maximum noise impact of 18 dBA at the permanent residences POR 1, 17 dBA at POR2, and 22 dBA at POR3. As the calculated worst predictable case noise impacts are significantly lower than the applicable MOE exclusionary limits of 45 / 40 / 40 dBA for daytime / evening /nighttime periods respectively, it is concluded that the proposed facility would be in compliance with MOE noise criteria.

This executive summary is a brief summary of the report and should not be used as substitute for reading the report in its entirety.

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1 Introduction

Exp services Inc. (**exp**) was retained by Future Solar Developments Inc. to prepare an acoustic assessment report (AAR) for a proposed solar facility on the site located at 419 Penetanguishene Road in the Township of Oro-Medonte (herein referred to as the “Site”). The assessment was required for a Type 3 solar panel project under O.Reg. 359/09, Renewable Energy Approvals under Part V.0.1 of the Act as amended by O.Reg. 521/10 and O.Reg. 231/11.

The proposed facility would comprise of a solar panel array, ground mounts for the array, twenty (20) Aurora PV Inverters (model PVI-5000-OUTD-US) to convert DC energy harvested by the panels to AC, and one (1) transformer to step-up the power to enable feed into the Hydro One distribution system.

The proposed facility is to be located at 419 Penetanguishene Road in the Township of Oro-Medonte in Ontario, to the east of Penetanguishene Road, south of Gore Road and north of Sideroad 5 & 6. The solar equipment is to be located to the northwest of the existing property buildings (see Site plans in Appendix A).

The proposed project is considered a Type 3 Renewable Energy Project as it would have a maximum name plate capacity greater than 12 kW. The electricity produced by the solar facility is intended to be fed into a local Hydro One distribution line. Equipment to be installed at the facility complies with the Ontario manufactured percentages as required by the Ontario Power Authority's Feed-in-Tariff Program.

This report assesses noise arising from identified sources, details the anticipated impact on the nearest receptors, and evaluates the calculated impact versus MOE criteria.

In accordance with legislative requirements, a copy of this report is to be made available to interested parties including the public and the local municipality at least 60 days prior to the final public consultation meeting.

2 Facility Description

The proposed facility consists of a ground-mounted solar array that will produce electricity from the sun's energy. The direct current generated by the solar array will be converted into alternating current and transformed to enable power to be fed into the Hydro One Network.

The proposed solar array will be attached to mounts on concrete blocks installed in the ground and will occupy an area of approximately 66 by 37 metres. As such the facility represents a fixed system and therefore the array will not produce any noise (c.f. sun tracking arrays). The associated inverters and transformer will be located to the west side of the solar array (south of the existing farm buildings).

The surrounding land use to the south, north and west is designated as General Agriculture/Rural (A/RU). Zoning maps have been included in Appendix A, as well as Site Plan Aerial maps which show details of the surrounding properties. Given the existing land use and land use in the surrounding area, the project is considered to be in a rural environment. Whilst background sound measurements have not been taken in support of this assessment, the acoustical environment is expected to be dominated by natural sounds as the closest significant roads are Penetanguishene Road approximately 600 m from the Site and Highway 400 approximately 1.2 km from the Site.

Solar facilities operate during daylight hours, the earliest sunrise at the Site is approximately 5:35 am and the latest sunset is approximately 9:10 pm. As such, it is appropriate to evaluate the project against MOE daytime (07:00 – 19:00), evening (19:00 – 23:00) and night-time (23:00 – 07:00) hours.

3 Noise Source Summary

The locations of all noise sources can be found in the Site Location Aerial Maps (Appendix A).

3.1 Noise Sources

The following noise sources were identified:

- Twenty (20) Aurora PV Inverters (model PVI-5000-OUTD-US) located northwest of the farm buildings; and,
- One (1) oil-filled step-up transformer (make and model to be confirmed) located adjacent to the inverter.

The proposed solar array is a fixed system and therefore does not include motors etc. as required with tracking systems.

3.2 Road Traffic

Other than construction traffic, the proposed renewable energy project will result in minimal increase in on-site road traffic associated with troubleshooting / maintenance visits as required. As such visits will be infrequent, road traffic noise associated with the proposed project is considered negligible.

3.3 Technical Information – Sources

Table 1 summarizes the specifications and locations of each significant stationary noise source of the proposed renewable solar energy project:

Table 3.1. Technical Information and Locations of Noise Source

ID	Description	Location	Make	Model #	Rating
I01 – I20	Inverters	West of property building, 419 Penetanguishene Road, Oro-Medonte, ON. Detailed location indicated on map in Appendix A.	Aurora	PVI-5000-OUTD-US	5000 W
T01	Transformer	Adjacent to inverter	To Be Confirmed	To Be Confirmed	To Be Confirmed

The planned locations of significant noise sources are provided in Figure 1 and approximate co-ordinates are provided in Table 5, Appendix B.

4 Points of Reception

Points of Reception for the approval of new sources, including verifying compliance with the Environmental Protection Act, are defined in Publication NPC-205¹ as premises in use, or zoned for future use, as:

- Permanent or seasonal residences;
- Hotels/motels
- Nursing/retirement homes;
- Rental residences;
- Hospitals;
- Camp grounds; and,
- Noise sensitive buildings such as schools and places of worship.

The closest points of reception to the project LP#8 are located approximately 320 m to the west of the project, 360 m to the southwest of the project and 200 m to the north of the project. Other receptors are located >500 m from the proposed project location. Below is a description of each point of reception. The points of reception have been taken as the property boundary for each receptor; this results in a distance lower than that between the sources and a point within 30 m of a dwelling or a camping area as stipulated in Section 7 of NPC-232.

POR1: A residential property located approximately 320 metres west of the project noise sources. The property is located east of Penetanguishene Road. Source to receptor separation distances based on planned equipment locations are provided in Table 3, Appendix B.

POR2: A residential property located approximately 360 metres east of the project noise sources. It is located east of Penetanguishene Road. Source to receptor separation distances based on planned equipment locations are provided in Table 3, Appendix B.

POR3: A residential property located approximately 200 metres north of the project noise sources. It is located east of Penetanguishene Road. Source to receptor separation distances based on planned equipment locations are provided in Table 3, Appendix B.

5 Assessment Criteria (Performance Limits)

The subject property is located in the Township of Oro-Medonte, a rural area (Class 3 Area). Criteria for assessing the impact of noise from stationary sources are provided in the MOE Publication NPC-232 (Sound Level Limits for Stationary Sources in Class 3 Areas (Rural), October 1995, Ministry of the Environment):

NPC-232 Table 232-1: Minimum Values of One Hour L_{eq} or L_{lm} by Time of Day

	One Hour L_{eq} (dBA) or L_{LM} (dBA)
Time of Day	Class 3 Area
07:00 – 19:00	45
19:00 – 23:00	40
23:00 – 07:00	40

Dependent on day of the year, the facility may generate electricity between 5:35 and 21:10. POR1, POR2 and POR3 are located in Class 3 areas where background noise is anticipated to be dominated by natural sounds. Therefore, the appropriate limits for total equipment operation are the MOE exclusionary limits of 45 dBA / 40 dBA (Class 3 Area, 07:00 – 19:00 (daytime operation) / 19:00 – 7:00 (evening and nighttime operation)).

