KINGSTON SOLAR LP

KINGSTON SOLAR LP
SOL-LUCE KINGSTON
SOLAR PV ENERGY PROJECT

DRAFT NOISE STUDY REPORT

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REV.	DATE	DETAILS OR PURPOSE OF REVISION	PREPARED	CHECKED	APPROVED
A	01/03/12	Issued for client review			
B	04/24/12	Issued for client review			
C	05/04/12	Final version			
D	08/05/12	Used for use.			
E	11/07/12	Incorporating adjacent solar projects and vacant lot receptors			

EXECUTIVE SUMMARY

AMEC Environment & Infrastructure, a Division of AMEC Americas Limited (AMEC), was retained by Kingston Solar LP (hereinafter referred to as the "Proponent") to prepare a Renewable Energy Approval (REA) application, as required under Ontario Regulation 359/09, for its proposed Sol-Luce Kingston Solar PV Energy Project in Kingston, Ontario (the Project). This Draft *Noise Study Report* has been completed as a component of the REA application. The purpose of this study is to assess and document potential environmental noise impact of the proposed solar electricity generating project on neighbouring land uses that are considered as noise sensitive in accordance with the Ministry of the Environment (MOE) noise guidelines. This report presents the results of the noise study required for solar facilities under Ontario Regulation 359/09.

This Draft *Noise Study Report* has been prepared in accordance with the MOE's, "Basic Comprehensive Certificates of Approval User Guide", Version 2.1, March 2011 and NPC-233, "Information to be Submitted for Approval of Stationary Sources of Sound", dated October 1995 as required by Ontario Ministry of the Environment (MOE). This noise study has taken into account cumulative noise effect from the neighbouring solar projects within 2 km of the proposed Sol-Luce Kingston Solar PV Energy Project and considered vacant lots as surrogate receptors for noise assessment. To determine adjacent solar projects, a search of current and proposed projects was completed within 2 km of the Project's property lines. The search was based on the Proponent's knowledge of other projects proposed; reviewing MOE's Renewable Energy Project listing (http://www.ene.gov.on.ca/environment/en/subject/renewable_energy/projects/index.htm); and reviewing websites of developers known to be active in the City of Kingston, Loyalist Township; and the County of Lennox-Addington. This search identified three potential projects within 2 km of the Project's property lines: SunE Westbrook Solar Farm; Kingston Gardiner Highway 2 South Solar Project; and SkyPower MajesticLight Solar Project. Of these, only the SunE Westbrook Solar Farm and Kingston Gardiner Highway 2 South Solar Project have published Noise Study Reports that could be used in this assessment. There was no information available on the MajesticLight Solar Project and it's status is unknown.

Kingston Solar LP is constructing a 100 MW AC solar power development in Eastern Ontario located in the City of Kingston and Loyalist Township. The Project is spread across portions of City of Kingston and Loyalist Township and would occupy approximately 261 hectares of land. The lands on which the solar panels would be located are privately owned and would be leased by Kingston Solar LP for the duration of the Project.

The Project is located in a Class 3 Area, based on the classification defined in Publication NPC-232 by the MOE. The Class 3 Area means a rural area with an acoustical environment that is dominated by natural sounds, having little or no traffic, such as an agricultural area. Eighty (80) representative noise-impacted points of reception, including thirty-one (31) vacant lots, are identified in the vicinity of the proposed project and used in the noise

study. Vacant lots considered were those falling within the 35 dBA contour as discussed with the MOE.

Ninety-eight (98) significant noise sources from the proposed Sol-Luce Kingston Solar PV Energy Project, thirty-one (31) from the SunE Westbrook Solar Farm and eleven (11) from the Kingston Gardiner Hwy 2 South Solar Energy Project have been identified and considered for this noise study. These sources include one 110 MVA transformer for the substation and ninety-seven (97) Medium Voltage Power Platforms (MVPP) at the Sol-Luce Kingston Solar PV Energy Project; twenty (20) hut inverters, ten (10) hut transformers and one (1) substation transformer at the SunE Westbrook Solar Farm; and ten (10) inverters and one (1) substation transformer at the the Kingston Gardiner Hwy 2 South Solar Energy Project. Each MVPP at the Sol-Luce Kingston Solar PV Energy Project houses two (2) SC-500HE-US 500 kW or equivalent inverters inside an enclosure and one 1 MVA transformer located outdoor.

There are no significant sources of vibration at the site and therefore, a vibration assessment is not required for this project. Sound levels from the Project operations were modelled using Cadna/A, a computerized version of the ISO 9613 environmental noise propagation algorithms, produced by Datakustik GmbH. The predicted sound levels from the Project noise sources at the modeled points of reception (POR 1 through POR 80) are not expected to exceed the MOE NPC-232 guideline limits for Class 3 Areas. The sound pressure levels at the points of reception reported as part of this noise study represent the worst-case impact from the project with cumulative noise effect from the neighbouring solar farms within 2 km of the proposed Sol-Luce Kingston Solar PV Energy Project.

The project attributable noise at each point of reception is not expected to exceed the applicable guideline limits. Therefore, the Project will be in compliance with MOE NPC-232 guidelines with the layout used in this study. No additional noise mitigation is therefore required.

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1.0 INTRODUCTION

Kingston Solar LP (hereinafter referred to as the "Proponent") has retained AMEC Environment & Infrastructure, a Division of AMEC Americas Limited (AMEC) to prepare a Renewable Energy Approval (REA) application, as required under Ontario Regulation 359/09, for its proposed Sol-Luce Kingston Solar PV Energy Project (the Project) in Kingston, Ontario. This Draft *Noise Study Report* is completed as a component of the REA application. This Draft *Noise Study Report* has been prepared in accordance with the MOE's, "Basic Comprehensive Certificates of Approval User Guide", Version 2.1, March 2011 and NPC-233, "Information to be Submitted for Approval of Stationary Sources of Sound", dated October 1995 as required by Ontario Ministry of the Environment (MOE).

