Eastervale Solar Project

Noise Impact Assessment

Client: Eastervale Solar Inc.
Reference: 23-014
Version 1.0

January 2024

Report Prepared for:
Eastervale Solar Inc.

Author:
Justin Lee

Checked by	Merlin Garnett	**Date**	17/01/2024
Reviewed and Approved by	Cameron Sutherland	**Date**	18/01/2024
Issued by	Jason Mah	**Date**	18/01/2024

Issue History	Date	Details
V1.0	18/01/2024	Final for Issue

Executive Summary

Eastervale Solar Inc. (Eastervale Solar) is developing a 300-megawatt (MW_{AC}) solar photovoltaic (PV) electricity generating facility with 200 MW/400 megawatt-hour (MWh) Battery Energy Storage System (BESS) called the Eastervale Solar Project (the Project). The Project is located approximately 14km southwest of the village of Czar, Alberta.

Eastervale Solar intend to first develop the solar PV facility only, which will consist of 67 inverter/transformer stations and a Project substation with two 167 MVA high voltage (HV) transformers. The BESS that will potentially be added at a later date would consist of 180 BESS units, 90 BESS transformers and 180 BESS Power Conversion Systems (PCS), with an additional 222 MVA HV transformer added to the Project substation specifically for the BESS.

The solar inverter/transformer units, Project substation, and BESS units are expected to be the only significant noise producing Project elements. As such, no other Project elements were considered in this assessment. For the purposes of the noise assessment, the noise producing Project elements were modelled to operate at full output. Recognizing this as a highly conservative approach, the solar inverter/transformer units and the transformers in the substation relating to the solar project were also modelled assuming up to 20% of full output to give a more realistic estimate of the highest expected sound levels during night hours.

GCR reviewed aerial imagery of the site, identifying ten receptors as having the potential to be affected by the noise from the proposed Project. The area was also checked for regulated third-party energy-related facilities that may produce noise within the vicinity of the Project. In March 2023, GCR personnel conducted a site visit to verify all identified receptors within the 1.5km study area. Any residences that could not be verified during the site visit were conservatively included in the assessment as two-storey dwellings. However, none of these locations are expected to be the most impacted receptors.

A software model was used to predict sound levels from the Project to determine compliance with the Alberta Utilities Commission (AUC) Rule 012: Noise Control requirements. The cumulative sound level was found to be less than 3dB below the Permissible Sound Level (PSL) for night-time periods, so a detailed noise assessment was carried out as per the AUC Rule 012, Appendix 3 – Summary report, recommendations. Where applicable, cumulative sound levels incorporated sound from: approved and existing regulated third-party energy-related facilities; third-party projects; the proposed Project; and ambient sources.

The highly conservative assessment for the Project assuming operation at full output concluded that when considering the solar PV facility only, cumulative sound levels would be compliant with permissible sound levels at all the assessed receptors with R3 being the most impacted receptor within the assessment area. However, if the BESS was added to this conservative model of the Project, cumulative sound levels would be compliant in all cases except at R3, which was found to exceed the night-time PSL by 2dB.

A more realistic assessment of the solar elements of the Project during night hours demonstrated that the BESS could be added to the solar farm without exceeding the night-time PSL at any property within 1.5km of the project boundary.

Calculating the night-time hours impacts from the solar project is made difficult by the lack of partial output sound power data for the relevant Project equipment.

To ensure that the addition of the BESS equipment does not cause the PSL at R3 to be exceeded, it is recommended that the proponent conduct sound measurements of the Solar PV equipment and conduct post-construction noise monitoring at R3 as a pre-commencement condition to installation of the BESS. The monitoring would establish night-time Project sound levels and night-time cumulative sound levels. This information would then be incorporated into

a modelling exercise to demonstrate that the combined facility would operate in compliance with the night-time PSL at all properties.

A Low Frequency Noise (LFN) assessment determined that sound from the proposed Project, with or without the additional BESS, would not result in any significant LFN effects.

Table of Contents

Executive Summary **2**

1 Introduction **6**

2 Rule 012 Assessment Process **7**

3 Noise Model **8**
3.1 Model Parameters 8

4 Baseline **9**
4.1 Study Area 9
4.2 Project Description 9
4.3 Sensitive Receptors 9
4.4 Existing Third-Party Regulated Energy-Related Facilities 10
4.5 Baseline Sound Levels 13
4.6 Total Baseline Sound Levels 15

5 Project Sound Levels **16**
5.1 PV Electricity Generating Facility 16
5.2 BESS 18
5.3 Substation 21
5.4 Modelling Results 23
5.5 Low Frequency Assessment 24

6 Cumulative Impact Assessment **26**
6.1 Assessment of Night-time Hours Solar Production 27

7 Conclusions **31**

8 Acoustic Practitioners' Information **32**

Appendix A: Rule 012 Glossary **33**

Appendix B: Supplemental Noise Source Information **37**

Appendix C: Vendor's Sound Power Data (SMA SC 4600) **38**

Appendix D: Vendor's Sound Power Data (EVLO Batteries) **40**

Appendix E: Vendor's Sound Power Data (EPC CAB1000) **41**

Appendix F: Project Sound Level Contours (Solar PV Facility only) **42**

Appendix G: Project Sound Level Contours (Solar PV Facility and BESS) 43

1 Introduction

Eastervale Solar Inc. (Eastervale Solar) retained Green Cat Renewables Canada Corporation (GCR) to conduct a noise impact assessment (NIA) for the proposed Eastervale Solar Project (the Project) located approximately 14km southwest of the village of Czar, Alberta. The Project will include a 300-megawatt (MW_{AC}) solar photovoltaic (PV) electricity generating facility and, at a later date, a 200 MW/400 megawatt-hour (MWh) Battery Energy Storage System (BESS). The Project location is shown in **Figure 1-1** below.