6 Impact Assessment

Noise produced by the inverters was assessed by using the sound rating given in the manufacturer's specifications for the unit. The inverter manufacturer's specifications are provided in Appendix C.

In the absence of a selected make and model number, noise produced by the transformer was assessed based on data published in Table 0.3 of NEMA Standards Publication No. TR 1-1993 (R2000). The transformer size was conservatively assumed to be in the range 101 – 300 kVA (expected size is 100 kVA).

As the noise producing stationary sources at the facility are limited to twenty (20) identical inverters and one (1) transformer, a simple assessment considering only attenuation due to geometric divergence using procedures detailed in ISO 9613 Part 2 has been conducted. This method of assessment is expected to produce a conservative estimate of noise impact as no consideration is given to attenuation through ground absorption, atmospheric absorption or barrier effects.

The predicted sound levels at the selected PORs due to operation of each noise source are summarized in Table 3 (Appendix B). Distances between each source and POR are also provided in this table.

Sample calculations are provided in Appendix D and an Acoustic Assessment Summary Table is provided as Table 4 in Appendix B.

7 Proposed Noise Control Measures

Noise control measures are not necessary for this renewable energy project since the noise resulting from the operation of the solar panels results in a noise level below the MOE exclusionary limits for daytime, evening and nighttime operation.

8 Conclusions

It is concluded that operation of stationary sources associated with proposed Project LP#8 at the Site located at 419 Penetanguishene Road, in the Township of Oro-Medonte, Ontario would result in noise levels at critical points of reception that are below MOE exclusionary limits for a Class 3 Area.

It is further concluded that, with respect to noise impact, operation of the proposed site would be compatible with existing land use planning guidance.

9 References

1. International Organization for Standardization, ISO 9613-2: *Acoustics – Attenuation of Sound During Propagation Outdoors Part 2: General Method of Calculation*, Geneva, Switzerland, 1996.
2. Ontario Ministry of the Environment, *Publication NPC-232: Sound Level Limits for Stationary Sources in Class 3 Areas (Rural)*, October 1995.
3. Ontario Ministry of the Environment, *Publication NPC-233: Information to be Submitted for Approval of Stationary Sources of Sound*, October 1995.
4. Ontario Ministry of the Environment, *Model Municipal Noise Control by-Law Publication NPC-103*, August 1978.
5. Ontario Ministry of the Environment, *Model Municipal Noise Control By-Law Publication NPC-104*, August 1978.
6. Ontario Ministry of the Environment, Environmental Assessment and Approvals Branch, *Basic Comprehensive Certificates of Approval (Air) User Guide Version 2.0*, April 2004.

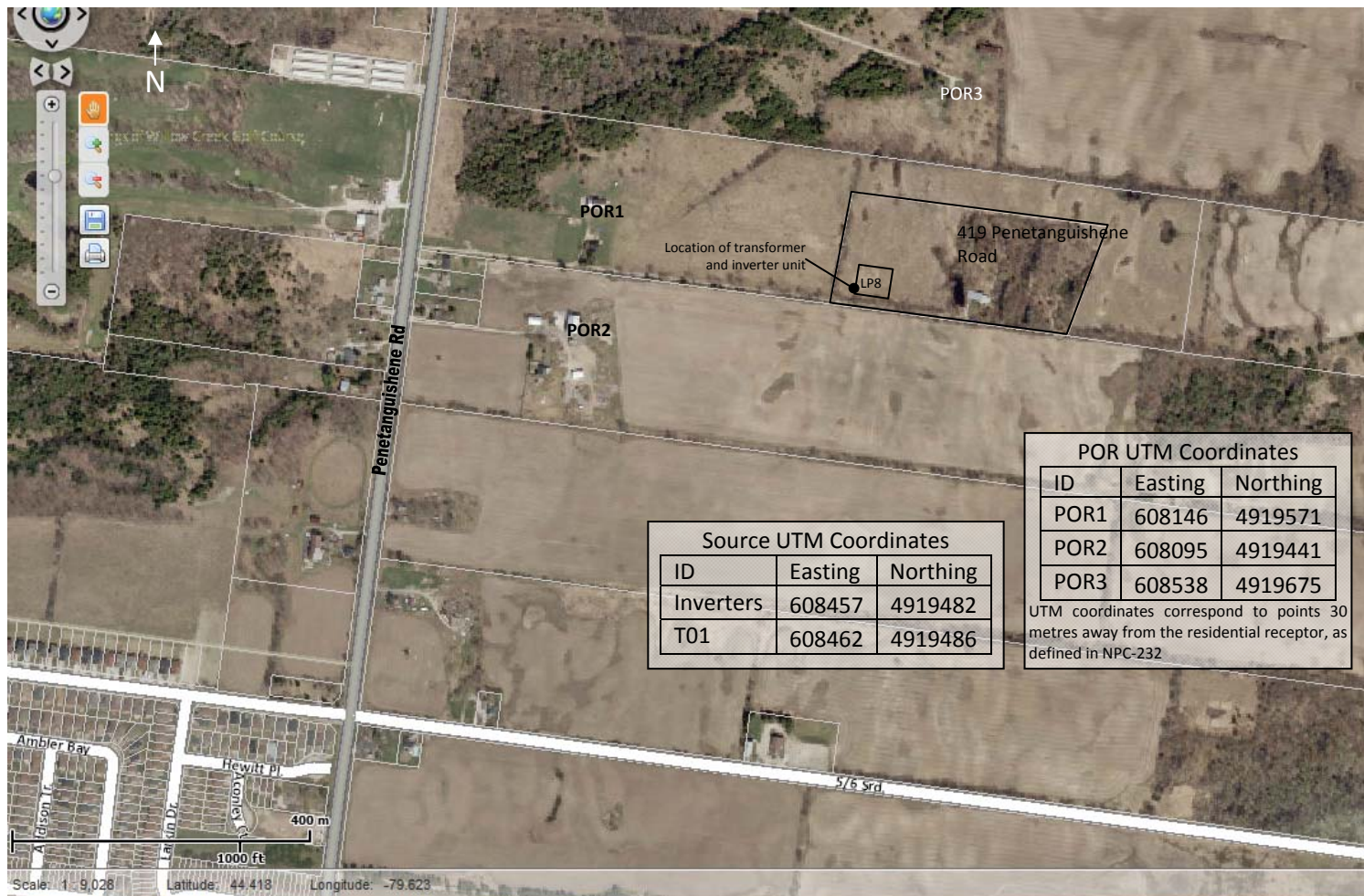
10 Limitations

The objective of this report was to assess noise impact from operation of equipment and processes within the context of our contract with respect to existing Regulations and Guidelines within the applicable jurisdiction. Compliance of past and current owners with applicable local, provincial and federal government laws and regulations was not included in our contract for services.