The objective of this study is to assess and document potential environmental noise impact of the proposed photovoltaic electricity generating project on neighbouring land uses that are considered as noise sensitive in accordance with the Ministry of the Environment (MOE) noise guidelines. This report presents the results of the noise study required for solar facilities under Ontario Regulation 359/09 to support application for the Renewable Energy Approval (REA).

A glossary of commonly used noise terminologies can be found in **Appendix A**.

2.0 PROJECT DESCRIPTION AND LAYOUT

Kingston Solar LP is constructing a 100 MW solar power development in Eastern Ontario located in the City of Kingston and Loyalist Township. The Project is spread across portions of City of Kingston and Loyalist Township as shown in Figure 1 and would occupy approximately 261 hectares of land. The lands on which the solar panels would be located are privately owned and would be leased by Kingston Solar LP for the duration of the Project.

The proposed facility will convert solar energy into electricity to be fed into the Hydro One distribution grid. The electrical output of the Project will be collected and connected to an electrical substation capable of transforming the power from distribution voltage to a transmission voltage of 230 kV. The Project is designated as a Class 3 solar farm as defined by Section 4 of O.Reg. 359/09.

The new electric generating facility that will utilize photovoltaic (PV) panels installed on fixed racking structures, mounted on the ground. The PV panels generate DC electricity, which is converted to 200 Low Voltage AC electricity by the inverters at the Medium Voltage Power Platforms (MVPP). The 200 Low Voltage AC power is then transformed to 34.5 kV by a step-up transformer located at the MVPP. The 34.5-kV power is brought to a single central substation transformer to be stepped up to 230 kV for transmission to the nearby Hydro One transmission line.

Figure 1 shows the project location and project boundaries along with neighbouring solar projects within 2 km. The proposed schedule for the Project is to commence construction in 2013 with completion in 2014. The electrical substation will be located at south end of Property# 4. O&M building will be located on west of the substation on Property# 4.

The Project is spread over nineteen (19) private properties (e.g., P1 through P4, P6A, P7, P9, P10, P11A, P12, P14A, P14B, P14C, and P19 through P24) in the City of Kingston and Loyalist Township. The Project is bounded to the south by Westbrook Road and Highway 401, to the east by County Road 38 and farm lands, to the north by farm lands and to the west by farm lands and County Road 19. The zoning maps for the project site and surrounding areas are included in **Appendix B**. The project drawings and layouts are included in **Appendix C**.

The Project is composed of one (1) 110 MVA transformer for the substation and ninety-seven (97) Medium Voltage Power Platforms (MVPP), each of them houses two (2) SC-500HE-US 500 kW or equivalent inverters inside the enclosure and one 1 MVA transformer outdoor. The solar panels produce electricity during daytime only. After sunset, the facility will not receive solar radiation to generate any electricity. Under these conditions, the inverters will not produce noise, the transformers energized, but not in operation (no fans).

3.0 NOISE SOURCE SUMMARY

Two types of noise sources associated with the Project were identified: transformers and inverters. The inverters are located inside Medium Voltage Power Platform (MVPP) enclosure. There are ninety-seven (97) MVPPs proposed for this project, each houses two (2) SC-500HE-US 500 kW or equivalent inverters inside an enclosure and one (1) 1 MVA step-up transformer outdoor. A 110 MVA transformer is proposed for the substation. The layout of the site is provided in **Appendix C** and manufacturer's sound data for the MVPP is provided in **Appendix D**. Noise sources for the Project are shown in Figures 2 through 7 and are presented in Table 1.

3.1 Substation

The Project's electrical substation will be located south end of the PV panels on Property# 4 site. See layout in **Appendix C** for details. At this point, it is anticipated that the step-up power transformer located in the substation will have a maximum rating of 110 MVA. The proposed transformer cutsheet along with sound data is provided in **Appendix D**. For the purpose of evaluating the potential noise impacts of the transformer, the sound pressure levels in octave band were estimated to match the manufacturer's overall sound pressure level and converted to sound power level based on the transformer size. Conversion of sound pressure level to sound power level is included in **Appendix E**.

Power transformers are considered as tonal noise sources by the MOE. A 5-dB penalty is added to the sound power spectrum, as recommended by Publication MOE NPC-104, “Sound Level Adjustments” for tonality.

3.2 Medium Voltage Power Platforms (MVPP)

Ninety-seven (97) 1 MW rated SMA Medium Power Platforms are proposed for this project (see **Appendix D** for cutsheets). Sixty-six (66) of them are mitigated units. Each MVPP houses two (2) SC-500HE-US 500 kW or equivalent inverters inside an enclosure and one (1) 1 MVA step-up transformer outdoor. The unmitigated configuration consists of the MVPP enclosure assembly (both walls and roof), housing two 500 kW inverters, made of sandwich panels separating two 18 gauge steel sheets by 3-inch deep cavity filled with fibreglass insulation. Sound data provided for the unmitigated configuration includes two 500 kW inverters. The total sound power levels provided by the manufacturer include sound emanating from two inverters through the walls, roof, louvered doors and exhaust openings. However, they do not include noise contribution from the step-up transformer located outdoor. In the absence of manufacturer sound data for the step-up transformer associated with the MVPP, sound power levels were estimated from the Canadian Standard Association (CSA C227.4) based on the transformer capacity. The octave band spectrum were estimated to match the overall CSA sound pressure levels and converted to sound power levels based on the transformer size. The sound data for the enclosed inverters as provided by the manufacturer is added with the estimated sound data for one 1 MVA step-up transformer and used in the noise study.