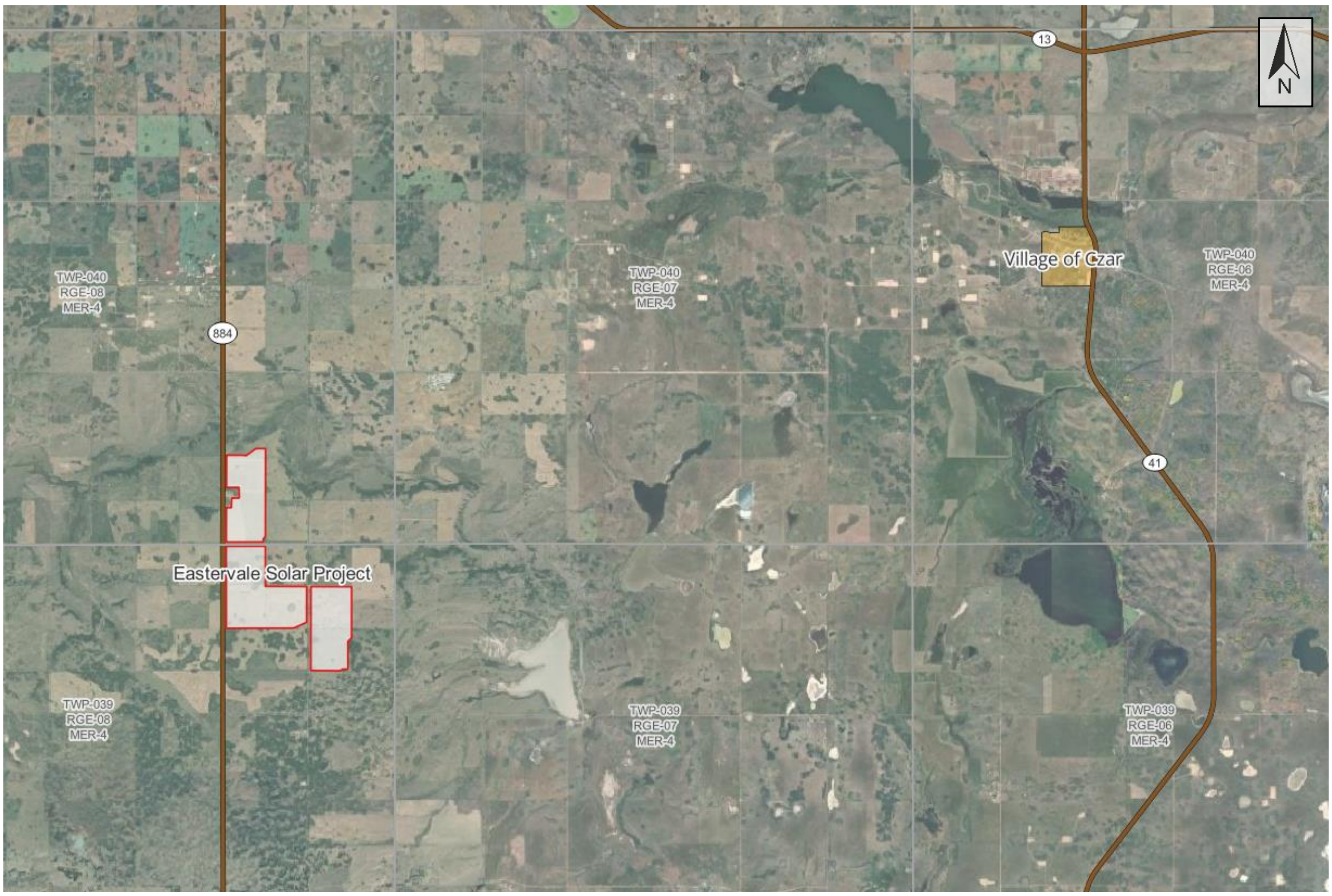


Figure 1-1 – Eastervale Solar Project Location

2 Rule 012 Assessment Process

The assessment process follows AUC Rule 012 guidelines. The International Standard 'ISO 9613-2: Acoustics – Attenuation of sound during propagation outdoors', was followed in the prediction of noise levels at nearby receptors. A glossary of relevant AUC Rule 012 terms is reproduced in Appendix A.

The following steps give an overview of the process followed in identifying potential noise impacts on the most affected receptors.

- Define study area (distance contour at site boundary + 3km)
- Identify active and approved third party regulated energy-related facilities (AUC or Alberta Energy Regulated (AER)) within the study area
- Identify noise receptor(s) within 1.5km of the site boundary, or along the 1.5km boundary criteria (where no noise receptors exist).

For each noise receptor:

- Determine Basic Sound Level (BSL) and Ambient Sound Level (ASL)
- Predict sound level from existing and approved third party regulated energy-related facilities
- Combine facility and Ambient Sound Levels to give baseline sound levels
- Predict sound level from the proposed project
- Assess for Low Frequency Noise (LFN) content due to project
- Calculate Permissible Sound Levels (PSLs)
- Calculate Cumulative Sound Levels
- Assess compliance with AUC Rule 012 requirements

3 Noise Model

All noise propagation calculations were performed using CadnaA v2023 Software from DataKustik GmbH. This quality assured software includes an implementation of the ISO 9613 method that was the basis for all calculations.