The conclusions of this report are based, in part, on the information provided by others and any testing and analyses described in the report. The possibility remains that unexpected environmental conditions may be encountered. Should such an event occur, **exp** should be notified in order that we may determine if modifications to our conclusions are necessary.

This report has been prepared for the exclusive use of Future Solar Developments Inc. in accordance with accepted environmental study and/or engineering practices for a Noise Study. No other warranties, either expressed or implied, are made as to the professional services provided under the terms of the Survey and included in this report. Any use which a third party makes of this report, or any part hereof, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. **Exp** Services Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Appendix A – Figures



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Drawing Title: Site Plan Closest Receptors LP8

Prepared By: Rebecca Orth
Date: February 2012
Project No.: WSL-00002250-00

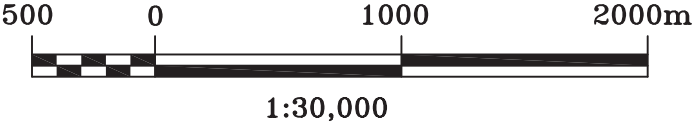
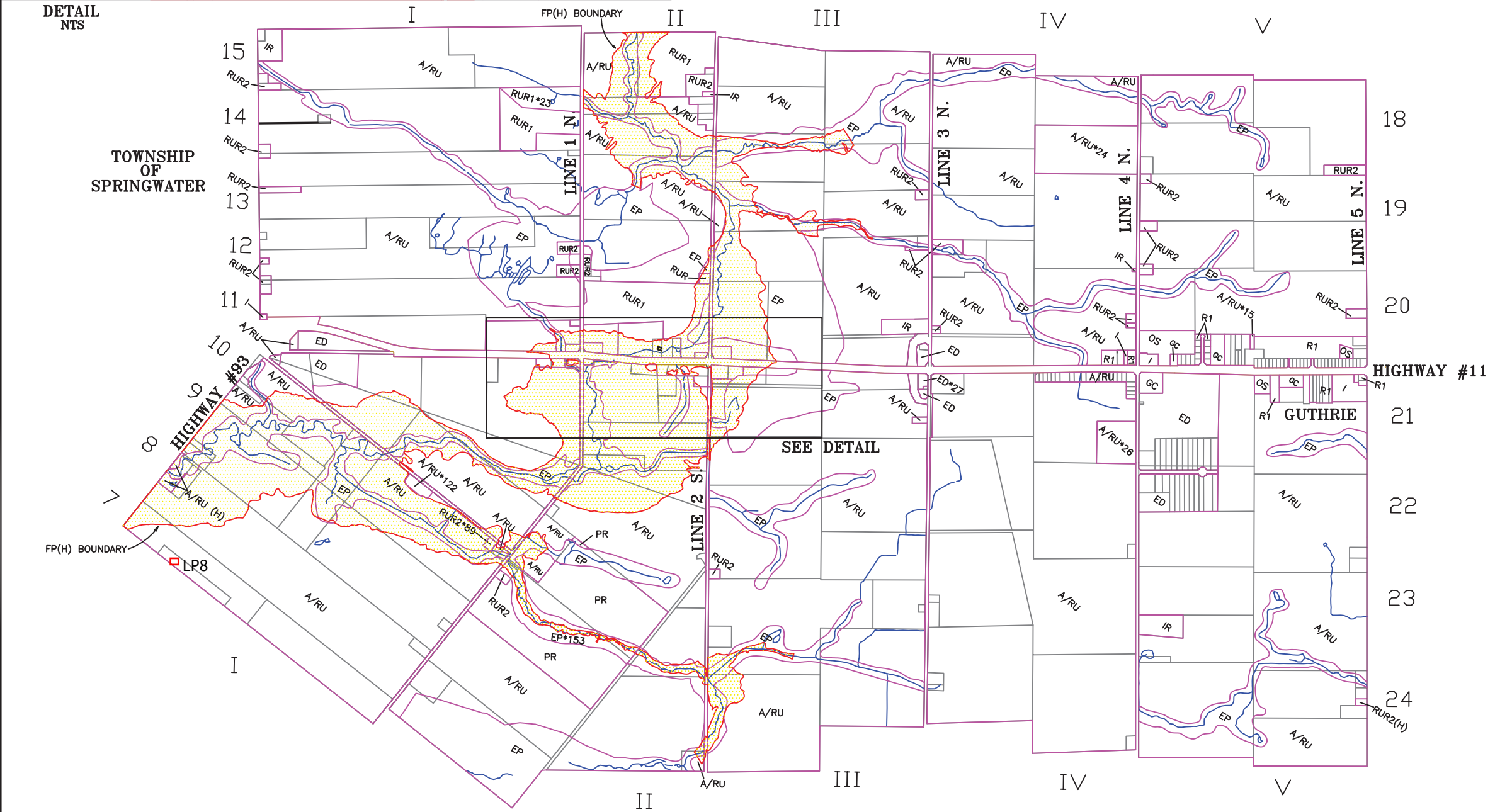
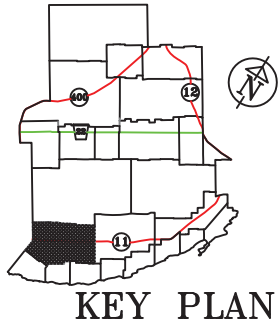
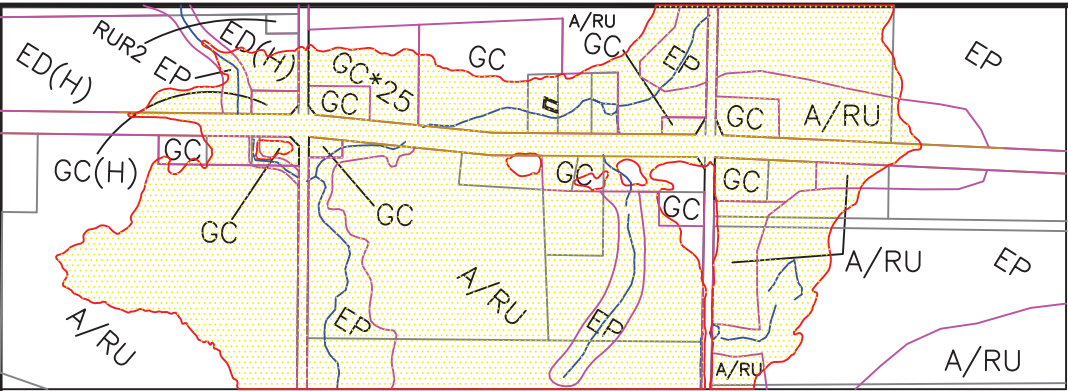
Acoustic Assessment, LP8