The mitigated configuration of the MVPP enclosure includes perforated steel on the inner side of enclosure wall, instead of solid steel sheet. Additionally, each inverter exhaust is attached with an acoustically lined rectangular duct of 2 m in length. The acoustic lining inside the duct is 25 mm thick. Details of the mitigation are provided in the Sound Prediction Report for the MVPP units completed by HGC Engineering (see **Appendix D**), as provided by the manufacturer. The mitigated unit sound power levels provided by the manufacturer include sound emanating from two inverters through the walls, roof, louvered doors and exhaust openings. Estimated sound data, based on CSA Standards, for one 1 MVA step-up transformer is added with the mitigated MVPP sound data for the noise study.

Each MVPP was modelled as single point source (combination of two enclosed inverters and one outdoor step-up transformer). A 5-dBA penalty was added to the frequency spectrum, as stipulated in Publication MOE NPC-104, “Sound Level Adjustments” to allow for tonality.

The “barrier effect” provided by the solar panels surrounding MVPPs has not been modelled, which means that the actual sound pressure levels at any Point of Reception (POR) may be lower than the predicted levels. The solar facility is not expected to operate during night-time and the inverters do not produce noise during night-time. However, the step-up transformers will be energized and make some magnetostrictive noise at a reduced level. None of these assumptions should affect the conclusions of this study as AMEC has modelled the worst-case scenario.

The substation transformer and SMA MVPP technical specifications provided by the manufacturer are included in **Appendix D**. Noise calculations of transformers and MVPPs are included in **Appendix E**. A summary of the sound sources described above, including sound levels, characteristics and potential noise control measures is presented in Table 1.

3.3 Neighbouring Solar Projects (for Cumulative Noise Effect)

This noise study has taken into account cumulative noise effect from the neighbouring solar farms within 2 km of the proposed Sol-Luce Kingston Solar PV Energy Project. To determine adjacent solar projects, a search of current and proposed projects was completed within 2 km of the Project's property lines. The search was based on the Proponent's knowledge of other projects proposed; reviewing MOE's Renewable Energy Project listing (http://www.ene.gov.on.ca/environment/en/subject/renewable_energy/projects/index.htm); and reviewing websites of developers known to be active in the City of Kingston, Loyalist Township; and the County of Lennox-Addington. This search identified three potential projects within 2 km of the Project's property lines: SunE Westbrook Solar Farm; Kingston Gardiner Highway 2 South Solar Project; and SkyPower MajesticLight Solar Project. Of these, only the SunE Westbrook Solar Farm and Kingston Gardiner Highway 2 South Solar Project have published Noise Study Reports that could be used in this assessment. There was no information available on the MajesticLight Solar Project and it's status is unknown.

Twenty (20) hut inverters, ten (10) hut transformers and one (1) substation transformer at the SunE Westbrook Solar Farm, and ten (10) inverters and one (1) substation transformer at the the Kingston Gardiner Hwy 2 South Solar Energy Project are included in the assessment. Sound power levels, location and heights for the noise sources are taken from the noise study report for the respective projects. Noise study reports for the SunE Westbrook Solar Farm and Kingston Gardiner Hwy 2 South Solar Energy Project are provided in **Appendix F**.

A 5-dB penalty is added to the sound power spectrum, as recommended by Publication MOE NPC-104, "Sound Level Adjustments" to allow for tonality.

A summary of the sound sources described above, including sound levels, characteristics and potential noise control measures is presented in Table 1.

Table 1: Noise Source Summary

Source ID [1]	Source Description	Sound Power Level [2] (dBA/dBAI)	Source Location [3] (I or O)	Sound Characteristics [4] (S,Q,I,B,T,C)	Noise Control Measures [5] (S,A,B,L,E,O,U)
Sol-Luce Kingston Solar PV Energy Project					
P1_U1	MVPP P1_U1	94	O	S, T	U
P1_U2	MVPP P1_U2	85	O	S, T	A,E
P1_U3	MVPP P1_U3	85	O	S, T	A,E
P2_1_U1	MVPP P2/1_U1	85	O	S, T	A,E
P3_U1	MVPP P3_U1	85	O	S, T	A,E
P3_U2	MVPP P3_U2	94	O	S, T	U
P3_U3	MVPP P3_U3	85	O	S, T	A,E
P3_U4	MVPP P3_U4	85	O	S, T	A,E
P3_U5	MVPP P3_U5	85	O	S, T	A,E
P3_U6	MVPP P3_U6	85	O	S, T	A,E
P4_U1	MVPP P4_U1	94	O	S, T	U
P4_U2	MVPP P4_U2	94	O	S, T	U
P4_U3	MVPP P4_U3	85	O	S, T	A,E
P4_U4	MVPP P4_U4	85	O	S, T	A,E
P4_U5	MVPP P4_U5	94	O	S, T	U
P6A_U1	MVPP P6A_U1	94	O	S, T	U
P6A_U2	MVPP P6A_U2	85	O	S, T	A,E
P6A_U3	MVPP P6A_U3	85	O	S, T	A,E
P7_9_10_U1	MVPP P7/9/10_U1	94	O	S, T	U
P7_9_10_U2	MVPP P7/9/10_U2	94	O	S, T	U
P7_9_10_U3	MVPP P7/9/10_U3	94	O	S, T	U
P7_9_10_U4	MVPP P7/9/10_U4	94	O	S, T	U
P11A_U1	MVPP P11A_U1	94	O	S, T	U
P11A_U2	MVPP P11A_U2	94	O	S, T	U
P11A_U3	MVPP P11A_U3	85	O	S, T	A,E
P12_U1	MVPP P12_U1	94	O	S, T	U
P12_U2	MVPP P12_U2	94	O	S, T	U
P12_U3	MVPP P12_U3	94	O	S, T	U
P12_U4	MVPP P12_U4	94	O	S, T	U
P12_U5	MVPP P12_U5	94	O	S, T	U
P12_U6	MVPP P12_U6	85	O	S, T	A,E
P12_U7	MVPP P12_U7	85	O	S, T	A,E
P14A_U1	MVPP P14A_U1	94	O	S, T	U
P14A_U2	MVPP P14A_U2	94	O	S, T	U
P14A_U3	MVPP P14A_U3	85	O	S, T	A,E
P14A_U4	MVPP P14A_U4	85	O	S, T	A,E
P14A_U5	MVPP P14A_U5	85	O	S, T	A,E
P14A_U6	MVPP P14A_U6	85	O	S, T	A,E
P14A_U7	MVPP P14A_U7	94	O	S, T	U
P14A_U8	MVPP P14A_U8	94	O	S, T	U
P14A_U9	MVPP P14A_U9	94	O	S, T	U
P14A_U10	MVPP P14A_U10	94	O	S, T	U
P14A_U11	MVPP P14A_U11	94	O	S, T	U