3.1 Model Parameters

Summer-time climatic conditions were assumed as required by AUC Rule 012. **Table 3-1** shows the modelling parameters that were adopted for all calculations.

Table 3-1 – Model Parameters

Modelling Parameter	Setting
Terrain of Site Area	3m Height Contours[1]
Barrier Effects Included	Yes[2]
Temperature	10°C
Relative Humidity	70%
Wind	1 – 5ms^{-1} from facility to receptor as per ISO-9613
Ground Attenuation	0.0 for Water Body, otherwise 0.5[3]
Number of Sound Reflections	1
Receptor Height	1.5m (for one-storey) 4.5m (for two-storey)
Operation Condition	Full output [Night-time also modelled with Solar Farm at <20% output]
Source Height	1.9m for Inverter Stations 1.4m for Transformer Stations 4.0m for Battery Energy Storage System (BESS) units 2.0m for BESS Power Conversion Systems 1.1m for BESS Transformers 4.0m for Substation Transformers

[1] Data obtained from AltaLIS.
[2] BESS containers were included in the noise models as physical objects.
[3] Ground Attenuation of 0.5 represents mixed ground and is conservative for a farmland area.

4 Baseline

4.1 Study Area

The development site has a total fenced area of approximately 1,014 acres. The study area includes rural/agricultural land and waterbodies.

Ten potentially habitable structures were identified within the 1.5km boundary criterion. Of these ten structures, six were verified to meet the definition of a dwelling as outlined in AUC Rule 012. The other four could not be verified but were conservatively included in the assessment as two-storey dwellings. Thus, all ten identified structures have been assessed for cumulative noise impacts from the Project and other adjacent facilities, as required per AUC Rule 012.

4.2 Project Description

The Project will encompass an area of approximately 1,014 acres of land with a total generating capacity of $300MW_{AC}$ and energy storage capacity of 200 MW/400 MWh. It is understood that Eastervale Solar will first develop the solar PV facility but wish to retain the option to add BESS at a later date.

The solar PV facility will utilize ground mounted, fixed-tilt modules which will feed sixty-seven (67) inverter/transformer stations. The BESS would consist of one-hundred and eighty (180) BESS units accompanied by ninety (90) BESS transformer stations and one-hundred and eighty (180) BESS Power Conversion Systems (PCS). A project substation containing two 167 MVA HV transformers relating to the solar PV facility and one 222 MVA high voltage (HV) transformer for the BESS is also included. The two 167 MVA transformers will be used to transform electricity generated from the PV systems to grid voltage, and therefore, will be installed first. The 222 MVA transformer will be added to the Project substation at a later date if the BESS is added to the Project. No other project elements are considered in this assessment.

Daytime periods are defined as occurring between 07:00-22:00, while night-time periods fall between 22:00-07:00. The solar PV facility's operation during actual daylight hours largely corresponds to the defined daytime period; however, sunrise on the longest days of the year will occur at approximately 05:00, which falls within the night-time period. Therefore, the assessment considers both daytime and night-time operational impacts.

4.3 Sensitive Receptors

Residential dwellings located within the 1.5km study area were identified during a site visit conducted by GCR in March 2023. Upon completion of the site visit, six residential dwellings and four potentially habitable but unverified structures were identified within 1.5km from the Project boundary. The dwellings were found to be either one-storey or two-storey. To provide a conservative assessment, any dwellings with the potential to be considered as higher than a one-storey dwelling, as well as the four potentially habitable but unverified structures, were modelled at a two-storey elevation of 4.5m. **Table 4-1** shows the location details and the height of the receptors.

Table 4-1 – Receptor Details

Receptor ID	UTM Coordinates (NAD 83, Zone 12N)		Dwelling Type	Receptor Height (m)	Relative location from site boundary
	Easting	Northing			
R1	496134	5808570	Two-Storey	4.5	820m N
R2	496180	5808158	Two-Storey	4.5	410m N
R3	496119	5807056	Two-Storey	4.5	60m W
R4	497418	5806777	One-Storey	1.5	730m E
R5*	497459	5806843	Two-Storey	4.5	770m E
R6	498080	5805982	Two-Storey	4.5	730m N
R7	495823	5805101	Two-Storey	4.5	120m W
R8*	495206	5804086	Two-Storey	4.5	830m SW
R9*	495183	5804167	Two-Storey	4.5	820m SW
R10*	494969	5804179	Two-Storey	4.5	1020m SW

*Receptor could not be verified by GCR during March 2023 site visit. To provide a conservative assessment, these were included in the assessment as two-storey receptors.

4.4 Existing Third-Party Regulated Energy-Related Facilities

A search for active and approved regulated energy-related facilities and pumping wells within 3km of the Project boundary was conducted in November 2023. The AER's Facilities list (ST102) and Wells list (ST037) were consulted for the AER regulated facilities and wells, and the AUC eFiling portal was used to identify any existing and approved AUC regulated facilities. GCR identified two (2) AER regulated facilities and six (6) pumping wells that were considered to have the potential to influence cumulative sound levels. No AUC regulated facilities have been identified within the assessment area.