Future Solar Developments Inc.
8-3400 Pharmacy Ave.
Scarborough, Ontario M1W 3J8

LEGEND

ZONES

- R1 - Residential One
R2 - Residential Two
RUR1 - Rural Residential One
RUR2 - Rural Residential Two
SR - Shoreline Residential
RLS - Residential Limited Service
IR - Rural Industrial
LI - Local Industrial
ED - Economic Development
AP - Airport
WD - Waste Disposal
LC - Local Commercial
GC - General Commercial
A/RU - Agricultural/Rural
EP - Environmental Protection
OS - Open Space
PR - Private Recreational
FP  - Floodplain Overlay
MAR1 - Mineral Aggregate Resource One
MAR2 - Mineral Aggregate Resource Two
I - Institutional
FD - Future Development



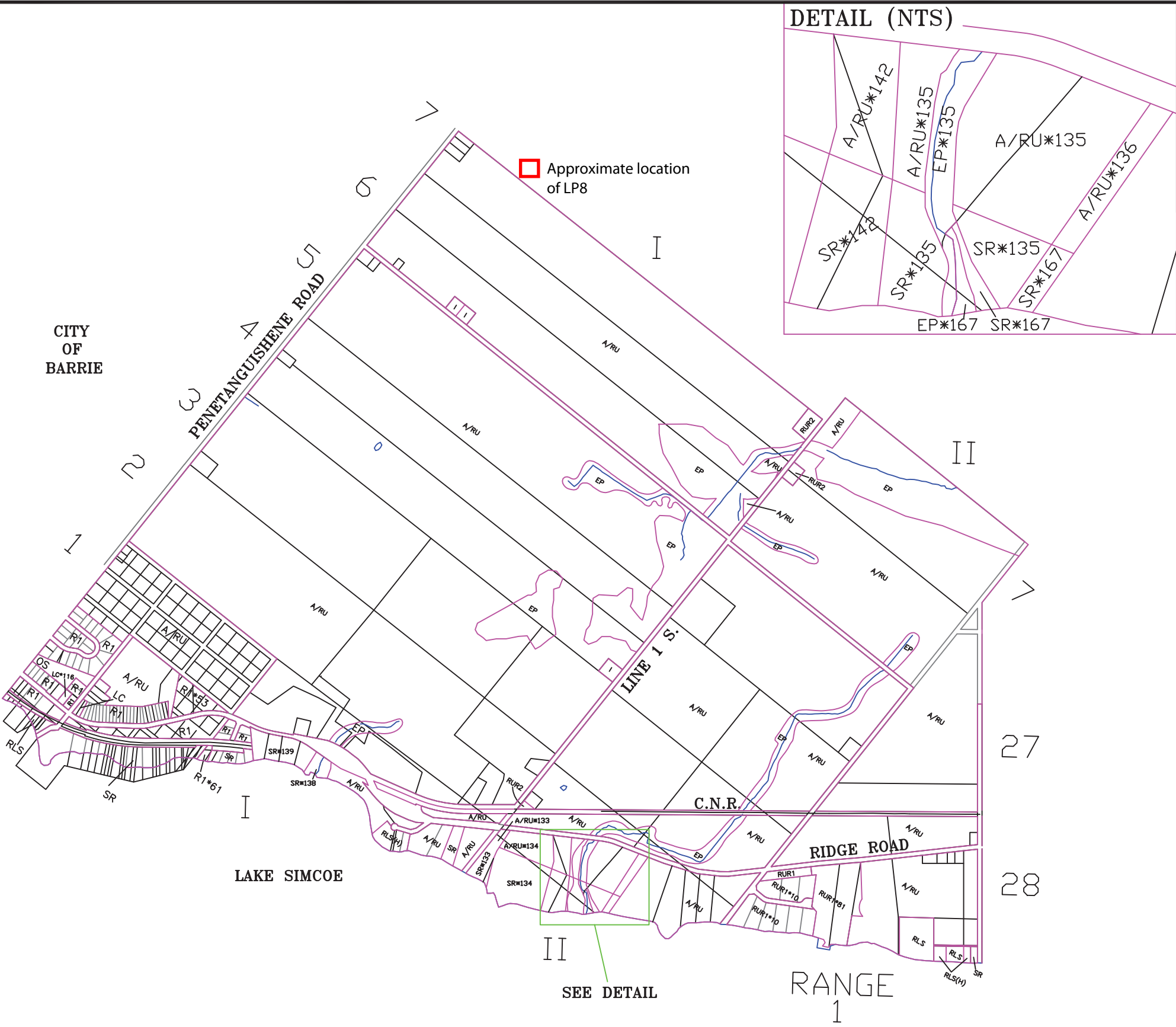
REVISED FEBRUARY 24, 2010

TOWNSHIP OF ORO-MEDONTE
ZONING BY-LAW
SCHEDULE A9

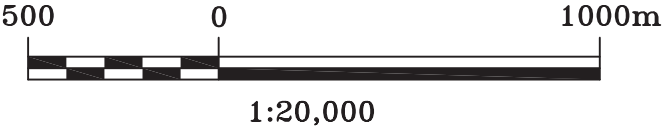
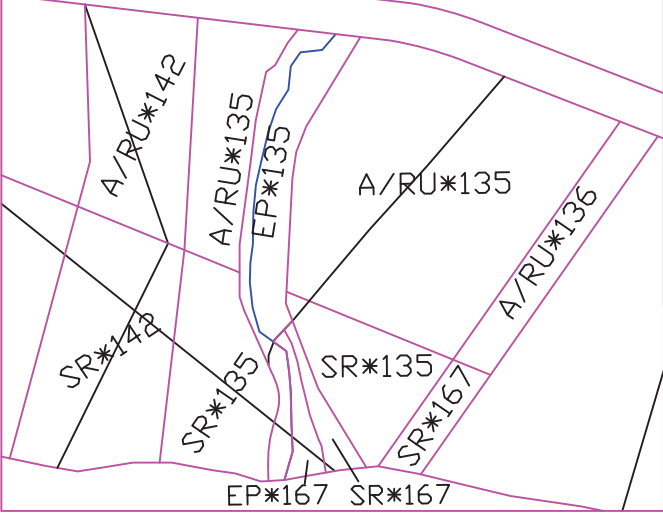
LEGEND