Table 1: Noise Source Summary (continued)

Source ID [1]	Source Description	Sound Power Level [2] (dBA/dBAI)	Source Location [3] (I or O)	Sound Characteristics [4] (S,Q,I,B,T,C)	Noise Control Measures [5] (S,A,B,L,E,O,U)
P14A_U12	MVPP P14A_U12	85	O	S, T	A,E
P14A_U13	MVPP P14A_U13	85	O	S, T	A,E
P14A_U14	MVPP P14A_U14	85	O	S, T	A,E
P14A_U15	MVPP P14A_U15	94	O	S, T	U
P14A_U16	MVPP P14A_U16	94	O	S, T	U
P14A_U17	MVPP P14A_U17	94	O	S, T	U
P14A_U18	MVPP P14A_U18	94	O	S, T	U
P14A_U19	MVPP P14A_U19	85	O	S, T	A,E
P14A_U20	MVPP P14A_U20	85	O	S, T	A,E
P14A_U21	MVPP P14A_U21	85	O	S, T	A,E
P14B_U1	MVPP P14B_U1	94	O	S, T	U
P14B_U2	MVPP P14B_U2	94	O	S, T	U
P14B_U3	MVPP P14B_U3	85	O	S, T	A,E
P14B_U4	MVPP P14B_U4	85	O	S, T	A,E
P14B_U5	MVPP P14B_U5	85	O	S, T	A,E
P14B_U6	MVPP P14B_U6	85	O	S, T	A,E
P14B_U7	MVPP P14B_U7	85	O	S, T	A,E
P14B_U8	MVPP P14B_U8	85	O	S, T	A,E
P14C_U1	MVPP P14C_U1	94	O	S, T	U
P14C_U2	MVPP P14C_U2	94	O	S, T	U
P14C_U3	MVPP P14C_U3	94	O	S, T	U
P14C_U4	MVPP P14C_U4	94	O	S, T	U
P19_20_U1	MVPP P19/20_U1	94	O	S, T	U
P19_U1	MVPP P19_U1	85	O	S, T	A,E
P19_U2	MVPP P19_U2	85	O	S, T	A,E
P19_U3	MVPP P19_U3	85	O	S, T	A,E
P19_U4	MVPP P19_U4	94	O	S, T	U
P19_U5	MVPP P19_U5	85	O	S, T	A,E
P20_U1	MVPP P20_U1	94	O	S, T	U
P21_U1	MVPP P21_U1	85	O	S, T	A,E
P21_U2	MVPP P21_U2	94	O	S, T	U
P21_U3	MVPP P21_U3	94	O	S, T	U
P21_U4	MVPP P21_U4	94	O	S, T	U
P21_U5	MVPP P21_U5	94	O	S, T	U
P21_U6	MVPP P21_U6	94	O	S, T	U
P21_U7	MVPP P21_U7	94	O	S, T	U
P21_U8	MVPP P21_U8	85	O	S, T	A,E
P21_U9	MVPP P21_U9	85	O	S, T	A,E
P22_U1	MVPP P22_U1	94	O	S, T	U
P22_U2	MVPP P22_U2	94	O	S, T	U
P22_U3	MVPP P22_U3	94	O	S, T	U
P22_U4	MVPP P22_U4	94	O	S, T	U
P22_U5	MVPP P22_U5	85	O	S, T	A,E
P22_U6	MVPP P22_U6	85	O	S, T	A,E

Table 1: Noise Source Summary (continued)