Table 4-2 lists the third-party energy-related facilities and pumping wells identified within 3km of the Project that have the potential to influence cumulative sound levels. Information was gathered in November 2023 using the AER databases.

Table 4-2 – Third Party Sound Sources

Map Label	Name	Type	Operator Name	UTM Coordinates (NAD 83, Zone 12N)	
				Easting	Northing
AER1	BOWVIEW 12-27-39-8-W4	Gas Single-Well Battery	Crescent Point Energy Corp.	494432	5803709
AER2	TORPEDO PETROLEUM PROVOST 6-24	Gas Single-Well Battery	Battle River Energy Ltd.	498082	5801783
AER3	ACL ET AL PROVO 15-19-39-7	Pumping Well (OIL)	Battle River Energy Ltd.	500189	5802457
AER4	ACL PROVO 2-30-39-7	Pumping Well (OIL)	Battle River Energy Ltd.	500107	5803241
AER5	ACL PROVOST 3-31-39-7	Pumping Well (OIL)	Battle River Energy Ltd.	499606	5804821

Map Label	Name	Type	Operator Name	UTM Coordinates (NAD 83, Zone 12N)	
				Easting	Northing
AER6	ACL ET AL PROVOST 12-1-40-8	Pumping Well (OIL)	Battle River Energy Ltd.	497846	5807251
AER7	ACL 13A PROVOST 13-12-40-8	Pumping Well (OIL)	Battle River Energy Ltd.	497871	5808973
AER8	ACL PROVOST 6-10-40-8	Pumping Well (OIL)	Battle River Energy Ltd.	494809	5808344

All third-party noise sources as well as the 1.5km and 3km study area boundaries are noted on **Figure 4-1**.[4]

[4] Note that there are several third-party facilities visible from satellite imagery that are either suspended or abandoned and thus have not been included in the noise impact assessment.

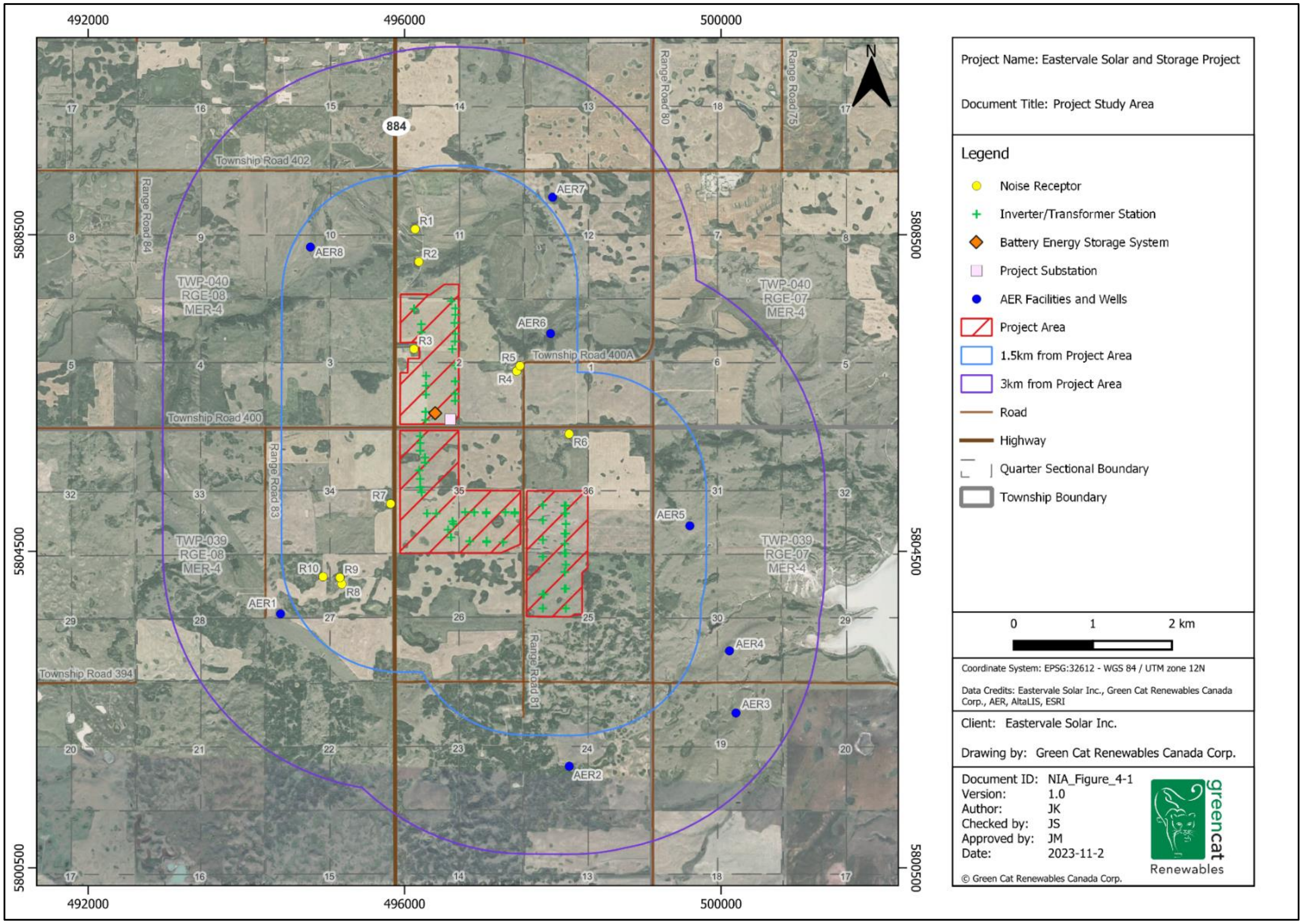


Figure 4-1 – Project Study Area

4.5 Baseline Sound Levels

Baseline sound levels for the receptors incorporate a contribution from all existing and approved AER and AUC facilities with the addition of the Ambient Sound Level (ASL). ASL is determined from the Basic Sound Level (BSL).