ZONES

- R1 - Residential One
- R2 - Residential Two
- RUR1 - Rural Residential One
- RUR2 - Rural Residential Two
- SR - Shoreline Residential
- RLS - Residential Limited Service
- IR - Rural Industrial
- LI - Local Industrial
- ED - Economic Development
- AP - Airport
- WD - Waste Disposal
- LC - Local Commercial
- GC - General Commercial
- A/RU - Agricultural/Rural
- EP - Environmental Protection
- OS - Open Space
- PR - Private Recreational
- FP - Floodplain Overlay
- MAR1 - Mineral Aggregate Resource One
- MAR2 - Mineral Aggregate Resource Two
- I - Institutional
- FD - Future Development

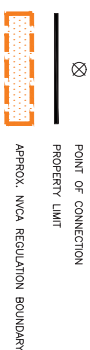


DETAIL (NTS)



REVISED MARCH 12, 2010

TOWNSHIP OF ORO-MEDONTE
ZONING BY-LAW
SCHEDULE A1




NUMBER OF MODULES: 507
NUMBER OF MODULES PER STRING: 13
NUMBER OF STRINGS: 39
PANEL TYPE: CANADIAN SOLAR CS6P-230
FEEDER NAME: F1
CONNECTION VOLTAGE: 4.8kV



NOTES

THE POSITION OF ALL POLE LINES, CONDUITS, WATERMANS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES, AND THE LOCATION OF ALL STRUCTURES, SHALL BE SHOWN ON THE CONTRACT DRAWINGS, AND WHERE EXISTING, THE LOCATION OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK DETERMINE THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

[illegible]

SCALE	<p>HORZ 1:1250</p> <p>VERT 1:50</p> 
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FUTURE SOLAR DEVELOPMENTS INC

3400 PHARMACY AVE, SCARBOROUGH, ON

419 PENETANGUISHENE RD, BARRIE, ON

WSL-2250

FBS

DATE
OCT 7, 2011

PRELIMINARY SITE PLAN

LP8




SP 4

DRAFT



KEY PLAN

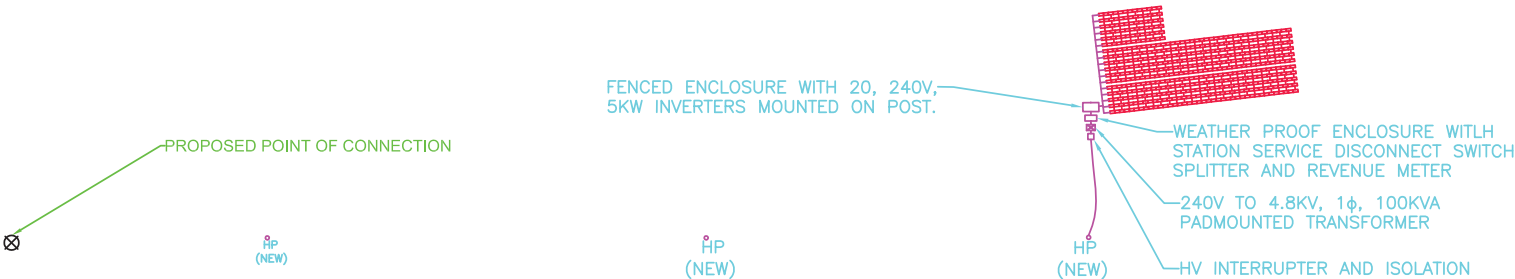
LEGEND

-  POINT OF CONNECTION
-  PROPERTY LIMIT
-  APPROX. NVCA REGULATION BOUNDARY

LP8 STATISTICS:

NUMBER OF MODULES: 507
NUMBER OF MODULES PER STRING: 13
NUMBER OF STRINGS: 39
PANEL TYPE: CANADIAN SOLAR CS6P-230
FEEDER NAME: F1
CONNECTION VOLTAGE: 4.8Kv

PENETANGUISHENE ROAD



NOTE:
AERIAL IMAGERY, TOPOGRAPHIC INFORMATION, AND PROPERTY LIMITS SHOWN AS SUPPLIED BY FIRST BASE SOLUTIONS.

NOTES

THE POSITION OF ALL POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, DETERMINE THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

PRELIMINARY
NOT FOR CONSTRUCTION

NO.		REVISION DESCRIPTION	DATE	BY	APPD	NO.	REVISION DESCRIPTION	DATE	BY	APPD
						1	ISSUED FOR ??????	DD/MM/YY	ABC	ABC

SCALE	
HORZ 1:1250 VERT 1:50	

DESIGNED BY	REVIEWED BY

CLIENT
FUTURE SOLAR DEVELOPMENTS INC.

3400 PHARMACY AVE, SCARBOROUGH, ON
 HAMMERSCHLAG + JOFFE INC. 69 Leaslie Road Toronto, Ontario Canada M6S 2T8 T: (416) 444-9293 F: (416) 444-1463 E: dwg@hampel.com

BASEPLAN	K.H.
DESIGN	J.W.
CHECKED	J.W.
DAD	S.C.
PROJ. MAN	B.B.
APPROVED	B.B.

PROJECT	FUTURE SOLAR
9274 UNION DR, STRATHROY, ON	
TITLE	PRELIMINARY SITE PLAN
LP8	

PROJ. NO.	11-680
SURVEY	FBS
DATE	OCT 7, 2011
DRAWING NO.	ES-4

Appendix B – Tables

Table 1: Noise Summary Table

Source	Sound Power Level (dBA)	Location	Sound Characteristics	Existing Noise Control Measures
I01 – Aurora PVI	66.0 ^a	O	S, T	U
I02 – Aurora PVI	66.0 ^a	O	S, T	U
I03 – Aurora PVI	66.0 ^a	O	S, T	U
I04 – Aurora PVI	66.0 ^a	O	S, T	U
I05 – Aurora PVI	66.0 ^a	O	S, T	U
I06 – Aurora PVI	66.0 ^a	O	S, T	U
I07 – Aurora PVI	66.0 ^a	O	S, T	U
I08 – Aurora PVI	66.0 ^a	O	S, T	U
I09 – Aurora PVI	66.0 ^a	O	S, T	U
I10 – Aurora PVI	66.0 ^a	O	S, T	U
I11 – Aurora PVI	66.0 ^a	O	S, T	U
I12 – Aurora PVI	66.0 ^a	O	S, T	U
I13 – Aurora PVI	66.0 ^a	O	S, T	U
I14 – Aurora PVI	66.0 ^a	O	S, T	U
I15– Aurora PVI	66.0 ^a	O	S, T	U
I16 – Aurora PVI	66.0 ^a	O	S, T	U
I17 – Aurora PVI	66.0 ^a	O	S, T	U
I18– Aurora PVI	66.0 ^a	O	S, T	U
I19 – Aurora PVI	66.0 ^a	O	S, T	U
I20 – Aurora PVI	66.0 ^a	O	S, T	U
Transformer (liquid filled)	71.0 ^a	O	S, T	U

^a A 5 dB penalty has been applied to these sources as required by the MOE publication NPC 104, and included in the Sound Power Level provided in this table.