Source ID [1]	Source Description	Sound Power Level [2] (dBA/dBAI)	Source Location [3] (I or O)	Sound Characteristics [4] (S,Q,I,B,T,C)	Noise Control Measures [5] (S,A,B,L,E,O,U)
P23_U2	MVPP P23_U2	94	O	S, T	U
P23_U3	MVPP P23_U3	94	O	S, T	U
P23_U4	MVPP P23_U4	94	O	S, T	U
P23_U5	MVPP P23_U5	94	O	S, T	U
P23_U6	MVPP P23_U6	85	O	S, T	A,E
P23_U7	MVPP P23_U7	85	O	S, T	A,E
P24_U1	MVPP P24_U1	94	O	S, T	U
P24_U2	MVPP P24_U2	94	O	S, T	U
P24_U3	MVPP P24_U3	94	O	S, T	U
TS	Transformer Station	111	O	S, T	B
SunE Westbrook Solar Farm					
H1T	Hut 1 Transformer	78	O	S, T	U
H1I1	Hut 1 Inverter 1	89	O	S, T	E
H1I2	Hut 1 Inverter 2	89	O	S, T	E
H2T	Hut 2 Transformer	78	O	S, T	U
H2I1	Hut 2 Inverter 1	89	O	S, T	E
H2I2	Hut 2 Inverter 2	89	O	S, T	E
H3T	Hut 3 Transformer	78	O	S, T	U
H3I1	Hut 3 Inverter 1	89	O	S, T	E
H3I2	Hut 3 Inverter 2	89	O	S, T	E
H4T	Hut 4 Transformer	78	O	S, T	U
H4I1	Hut 4 Inverter 1	89	O	S, T	E
H4I2	Hut 4 Inverter 2	89	O	S, T	E
H5T	Hut 5 Transformer	78	O	S, T	U
H5I1	Hut 5 Inverter 1	89	O	S, T	E
H5I2	Hut 5 Inverter 2	89	O	S, T	E
H6T	Hut 6 Transformer	78	O	S, T	U
H6I1	Hut 6 Inverter 1	89	O	S, T	E
H6I2	Hut 6 Inverter 2	89	O	S, T	E
H7T	Hut 7 Transformer	78	O	S, T	U
H7I1	Hut 7 Inverter 1	89	O	S, T	E
H7I2	Hut 7 Inverter 2	89	O	S, T	E
H8T	Hut 8 Transformer	78	O	S, T	U
H8I1	Hut 8 Inverter 1	89	O	S, T	E
H8I2	Hut 8 Inverter 2	89	O	S, T	E
H9T	Hut 9 Transformer	78	O	S, T	U
H9I1	Hut 9 Inverter 1	89	O	S, T	E
H9I2	Hut 9 Inverter 2	89	O	S, T	E
H10T	Hut 10 Transformer	78	O	S, T	U
H10I1	Hut 10 Inverter 1	89	O	S, T	E
H10I2	Hut 10 Inverter 2	89	O	S, T	E
ST	Substation Transformer	92	O	S, T	U

Table 1: Noise Source Summary (continued)

Source ID [1]	Source Description	Sound Power Level [2] (dBA/dBAI)	Source Location [3] (I or O)	Sound Characteristics [4] (S,Q,I,B,T,C)	Noise Control Measures [5] (S,A,B,L,E,O,U)
Kingston Gardiner Highway 2 South Solar Project					
Sub	44-kV/10-MVA Substation transformer	91	O	S, T	U
Inv1	Sunny Central 1000MV inverter unit	102	O	S, T	E, S
Inv2	Sunny Central 1000MV inverter unit	102	O	S, T	E, S
Inv3	Sunny Central 1000MV inverter unit	102	O	S, T	E, S
Inv4	Sunny Central 1000MV inverter unit	102	O	S, T	E, S
Inv5	Sunny Central 1000MV inverter unit	102	O	S, T	E, S
Inv6	Sunny Central 1000MV inverter unit	102	O	S, T	E, S
Inv7	Sunny Central 1000MV inverter unit	102	O	S, T	E, S
Inv8	Sunny Central 1000MV inverter unit	102	O	S, T	E, S
Inv9	Sunny Central 1000MV inverter unit	102	O	S, T	E, S
Inv10	Sunny Central 1000MV inverter unit	102	O	S, T	E, S

Notes to Table:

1. Source ID matches the identifiers used in the inverter layout.
2. Sound Power Level of Source, in dBA, including sound characteristic adjustments per NPC-104.
3. Source Location: O = Outside of building, including the roof, I = Inside of building
4. Sound Characteristic, per NPC-104
   S = Steady I = Impulsive T = Tonal
   Q = Quasi-Steady Impulsive B = Buzzing C = Cyclic
5. Noise Control Measures to Be Included
   S = Silencer/Muffler L = Lagging O = other
   A = Acoustic lining for the exhaust opening E = acoustic enclosure U = uncontrolled
   B = Barrier on south and west sides of the transformer station

4.0 MITIGATION MEASURES SUMMARY

The mitigation for operation of the Project has been modelled and considered to be feasible. The proposed mitigation for this project is: a) acoustic barriers on south and west sides of the substation transformer, and b) forty-two (42) mitigated Medium Voltage Power Platform (MVPP) units as provided in the Sound Prediction Report for the MVPP units completed by HGC Engineering (see **Appendix D**). A combination of berms and barriers can also be used to mitigate the substation transformer noise impact on the PORs.

The minimum construction requirements for the proposed noise barrier for the substation transformer are presented in Table 2 (see Figure 5). Mitigated MVPPs are identified in Table 2.