4.5.1 Determination of Basic Sound Level (BSL)

Rule 012 criteria for the determination of BSL include: dwelling density; road and rail traffic noise; and aircraft flyovers. In this case, dwelling density and road & traffic noise are the determining factors. Criteria are given in **Table 4-3**.

Table 4-3 – Rule 012 Criteria for determination of Basic Sound Levels (BSL)

Proximity to transportation	Dwelling density per quarter section of land		
	(1) 1 to 8 dwellings; 22:00 - 07:00 (night-time) (dBA Leq)	(2) 9 to 160 dwellings; 22:00 - 07:00 (night-time) (dBA Leq)	(3) >160 dwellings; 22:00 - 07:00 (night-time) (dBA Leq)
Category 1[5]	40	43	46
Category 2[6]	45	48	51
Category 3[7]	50	53	56

The assessed receptors in the study area have been evaluated to determine the category for both dwelling density and proximity to transportation. All dwellings have been assessed as 'Category 1' for both dwelling density and proximity to transportation.

4.5.2 Determination of Ambient Sound Level (ASL)

The Project is located in an area typical of rural Alberta (including agricultural and oil & gas industries). AUC Rule 012 states that 'In the absence of measurement, the night-time ambient sound level is assumed to be five dB less than the basic sound level and the daytime ambient sound level is assumed to be five dB less than the basic sound level plus the daytime adjustment'.[8] This results in a night-time ASL of 35dB(A) and a daytime ASL of 45dB(A) for the assessed receptors. BSL and ASL for night-times and daytimes for the receptors are given in **Table 4-4**.

4.5.3 Determination of Permissible Sound Level (PSL)

For each receptor, the PSL is determined using Basic Sound Level (BSL) plus any allowed adjustments. In this case, as no special conditions exist, the PSL is determined as:

Night-Time (NT) Permissible Sound Level = Basic Sound Level

Daytime (DT) Permissible Sound Level = Basic Sound Level + Daytime Adjustment (10dB)

BSLs, ASL, and PSLs for night-times and daytimes and for the assessed receptor is given in **Table 4-4.**

[5] Category 1—dwelling(s) distance is more than or equal to 500 metres (m) from heavily travelled roads or rail lines and not subject to frequent aircraft flyovers.

[6] Category 2—dwelling(s) distance is more than or equal to 30 m, but less than 500 m from heavily travelled roads or rail lines and not subject to frequent aircraft flyovers.

[7] Category 3—dwelling(s) distance is less than 30 m from heavily travelled roads, or rail lines or subject to frequent aircraft flyovers.

[8] The daytime ASL accounts for the addition of the standard 10db(A) daytime adjustment to the night-time ASL for the hours between 7 a.m. and 10 p.m., without any further adjustments, i.e., Class A, B, and C adjustments were not applied.

Table 4-4 – Daytime and Night-time BSL, ASL, and PSL

Dwelling ID	Transportation Category	Dwelling Category	BSL	ASL		PSL	
			NT/DT	NT	DT	NT	DT
R1	1	1	40	35	45	40	50
R2	1	1	40	35	45	40	50
R3	1	1	40	35	45	40	50
R4	1	1	40	35	45	40	50
R5	1	1	40	35	45	40	50
R6	1	1	40	35	45	40	50
R7	1	1	40	35	45	40	50
R8	1	1	40	35	45	40	50
R9	1	1	40	35	45	40	50
R10	1	1	40	35	45	40	50

4.5.4 AER Facility Sound Power Levels

Sound power data for AER regulated energy-related facilities within 3km of the Project were compiled from an internal noise measurement database and third-party NIAs that included measurements of similar facilities. In each case, the quoted sound power levels are the average of at least two similar facilities and are deemed typical and representative of each facility type.

For the purpose of this assessment, all noise producing AER facilities were deemed to operate at full load and produce noise continuously.

Table 4-5 shows the octave band sound power levels for the included AER regulated energy-related facilities within 3km of the Project.

Table 4-5 – Octave Band Sound Power Levels for AER Regulated Facilities

Map Label	Facility	Octave Band Centre Frequency, Hz									Total	
		31.5	63	125	250	500	1000	2000	4000	8000	dB	dB(A)
AER1	Gas Single-Well Battery	104.9	98.2	95.3	93.6	95.2	87.6	86.0	85.8	80.1	106.8	95.6
AER2	Gas Single-Well Battery	104.9	98.2	95.3	93.6	95.2	87.6	86.0	85.8	80.1	106.8	95.6
AER3	Pumping Well (OIL)	103.4	96.7	93.3	88.9	90.1	84.9	83.2	83.3	79.5	104.9	92.0
AER4	Pumping Well (OIL)	103.4	96.7	93.3	88.9	90.1	84.9	83.2	83.3	79.5	104.9	92.0
AER5	Pumping Well (OIL)	103.4	96.7	93.3	88.9	90.1	84.9	83.2	83.3	79.5	104.9	92.0
AER6	Pumping Well (OIL)	103.4	96.7	93.3	88.9	90.1	84.9	83.2	83.3	79.5	104.9	92.0
AER7	Pumping Well (OIL)	103.4	96.7	93.3	88.9	90.1	84.9	83.2	83.3	79.5	104.9	92.0