Location	Sound Characteristics	Existing Noise Control Measures
O – Outside building I – Inside building	S – Steady QSI – quasi-steady impulsive I – Impulsive B – Buzzing T – Tonal C – Cyclic	S – Silencer A – Acoustic Lining B – Barrier L - Lagging E – Enclosure O – Other U – Uncontrolled

Table 2: Performance Limits Summary Table

Point of Reception ID	MOE Designation	Performance Limit (dBA)	
		Day-time	Evening / Night-time
POR1	Class 3	45	40
POR2	Class 3	45	40
POR3	Class 3	45	40

Table 3: Point of Reception Noise Impact Table

Source ID	POR1			POR2			POR3		
	Distance ^a (m)	Sound Level (dBA)		Distance ^a (m)	Sound Level (dBA)		Distance ^a (m)	Sound Level (dBA)	
		Day	Evening /Night		Day	Evening /Night		Day	Evening /Night
I01 – Aurora PVI	323	5	5	364	4	4	209	9	9
I02 – Aurora PVI	324	5	5	365	4	4	209	9	9
I03 – Aurora PVI	325	5	5	366	4	4	209	9	9
I04 – Aurora PVI	326	5	5	367	4	4	208	9	9
I05 – Aurora PVI	327	5	5	368	4	4	208	9	9
I06 – Aurora PVI	323	5	5	365	4	4	208	9	9
I07 – Aurora PVI	324	5	5	366	4	4	208	9	9
I08 – Aurora PVI	325	5	5	367	4	4	208	9	9
I09 – Aurora PVI	326	5	5	368	4	4	207	9	9
I10 – Aurora PVI	327	5	5	369	4	4	207	9	9

Source ID	POR1			POR2			POR3		
	Distance ^a (m)	Sound Level (dBA)		Distance ^a (m)	Sound Level (dBA)		Distance ^a (m)	Sound Level (dBA)	
		Day	Evening /Night		Day	Evening /Night		Day	Evening /Night
I11 – Aurora PVI	323	5	5	365	4	4	207	9	9
I12 – Aurora PVI	324	5	5	366	4	4	207	9	9
I13 – Aurora PVI	325	5	5	367	4	4	207	9	9
I14 – Aurora PVI	326	5	5	368	4	4	206	9	9
I15 – Aurora PVI	327	5	5	369	4	4	206	9	9
I16 – Aurora PVI	323	5	5	365	4	4	207	9	9
I17 – Aurora PVI	324	5	5	366	4	4	206	9	9
I18 – Aurora PVI	325	5	5	367	4	4	206	9	9
I19 – Aurora PVI	326	5	5	368	4	4	205	9	9
I20 – Aurora PVI	327	5	5	369	4	4	205	9	9
T01	327	10	10	370	9	9	204	14	14

^a Calculated distances are based on best available data regarding source locations.

Table 4: Acoustic Assessment Summary Table

POR ID	POR Description	Time of Day	Sound Level at POR (dBA)	Verified by Acoustic Audit? (Yes/No)	Performance Limit (dBA) Leq	Compliance with Performance Limit (Yes/No)
POR1	Permanent residence	Day	18	No	45	Yes
		Evening/ night	18	No	40	Yes
POR2	Permanent residence	Day	17	No	45	Yes
		Evening/ night	17	No	40	Yes
POR3	Permanent residence	Day	22	No	45	Yes
		Evening/ night	22	No	40	Yes

Table 5: Source and Receptor Co-ordinates

Item	Identifier	UTM Easting ¹	UTM Northing
Source	I01	608457	4919482
	I02	608458	4919482
	I03	608459	4919482
	I04	608460	4919482
	I05	608461	4919482
	I06	608457	4919483
	I07	608458	4919483
	I08	608459	4919483
	I09	608460	4919483
	I10	608461	4919483
	I11	608457	4919484
	I12	608458	4919484
	I13	608459	4919484
	I14	608460	4919484
	I15	608461	4919484
	I16	608457	4919485
	I17	608458	4919485
	I18	608459	4919485
	I19	608460	4919485
	I20	608461	4919485
	T01	608462	4919486
Receptor	POR1	608146	4919571
	POR2	608095	4919441
	POR3	608538	4919675

¹ Zone 17

Appendix C – Manufacturer's Data

PVI-5000-OUTD-US PVI-6000-OUTD-US

GENERAL SPECIFICATIONS OUTDOOR MODELS

Designed for residential and small commercial PV installations, this inverter fills a specific niche in the Aurora product line to cater for those installations producing between 5kW and 20kW.

This inverter has all the usual Aurora benefits, including dual input section to process two strings with independent MPPT, high speed and precise MPPT algorithm for real-time power tracking and energy harvesting, as well as transformerless operation for high performance efficiencies of up to 97.1%.

The wide input voltage range makes the inverter suitable to low power installations with reduced string size. This outdoor inverter has been designed as a completely sealed unit to withstand the harshest environmental conditions.