Table 2: Summary of Mitigation Measures

Source ID	Mitigation Description	Attenuation (dB)							
		63	125	250	500	1K	2K	4K	8K
MVPP P1_U2	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P1_U3	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P2/1_U1	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P3_U1	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P3_U3	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P3_U4	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P3_U5	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P3_U6	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P4_U3	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P4_U4	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P6A_U2	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P6A_U3	MVPP Acoustic Enclosure and 2 m long lined duct for inverter	5	8	13	18	18	18	18	18

Table 2: Summary of Mitigation Measures (continued)

Source ID	Mitigation Description	Attenuation (dB)							
		63	125	250	500	1K	2K	4K	8K
	exhausts								
MVPP P11A_U3	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P12_U6	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P12_U7	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P14A_U3	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P14A_U4	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P14A_U5	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P14A_U6	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P14A_U12	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P14A_U13	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P14A_U14	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P14A_U19	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P14A_U20	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P14A_U21	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P14B_U3	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P14B_U4	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P14B_U5	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18

Table 2: Summary of Mitigation Measures (continued)

Source ID	Mitigation Description	Attenuation (dB)							
		63	125	250	500	1K	2K	4K	8K
MVPP P14B_U6	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P14B_U7	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P14B_U8	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P19_U1	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P19_U2	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P19_U3	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P19_U5	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P21_U1	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P21_U8	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P21_U9	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P22_U5	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P22_U6	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P23_U6	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18
MVPP P23_U7	MVPP Acoustic Enclosure and 2 m long lined duct for inverter exhausts	5	8	13	18	18	18	18	18

Note:- The proposed mitigation listed above is for inverters only (i.e., inverters are inside the enclosure and transformers are located outdoor.

Noise Barrier Dimensions for the Substation

Mitigation ID	Location	Face Density (Kg/m2)	Approximate Length (m)	Approximate Height (m)	Maximum Distance From Source (m)
Barrier_1	South of substation	20	88	6	45
Barrier_2	West of substation	20	61	6	29

Note:- Barrier-source distance is from the centre of the source

5.0 POINT OF RECEPTION (POR) SUMMARY

A total of eighty (80) representative impacted points of reception are identified in the area and are considered in this noise study. They include forty-nine (49) existing houses and thirty-one (31) vacant lots.

5.1 Existing Houses

Forty-nine (49) existing houses surrounding the proposed Sol-Luce Kingston Solar PV Energy Project are identified and considered in this assessment. They are presented in Table 3 and shown in Figures 8 through 12. The receptor location considered for all houses are at 1.5 m above the grade and 30 m away from the house as they are the worse impact location.

5.2 Vacant Lots

Thirty-one (31) vacant lots surrounding the proposed Sol-Luce Kingston Solar PV Energy Project are identified and considered in this assessment. They are presented in Table 3 and shown in Figures 8 through 12. The receptor location considered for all vacant lots are at 1.5 m above the grade as they are the worse impact location. As agreed in discussion with the MOE, vacant lots considered in this assessment are only those which experience 35 dBA or higher noise levels from the Sol-Luce Kingston Solar PV Energy Project (see **Appendix G**).

Zoning maps for the site are included in **Appendix B**. UTM coordinates for all modelled receptors are provided in Table 3.

Table 3: Points of Reception Summary

POR ID [1]	Point of Reception Description	UTM Coordinate	
		Easting	Northing
POR01	House 01	364166	4905882
POR02	House 02	364246	4906051
POR03	House 03	364328	4906180
POR04	House 04	364435	4906341
POR05	House 05	364535	4906443

Table 3: Points of Reception Summary (continued)

POR ID [1]	Point of Reception Description	UTM Coordinate	
		Easting	Northing
POR06	House 06	365333	4905535
POR07	House 07	365290	4905358
POR08	House 08	365438	4906947
POR09	House 09	365824	4906970
POR10	House 10	366076	4906749
POR11	House 11	366177	4906667
POR12	House 12	366036	4906191
POR13	House 13	366475	4906165
POR14	House 14	366841	4906227
POR15	House 15	366749	4907702
POR16	House 16	366878	4907989
POR17	House 17	366607	4908072
POR18	House 18	366624	4908373
POR19	House 19	366652	4908460
POR20	House 20	366655	4908543
POR21	House 21	366582	4908917
POR22	House 22	366648	4909043
POR25	House 25	367336	4907996
POR26	House 26	367424	4907955
POR27	House 27	367640	4907903
POR28	House 28	367636	4907974
POR29	House 29	367669	4908129
POR30	House 30	367948	4908749
POR31	House 31	368275	4908124
POR32	House 32	368313	4908138
POR33	House 33	368762	4908115
POR34	House 34	368477	4908346
POR35	House 35	368826	4908612
POR36	House 36	369362	4908338
POR37	House 37	369758	4908368
POR38	House 38	369924	4908274
POR39	House 39	370056	4908282
POR40	House 40	370552	4908625
POR41	House 41	370697	4908843
POR42	House 42	370666	4909184
POR43	House 43	370488	4909382
POR44	House 44	370378	4909505
POR45	House 45	370413	4909228
POR46	House 46	370365	4909176
POR47	House 47	370771	4907280
POR48	House 48	370350	4906948
POR49	House 49	370307	4906548
POR50	Vacant Lot Receptor 01	365719	4905791
POR51	Vacant Lot Receptor 02	366287	4906347
POR52	Vacant Lot Receptor 03	366249	4906424

Table 3: Points of Reception Summary (continued)