Map Label	Facility	Octave Band Centre Frequency, Hz									Total	
		31.5	63	125	250	500	1000	2000	4000	8000	dB	dB(A)
AER8	Pumping Well (OIL)	103.4	96.7	93.3	88.9	90.1	84.9	83.2	83.3	79.5	104.9	92.0

4.6 Total Baseline Sound Levels

Baseline sound levels include the noise contributions from third party energy facilities and the ambient sound level assessed for the local environment. Table 4-6 shows the cumulative baseline sound levels for night-time (NT) and daytime (DT) periods.

Table 4-6 – Cumulative Baseline Sound Levels for Night-time and Daytime Periods

Dwelling ID	Total Regulated Facilities		ASL		Baseline	
	NT	DT	NT	DT	NT	DT
R1	12.9	12.9	35	45	35.0	45.0
R2	11.3	11.3	35	45	35.0	45.0
R3	9.8	9.8	35	45	35.0	45.0
R4	15.9	15.9	35	45	35.1	45.0
R5	18.6	18.6	35	45	35.1	45.0
R6	9.0	9.0	35	45	35.0	45.0
R7	9.9	9.9	35	45	35.0	45.0
R8	17.3	17.3	35	45	35.1	45.0
R9	15.2	15.2	35	45	35.0	45.0
R10	19.3	19.3	35	45	35.1	45.0

Supplemental noise source information for the assessed receptors is provided in Appendix B.

5 Project Sound Levels

The solar arrays will be connected to sixty-seven (67) inverter/transformer stations, with a total capacity of up to 300MW_{AC}. The proposed BESS installation would consist of one-hundred and eighty (180) BESS units, ninety (90) BESS transformers, and one-hundred and eighty (180) BESS PCS units. Furthermore, a project substation has been proposed to be included in the project area, consisting of two 167 MVA HV transformers and one 222 MVA HV transformer. The two 167 MVA transformers will support the solar PV facility, whereas the 222 MVA transformer would be added to support the potential BESS installation.

For the purposes of this assessment, the noise producing Project elements are assumed to operate at full output during both daytime and night-time periods. This assumption is conservative for the solar PV facility, which will generally operate when the sun is out during daytime hours. The BESS could operate at any time, but in practice would not operate continuously at full output.

The sound power level data for the significant noise producing Project elements was used to model sound emissions for both daytime and night-time periods.

5.1 PV Electricity Generating Facility

5.1.1 Inverters

The inverter stations proposed for the PV electricity generating facility are the SMA SC 4600 UP-US units. The sound data measurements for these inverters provided by the equipment manufacturer are shown in **Appendix C**.

Table 5-1 shows the linear, 'A', and 'C' frequency weighted octave band sound power spectra for SMA SC 4600 UP-US.

Table 5-1 – One-Third Octave Band Sound Power Levels for SMA SC 4000 UP-US Inverters

Octave Band Frequency (Hz)	Sound Power (dB)	Sound Power (dBA)	Sound Power (dBC)
25	84.4	39.7	80.0
31.5	87.7	48.3	84.7
40	83.8	49.2	81.8
50	85.6	55.4	84.3
63	87.0	60.8	86.2
80	86.5	64.0	86.0
100	83.9	64.8	83.6
125	90.0	73.9	89.8
160	83.2	69.8	83.1
200	85.6	74.7	85.6
250	87.0	78.4	87.0
315	88.4	81.8	88.4
400	84.5	79.7	84.5

Octave Band Frequency (Hz)	Sound Power (dB)	Sound Power (dBA)	Sound Power (dBC)
500	81.2	78.0	81.2
630	79.7	77.8	79.7
800	82.0	81.2	82.0
1000	78.6	78.6	78.6
1250	78.0	78.6	78.0
1600	78.1	79.1	78.0
2000	75.8	77.0	75.6
2500	79.9	81.2	79.6
3150	87.8	89.0	87.3
4000	70.7	71.7	69.9
5000	71.1	71.6	69.8
6300	80.9	80.8	78.9
8000	70.8	69.7	67.8
10000	69.3	66.8	64.9
Sum	**98.6**	**93.0**	**97.9**

5.1.2 Transformers

The proposed MV transformers for the PV electricity generating facility are 4.6 MVA each and the manufacturer is yet to specify transformer sound level. The transformers have been modelled in (non-mineral) Oil Natural Air Natural (KNAN) conditions. KNAN conditions consider the use of a less flammable non-mineral oil to aid in cooling the transformer windings. Transformer sound levels are expected to be an order of magnitude lower than the equivalent inverters, thereby contributing a negligible amount to cumulative sound levels. Nevertheless, a typical transformer of a suitable type was modelled. The linear 'A' and 'C' frequency weighted octave band sound power spectra for the 4.6 MVA transformers used in the Project area is shown in **Table 5-2.**

Table 5-2 – Octave Band Sound Power Levels for the 4.6 MVA transformers[9]