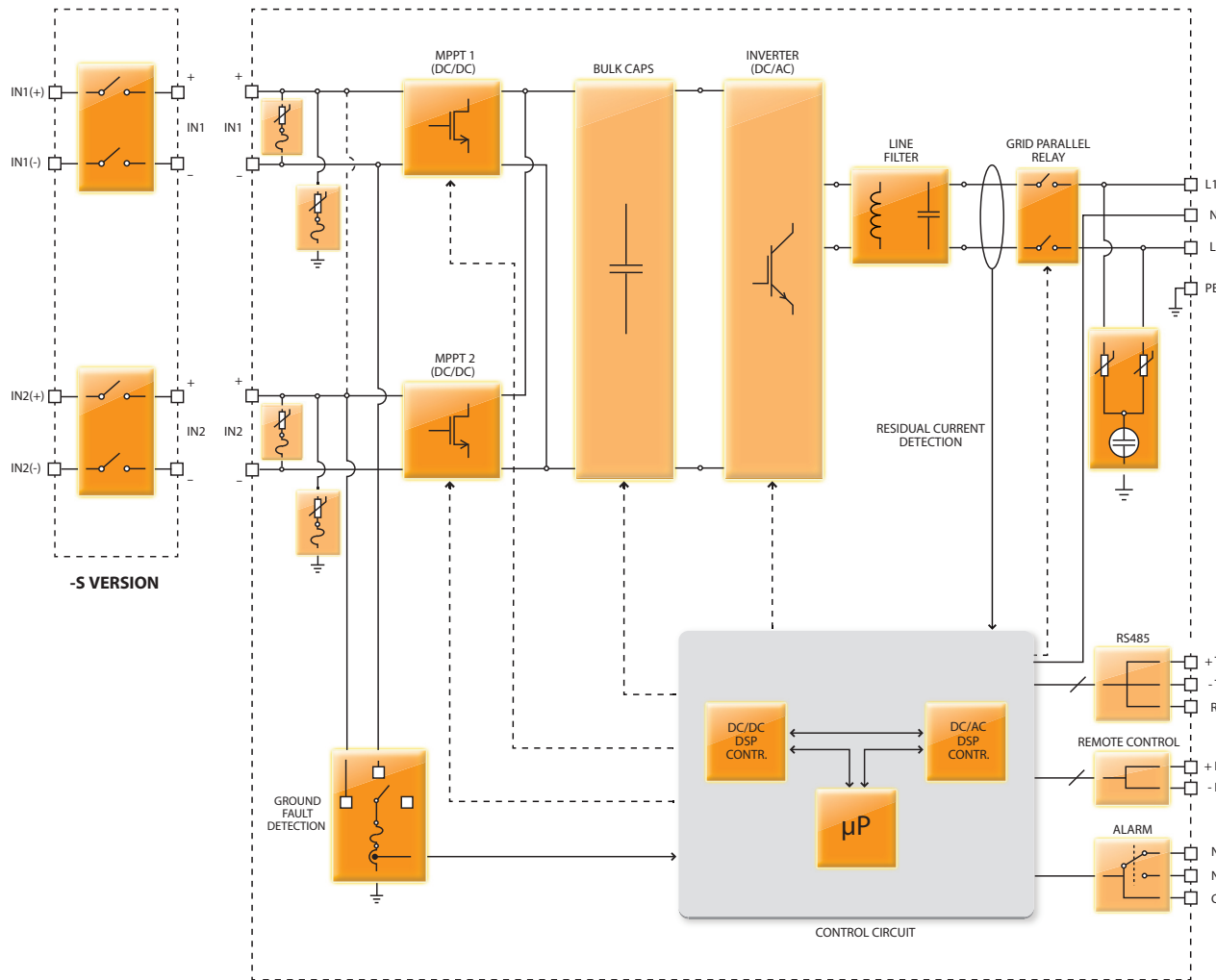


AURORA UNO

Features

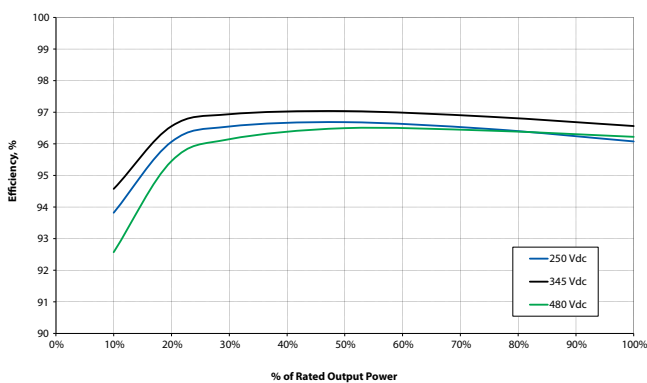
- Each inverter is set on specific grid codes which can be selected in the field
- Single phase output
- Dual input sections with independent MPP tracking, allows optimal energy harvesting from two sub-arrays oriented in different directions
- Wide input range
- High speed and precise MPPT algorithm for real time power tracking and improved energy harvesting
- Flat efficiency curves ensure high efficiency at all output levels ensuring consistent and stable performance across the entire input voltage and output power range
- Outdoor enclosure for unrestricted use under any environmental conditions
- RS-485 communication interface (for connection to laptop or datalogger)
- Compatible with PVI-RADIOMODULE for wireless communication with Aurora PVI-DESKTOP