POR ID [1]	Point of Reception Description	UTM Coordinate	
		Easting	Northing
POR53	Vacant Lot Receptor 04	366794	4907844
POR54	Vacant Lot Receptor 05	366765	4908063
POR55	Vacant Lot Receptor 06	366663	4908145
POR56	Vacant Lot Receptor 07	367428	4908096
POR57	Vacant Lot Receptor 08	366635	4908622
POR58	Vacant Lot Receptor 09	367016	4910060
POR59	Vacant Lot Receptor 10	367266	4910349
POR60	Vacant Lot Receptor 11	367411	4910357
POR61	Vacant Lot Receptor 12	368878	4908170
POR62	Vacant Lot Receptor 13	369605	4908239
POR63	Vacant Lot Receptor 14	370422	4909603
POR64	Vacant Lot Receptor 15	370395	4909646
POR65	Vacant Lot Receptor 16	368537	4906762
POR66	Vacant Lot Receptor 17	368747	4906779
POR67	Vacant Lot Receptor 18	368966	4906833
POR68	Vacant Lot Receptor 19	370294	4906668
POR69	Vacant Lot Receptor 20	370400	4906775
POR70	Vacant Lot Receptor 21	370645	4906988
POR71	Vacant Lot Receptor 22	366624	4908749
POR72	Vacant Lot Receptor 23	366705	4908451
POR73	Vacant Lot Receptor 24	366917	4907854
POR74	Vacant Lot Receptor 25	368426	4908150
POR75	Vacant Lot Receptor 26	369797	4908147
POR76	Vacant Lot Receptor 27	367133	4906729
POR77	Vacant Lot Receptor 28	367483	4906764
POR78	Vacant Lot Receptor 29	367503	4906637
POR79	Vacant Lot Receptor 30	367326	4906616
POR80	Vacant Lot Receptor 31	367154	4906611

6.0 APPLICABLE GUIDELINES

The noise sources associated with the Project are classified as "stationary sources", under the MOE definitions. As referenced in the MOE's, "Basic Comprehensive Certificates of Approval User Guide" the applicable environmental noise guidelines are found in the MOE Publication NPC-205, *"Sound Level Limits for Stationary Sources in Class 1 & 2 Areas (Urban)"and* NPC-232, *"Sound Level Limits for Stationary Sources in Class 3 Areas (Rural)".*

The Project is located in a Class 3 Area, based on the classification defined in Publication NPC-232 by the MOE. A Class 3 area is defined as one which is dominated by natural sounds, around the clock, where there is infrequent human activity and no clearly audible stationary sources other than those being assessed. This is typical of a rural, agricultural area; rural, recreational (cottage, resort) area; wilderness area; or a community with minimal population.

The applicable MOE guideline states that one-hour sound exposures (L_{eq} (1hr)) from stationary noise sources in Class 3 (rural) areas shall not exceed that of the background, where the background is considered to be:

- the higher of 45 dBA or background noise, during daytime hours (0700 - 1900h); and,
- the higher of 40 dBA, or background noise, during the early evening (1900 - 2300h) and nighttime (2300 - 0700h).

The Project will be operating during the daytime hours, 7:00 to 19:00 during most of the year. However, in the summer months, the sun may set past 21:00, although the inverters will be well below 100% loading conditions. This means that during the summer the Project will be operating at the time the applicable performance limit changes from 45 dBA to 40 dBA. During night-time hours the transformers are energized and therefore, the modelled sound pressure levels were compared to the lower limit of 40 dBA.

7.0 IMPACT ASSESSMENT

Offsite sound exposures due to the Project operations were modelled using Cadna/A, a computerized version of the ISO 9613 environmental noise propagation algorithms, produced by Datakustik GmbH. The modelling took into account the following factors:

- Source sound power level;
- Distance attenuation;
- Source-receptor geometry including heights and elevations;
- Surrounding topography;
- Ground and air (atmospheric) attenuation; and,
- Meteorological effects on noise propagation.

The elevation contours for the project site were taken from the Ontario Base Maps (OBM). The assessment of predictable worst-case facility impacts was completed through modelling as the facility is yet to be built. The combined Leq (1 hour) dBA values for the worst-case scenario were predicted at points of reception POR 1 through POR 71 from the individual significant sources as summarized in Appendix H. Noise contours have also been generated for the worst-case operation, and are shown in Figures 13 through 18. Key parameters included in the model are shown in Appendix I.

The noise study summary is provided in Table 4. Predicted sound levels at each point of reception are not expected to exceed the night-time criteria. Therefore, the Project is expected to be in compliance with MOE NPC-232 guidelines as presently configured.

Table 4: Noise Study Summary

Point of Reception ID	Point of Reception Description	Time Period [1]	Total Sound Level at PoR [2] (dBA)	Verified by Acoustic Audit [3] (Yes/No)	Performance Limit [4] (dBA/dBAI)	Performance Limit Source [4] (C / M/ D)	Compliance with Performance Limit (Yes/No)
POR01	House 01	Daytime	39	No	45	D	Yes
		Evening	39	No	40		Yes
		Night-time	39	No	40		Yes
POR02	House 02	Daytime	40	No	45	D	Yes
		Evening	40	No	40		Yes
		Night-time	40	No	40		Yes
POR03	House 03	Daytime	40	No	45	D	Yes
		Evening	40	No	40		Yes
		Night-time	40	No	40		Yes
POR04	House 04	Daytime	39	No	45	D	Yes
		Evening	39	No	40		Yes
		Night-time	39	No	40		Yes
POR05	House 05	Daytime	38	No	45	D	Yes
		Evening	38	No	40		Yes
		Night-time	38	No	40		Yes
POR06	House 06	Daytime	40	No	45	D	Yes
		Evening	40	No	40		Yes
		Night-time	40	No	40		Yes
POR07	House 07	Daytime	40	No	45	D	Yes
		Evening	40	No	40		Yes
		Night-time	40	No	40		Yes
POR08	House 08	Daytime	37	No	45	D	Yes
		Evening	37	No	40		Yes
		Night-time	37	No	40		Yes
POR09	House 09	Daytime	38	No	45	D	Yes
		Evening	38	No	40		Yes
		Night-time	38	No	40		Yes
POR10	House 10	Daytime	40	No	45	D	Yes
		Evening	40	No	40		Yes
		Night-time	40	No	40		Yes
POR11	House 11	Daytime	39	No	45	D	Yes
		Evening	39	No	40		Yes