Octave Band Frequency (Hz)	Sound Power (dB)	Sound Power (dBA)	Sound Power (dBC)
31.5	87.3	47.9	84.3
63	82.3	56.1	81.5
125	84.3	68.2	84.1
250	80.3	71.7	80.3
500	79.3	76.1	79.3
1000	68.3	68.3	68.3
2000	61.3	62.5	61.1
4000	56.3	57.3	55.5
8000	50.3	49.2	47.3
Sum	**90.7**	**78.6**	**89.4**

5.2 BESS

5.2.1 Energy Storage Battery Racks

The proposed battery energy storage units are EVLO batteries. The primary source of noise arising from the unit will be from the cooling fans. For the purpose of this assessment, it has been assumed that these fans will run at full capacity at all times of day. The sound power levels in octave band frequencies for EVLO batteries with cooling fans, provided by the manufacturer, are provided in **Appendix D**.

Table 5-3 shows the linear, ‘A’, and ‘C’ frequency weighted octave band sound power for the BESS units.

[9] Based on theoretical prediction method (Crocker, 2007).

Table 5-3 – Octave Band Sound Power Levels for the EVLO BESS Units

Octave Band Frequency (Hz)	Sound Power (dB)	Sound Power (dBA)	Sound Power (dBC)
31.5	--	--	--
63	85.6	59.4	84.8
125	84.7	68.6	84.5
250	80.5	71.9	80.5
500	76.0	72.8	76.0
1000	72.4	72.4	72.4
2000	68.0	69.2	67.8
4000	62.8	63.8	62.0
8000	59.3	58.2	56.3
Sum	**89.2**	**78.5**	**88.8**

5.2.2 BESS Inverter

The EVLO energy storage container is a standalone unit; therefore, a separate power conversion system is required. The inverters for power conversion system selected for EVLO battery storage containers are the EPC CAB1000 units.

The sound power levels in one-third octave band frequencies for CAB1000 provided by the manufacturer are provided in Appendix E.

Table 5-4 shows the linear, 'A', and 'C' frequency weighted octave band sound power for the BESS PCS units.

Table 5-4 – One-Third Octave Band Sound Power Levels for EPC CAB1000 PCS Units

Octave Band Frequency (Hz)	Sound Power (dB)	Sound Power (dBA)	Sound Power (dBC)
25	--	--	--
31.5	--	--	--
40	--	--	--
50	73.3	43.1	72.0
63	70.0	43.8	69.2
80	74.2	51.7	73.7
100	82.1	63.0	81.8
125	76.4	60.3	76.2
160	75.7	62.3	75.6
200	87.9	77.0	87.9
250	79.0	70.4	79.0

Octave Band Frequency (Hz)	Sound Power (dB)	Sound Power (dBA)	Sound Power (dBC)
315	81.2	74.6	81.2
400	78.6	73.8	78.6
500	78.0	74.8	78.0
630	79.3	77.4	79.3
800	78.0	77.2	78.0
1000	77.5	77.5	77.5
1250	75.9	76.5	75.9
1600	73.4	74.4	73.3
2000	72.2	73.4	72.0
2500	75.7	77.0	75.4
3150	75.7	76.9	75.2
4000	67.5	68.5	66.7
5000	73.2	73.7	71.9
6300	74.5	74.4	72.5
8000	71.3	70.2	68.3
10000	69.3	66.8	64.9
Sum	**92.3**	**87.6**	**92.1**

5.2.3 BESS Transformers

The proposed MV transformers for the BESS are 3 MVA in size. Specific sound levels have not been specified by the manufacturer. However, the sound levels arising from the 3 MVA transformers are expected to be significantly lower in comparison to other noise producing Project elements, contributing a negligible amount to cumulative sound levels. As such, a typical transformer of a suitable type has been modelled.

Table 5-5 shows the linear, ‘A’, and ‘C’ frequency weighted octave band sound power for the 3 MVA BESS transformers.

Table 5-5 – Octave Band Sound Power Levels for the 3 MVA BESS Transformers[10]

Octave Band Frequency (Hz)	Sound Power (dB)	Sound Power (dBA)	Sound Power (dBC)
31.5	70.7	31.3	67.7
63	74.7	48.5	73.9
125	77.7	61.6	77.5
250	75.7	67.1	75.7
500	75.7	72.5	75.7
1000	69.7	69.7	69.7
2000	64.7	65.9	64.5
4000	59.7	60.7	58.9
8000	51.7	50.6	48.7
Sum	**82.8**	**75.9**	**82.4**

5.3 Substation

The project substation will be comprised of two 167 MVA HV transformers and one 222 MVA HV transformer that will be used to transform electricity generated from the PV and BESS, respectively, to grid voltage. Each transformer has been modelled with Oil Natural Air Forced (ONAF) conditions for a conservative prediction. ONAF is an operation that uses second stage cooling for the transformers when there are higher ambient temperatures. Typically, in ONAF mode, the cooling fan is the source of the loudest noise emissions from the transformer. Octave band levels were derived using published ONAF spectral data.

Table 5-6 and **Table 5-7** shows the linear, 'A', and 'C' frequency weighted octave band sound power for the 167 MVA and 222 MVA HV substation transformers, respectively.

[10] Based on theoretical prediction method (Crocker, 2007).