BLOCK DIAGRAM OF PVI-5000-OUTD AND PVI-6000-OUTD FOR NORTH AMERICA

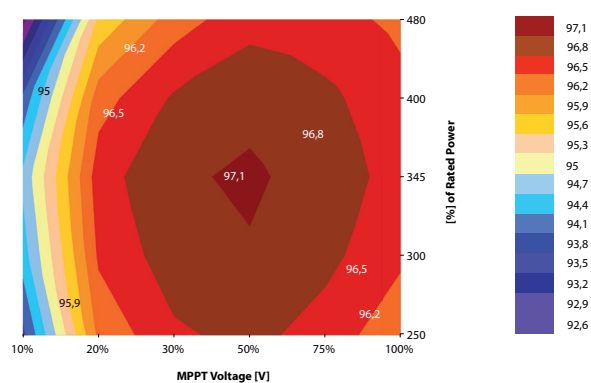


Block Diagram and Efficiency Curves

PVI-6000-OUTD-US



PVI-6000-OUTD-US



PARAMETER	PVI-5000-OUTD-US			PVI-6000-OUTD-US		
Input Side						
Absolute Maximum DC Input Voltage (V _{max,abs})	600 V					
Start-up DC Input Voltage (V _{start})	200 V (adj. 120...350 V)					
Operating DC Input Voltage Range (V _{dcmín...V_{dcmáx}})	0.7 x V _{start} ...580 V					
Rated DC Input Power (P _{dcr})	5150 W			6180 W		
Number of Independent MPPT	2					
Maximum DC Input Power for each MPPT (P _{MPPTmax})	4000 W					
DC Input Voltage Range with Parallel Configuration of MPPT at P _{acr}	200...530 V					
DC Power Limitation with Parallel Configuration of MPPT	Linear Derating From MAX to Null [530V≤V _{MPPT} ≤580V]					
DC Power Limitation for each MPPT with Independent Configuration of MPPT at P _{acr} , max unbalance example	4000 W [225V≤V _{MPPT} ≤530V] the other channel: P _{dcr} -4000W [90V≤V _{MPPT} ≤530V]			4000 W [230V≤V _{MPPT} ≤530V] the other channel: P _{dcr} -4000W [120V≤V _{MPPT} ≤530V]		
Maximum DC Input Current (I _{dcmáx}) / for each MPPT (I _{MPPTmax})	36.0 A / 18.0 A					
Maximum Input Short Circuit Current for each MPPT	22.0 A					
Number of DC Inputs Pairs for each MPPT	1					
DC Connection Type	Screw Terminal Block, 3 Knock-Outs: 1 ½" or 1" (w/ Ring Reducer)					
Input Protection						
Reverse Polarity protection	Yes, from limited current source					
Input Over Voltage Protection for each MPPT - Varistor	2					
Photovoltaic Array Isolation Control	GFDI (for use with either Positive or Negative Grounded Arrays)					
DC Switch Rating for each MPPT (-S Version)	25 A / 600 V					
Output Side						
AC Grid Connection Type	208 V	240 V	277 V	208 V	240 V	277 V
Rated AC Power (P _{acr})	Single phase / Split phase					
Maximum AC Output Power (P _{acmax})	5000 W			6000 W		
Rated AC Grid Voltage (V _{acr,r})	208 V	240 V	277 V	208 V	240 V	277 V
AC Voltage Range	183...228 V	211...264 V	244...304 V	183...228 V	211...264 V	244...304 V
Maximum AC Output Current (I _{ac,max})	27.0 A	23.0 A	20.0 A	30.0 A	28.0 A	24.0 A
Rated Output Frequency (f _r)	60 Hz					
Output Frequency Range (f _{min...f_{max}})	59.3...60.5 Hz					
Nominal Power Factor (Cosphi _{acr,r})	> 0.995					
Total Current Harmonic Distortion	< 2%					
AC Connection Type	Screw terminal block					
Output Protection						
Anti-Islanding Protection	208 V	240 V	277 V	208 V	240 V	277 V
Maximum AC Overcurrent Protection	According to UL 1741/IEE1547					
Output Overvoltage Protection - Varistor	35.0 A	30.0 A	25.0 A	40.0 A	35.0 A	30.0 A
Operating Performance	2 (L1 - L2 / L1 - PE)					
Maximum Efficiency (η _{max})	208 V	240 V	277 V	208 V	240 V	277 V
Weighted Efficiency (EURO/CEC)	97.1%			97.1%		
Feed In Power Threshold	96.0%	96.5%	96.5%	96.0%	96.5%	96.5%
Stand-by Consumption	20.0 W					
Communication	< 8.0 W					
Wired Local Monitoring						
Remote Monitoring	PVI-USB-RS485_232 (opt.), PVI-DESKTOP (opt.)					
Wireless Local Monitoring	PVI-AEC-EVO (opt.), AURORA-UNIVERSAL (opt.)					
User Interface	PVI-DESKTOP (opt.) with PVI-RADIOMODULE (opt.)					
Environmental	16 characters x 2 lines LCD display					
Ambient Temperature Range	-25...+60°C (-13...+ 140°F) with derating above 50°C (122°F)					
Relative Humidity	0...100% condensing					
Noise Emission	<50 db(A) @ 1 m					
Maximum Operating Altitude without Derating	2000 m / 6560 ft					
Physical						
Environmental Protection Rating	IP 65					
Cooling	Natural					
Dimension (H x W x D)	1052mm x 325mm x222mmm / 41.4" x 12.8" x 8.7"					
Weight	< 27.0 kg / 59.5 lb					
Mounting System	Wall bracket					
Safety						
Isolation Level	Transformerless					
Marking	cCSAus					
Safety and EMC Standard	UL 1741, CSA - C22.2 N. 107.1-01					
Grid Standard	IEEE 1547					
Available Products Variants						
With DC Switch	PVI-5000-OUTD-US			PVI-6000-OUTD-US		



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Appendix D –Calculations

Calculation of Sound Power Levels

Inverter

Aurora PVI specifications indicate a sound pressure level of <50 dB(A) at a distance of 1 m. Sound power level for the inverter has been calculated using the following equation:

$$L_w = L_p - \log(d_r/d_t) + 11$$

Where:

L_w = sound power (dBA)

d_r = Reference distance (1 m)

d_t = Test distance

$$L_w = 51 - \log(1/1) + 11 = 61.0 \text{ dB(A)}$$

In the absence of frequency spectra for the inverter it has been assumed that noise from the inverter is tonal and a 5 dB penalty has therefore been applied as required by Section 4 of NPC-104.

Transformer

In the absence of a transformer make and model number, sound pressure has been calculated using data published in NEMA TR 1 – 1993 (R2000) Table 0.3. From Table 0.3, for an immersed transformer:

Transformer Size	Average Sound Pressure (at ≤ 1 m)
51 – 100 kVA	51 dB
101 – 300 kVA	55 dB

Anticipated transformer size is 100 kVA, as this size is at the limit of a size range the average sound pressure (at ≤ 1 m) for the next highest size range has been conservatively applied. The sound power level for the transformer has been calculated using the following equation:

$$L_w = L_p - \log(d_r/d_t) + 11$$

Where:

L_w = sound power (dBA)

d_r = Reference distance (1 m)

d_t = Test distance

$$L_w = 55 - \log(1/1) + 11 = 66.0 \text{ dB(A)}$$

In the absence of frequency spectra for the inverter it has been assumed that noise from the transformer is tonal and a 5 dB penalty has therefore been applied as required by Section 4 of NPC-104.

Sound Pressure Levels

Sound pressure levels have been calculated conservatively assuming that sound attenuation between the source and the PORs was due solely to geometric divergence (atmospheric absorption, barriers and absorptive ground were not taken into consideration).

The on-site road traffic associated to the renewable energy project will be restricted to occasional visits for maintenance or engineering purposes. As such traffic will be infrequent and so excluded as per Annex to Publication NPC-232 section A.3 (2).

The following equations were employed to calculate sound pressure at points of reception from source power levels including attenuation due to geometric divergence only (from ISO 9613 (Part 2)) and to calculate the total sound pressure level at points of reception due to operation of multiple stationary sources:

$$Lp2 = Lp1 - 20 \log \left(\frac{d}{do} \right)$$

Where:

do = reference distance (1 m)

d = distance between source and receptor

$Lp1$ = Sound pressure level at do

$Lp2$ = Sound pressure level at d

$$L_{tot} = 10 \log \left(\sum_{i=1}^n \text{antilog} \frac{Ln}{10} \right)$$

Where:

L_{tot} = total sound pressure at POR for all sources

Ln = sound pressure level at POR from source n

Example Calculations:

I01 – Inverter is located 323 m from POR1 and generates a sound pressure of <50 dBA at a distance of 1 m (manufacturer's specifications). In the absence of frequency data a penalty of 5 dBA has been applied for possible tonality.

Sound pressure at 1 m = 55 dBA

$$Lp2 = Lp1 - 20 \log \left(\frac{d}{do} \right)$$

$$Lp2 = 55 - 20 \log \left(\frac{323}{1} \right) = 4.8$$

As each inverter generates the same sound pressure level at 1 m and is approximately the same distance from POR1:

$$L_{tot} = 10 \log \left(\sum_{i=1}^n \text{antilog} \frac{Ln}{10} \right)$$

$$L_{tot} = 10 \log \left(20 \left(\text{antilog} \frac{4.8}{10} \right) + \text{antilog} \frac{9.7}{10} \right) = 18$$

Tables 3 and 4 in Appendix B summarize results obtained through application of the above equations.