Table 4: Noise Study Summary (continued)

Point of Reception ID	Point of Reception Description	Time Period [1]	Total Sound Level at PoR [2] (dBA)	Verified by Acoustic Audit [3] (Yes/No)	Performance Limit [4] (dBA/dBAI)	Performance Limit Source [4] (C / M/ D)	Compliance with Performance Limit (Yes/No)
		Night-time	39	No	40		Yes
POR12	House 12	Daytime	37	No	45	D	Yes
		Evening	37	No	40		Yes
		Night-time	37	No	40		Yes
POR13	House 13	Daytime	30	No	45	D	Yes
		Evening	30	No	40		Yes
		Night-time	30	No	40		Yes
POR14	House 14	Daytime	29	No	45	D	Yes
		Evening	29	No	40		Yes
		Night-time	29	No	40		Yes
POR15	House 15	Daytime	34	No	45	D	Yes
		Evening	34	No	40		Yes
		Night-time	34	No	40		Yes
POR16	House 16	Daytime	37	No	45	D	Yes
		Evening	37	No	40		Yes
		Night-time	37	No	40		Yes
POR17	House 17	Daytime	34	No	45	D	Yes
		Evening	34	No	40		Yes
		Night-time	34	No	40		Yes
POR18	House 18	Daytime	37	No	45	D	Yes
		Evening	37	No	40		Yes
		Night-time	37	No	40		Yes
POR19	House 19	Daytime	38	No	45	D	Yes
		Evening	38	No	40		Yes
		Night-time	38	No	40		Yes
POR20	House 20	Daytime	38	No	45	D	Yes
		Evening	38	No	40		Yes
		Night-time	38	No	40		Yes
POR21	House 21	Daytime	32	No	45	D	Yes
		Evening	32	No	40		Yes
		Night-time	32	No	40		Yes
POR22	House 22	Daytime	33	No	45	D	Yes

Table 4: Noise Study Summary (continued)

Point of Reception ID	Point of Reception Description	Time Period [1]	Total Sound Level at PoR [2] (dBA)	Verified by Acoustic Audit [3] (Yes/No)	Performance Limit [4] (dBA/dBAI)	Performance Limit Source [4] (C / M/ D)	Compliance with Performance Limit (Yes/No)
		Evening	33	No	40		Yes
		Night-time	33	No	40		Yes
POR23	House 23	Daytime	39	No	45	D	Yes
		Evening	39	No	40		Yes
		Night-time	39	No	40		Yes
POR24	House 24	Daytime	39	No	45	D	Yes
		Evening	39	No	40		Yes
		Night-time	39	No	40		Yes
POR25	House 25	Daytime	37	No	45	D	Yes
		Evening	37	No	40		Yes
		Night-time	37	No	40		Yes
POR26	House 26	Daytime	38	No	45	D	Yes
		Evening	38	No	40		Yes
		Night-time	38	No	40		Yes
POR27	House 27	Daytime	39	No	45	D	Yes
		Evening	39	No	40		Yes
		Night-time	39	No	40		Yes
POR28	House 28	Daytime	39	No	45	D	Yes
		Evening	39	No	40		Yes
		Night-time	39	No	40		Yes
POR29	House 29	Daytime	39	No	45	D	Yes
		Evening	39	No	40		Yes
		Night-time	39	No	40		Yes
POR30	House 30	Daytime	37	No	45	D	Yes
		Evening	37	No	40		Yes
		Night-time	37	No	40		Yes
POR31	House 31	Daytime	40	No	45	D	Yes
		Evening	40	No	40		Yes
		Night-time	40	No	40		Yes
POR32	House 32	Daytime	40	No	45	D	Yes

Table 4: Noise Study Summary (continued)

Point of Reception ID	Point of Reception Description	Time Period [1]	Total Sound Level at PoR [2] (dBA)	Verified by Acoustic Audit [3] (Yes/No)	Performance Limit [4] (dBA/dBAI)	Performance Limit Source [4] (C / M/ D)	Compliance with Performance Limit (Yes/No)
		Evening	40	No	40		Yes
		Night-time	40	No	40		Yes
POR33	House 33	Daytime	40	No	45	D	Yes
		Evening	40	No	40		Yes
		Night-time	40	No	40		Yes
POR34	House 34	Daytime	38	No	45	D	Yes
		Evening	38	No	40		Yes
		Night-time	38	No	40		Yes
POR35	House 35	Daytime	39	No	45	D	Yes
		Evening	39	No	40		Yes
		Night-time	39	No	40		Yes
POR36	House 36	Daytime	40	No	45	D	Yes
		Evening	40	No	40		Yes
		Night-time	40	No	40		Yes
POR37	House 37	Daytime	40	No	45	D	Yes
		Evening	40	No	40		Yes
		Night-time	40	No	40		Yes
POR38	House 38	Daytime	38	No	45	D	Yes
		Evening	38	No	40		Yes
		Night-time	38	No	40		Yes
POR39	House 39	Daytime	38	No	45	D	Yes
		Evening	38	No	40		Yes
		Night-time	38	No	40		Yes
POR40	House 40	Daytime	35	No	45	D	Yes
		Evening	35	No	40		Yes
		Night-time	35	No	40		Yes
POR41	House 41	Daytime	39	No	45	D	Yes
		Evening	39	No	40		Yes
		Night-time	39	No	40		Yes
POR42	House 42	Daytime	40	No	45	D	Yes
		Evening	40	No	40		Yes
		Night-time	40	No	40		Yes