Table 5-6 – Octave Band Sound Power Levels for the 167 MVA HV Substation Transformer

Octave Band Frequency (Hz)	Sound Power (dB)	Sound Power (dBA)	Sound Power (dBC)
31.5	96.0	56.6	93.0
63	100.0	73.8	99.2
125	103.0	86.9	102.8
250	101.0	92.4	101.0
500	101.0	97.8	101.0
1000	95.0	95.0	95.0
2000	90.0	91.2	89.8
4000	85.0	86.0	84.2
8000	77.0	75.9	74.0
Sum	108.1	101.2	107.7

Table 5-7 – Octave Band Sound Power Levels for the 222 MVA HV Substation Transformers

Octave Band Frequency (Hz)	Sound Power (dB)	Sound Power (dBA)	Sound Power (dBC)
31.5	97.8	58.4	94.8
63	101.8	75.6	101.0
125	104.8	88.7	104.6
250	102.8	94.2	102.8
500	102.8	99.6	102.8
1000	96.8	96.8	96.8
2000	91.8	93.0	91.6
4000	86.8	87.8	86.0
8000	78.8	77.7	75.8
Sum	109.8	103.0	109.5

5.4 Modelling Results

Predicted sound levels for the solar PV facility only are shown in Table 5-8. The results assume full operation 24 hours a day for all 67 inverter/transformer stations and the two 167 MVA substation transformers, and they are applicable to night-time and daytime periods.

Table 5-8 – Predicted Project Case Sound Levels (Solar PV Facility only)

Dwelling ID	Project Sound Level (dBA)
R1	22.1
R2	25.3
R3	38.8
R4	33.0
R5	31.9
R6	29.0
R7	32.9
R8	24.0
R9	22.7
R10	23.0

R3 is expected to be the receptor most impacted by noise from the Project, having a maximum sound pressure level of 38.8dB(A). Project sound level contours are shown in Appendix F.

Predicted sound levels for the Project, with the BESS and associated 222 MVA HV transformer, are shown in Table 5-9. The results assume full operation 24 hours a day for all BESS equipment and the 222 MVA substation transformer, and they are applicable to night-time and daytime periods.

Table 5-9 – Predicted Project Case Sound Levels (Solar PV Facility and BESS)

Dwelling ID	Project Sound Level – Solar PV Facility Only (dBA)	Project Sound Level – BESS Only (dBA)	Project Sound Level – Total (dBA)
R1	22.1	21.8	25.0
R2	25.3	22.6	27.2
R3	38.8	36.5	40.8
R4	33.0	32.6	35.8
R5	31.9	30.9	34.3
R6	29.0	26.0	30.8
R7	32.9	29.2	34.4
R8	24.0	21.1	25.8

Dwelling ID	Project Sound Level – Solar PV Facility Only (dBA)	Project Sound Level – BESS Only (dBA)	Project Sound Level – Total (dBA)
R9	22.7	20.9	24.9
R10	23.0	21	25.1

R3 is expected to be the receptor most impacted by noise from the Project, having a maximum sound pressure level of 40.8dB(A). Project sound level contours are shown in **Appendix G**.

5.5 Low Frequency Assessment

Table 5-10 shows the difference between A and C weighted predicted sound levels at the receptor modelled when only the solar PV facility and the two 167 MVA HV transformers for the Project substation are considered.

Table 5-10 – Low Frequency Noise Assessment (Solar PV Facility Only)

Dwelling ID	Predicted Sound Level (dBA)	Predicted Sound Level (dBC)	Difference dBC – dBA
R1	22.1	32.6	10.5
R2	25.3	35.4	10.1
R3	38.8	47.9	9.1
R4	33.0	43.9	10.9
R5	31.9	42.6	10.7
R6	29.0	39.9	10.9
R7	32.9	42.7	9.8
R8	24.0	36.3	12.3
R9	22.7	34.2	11.5
R10	23.0	35.4	12.4

Table 5-11 shows the difference between A and C weighted predicted sound levels at the receptor modelled with the BESS and a 222 MVA HV transformer for the project substation is added to the Project.

Table 5-11 – Low Frequency Noise Assessment (Solar PV Facility and BESS)

Dwelling ID	Predicted Sound Level (dBA)	Predicted Sound Level (dBC)	Difference dBC – dBA
R1	25.0	35.2	10.2
R2	27.2	37.3	10.1
R3	40.8	49.4	8.6
R4	35.8	45.9	10.1
R5	34.3	44.2	9.9

Dwelling ID	Predicted Sound Level (dBA)	Predicted Sound Level (dBC)	Difference dBC – dBA
R6	30.8	41.2	10.4
R7	34.4	44.0	9.6
R8	25.8	37.5	11.7
R9	24.9	35.9	11.0
R10	25.1	36.8	11.7

The results show that the C-weighted and A-weighted receptor levels have differences well below the Rule 012 criterion of 20dB. This indicates that low frequency noise is not expected to be an issue.

6 Cumulative Impact Assessment

The cumulative impact assessment incorporates sound level contributions from the baseline and Project case assessments. Compliance with AUC Rule 012 is determined through comparison of cumulative sound levels with PSLs. Table 6-2 and Table 6-2 show the results of the cumulative impact and compliance assessment for the Solar PV facility only and Solar PV facility and BESS, respectively.

Table 6-1 – Cumulative Sound Level Assessment for Night-Time (NT) and Daytime (DT) Periods (Solar PV Facility Only)

Receptor	Baseline Sound Level (dBA)		Project Sound Level (dBA)		Cumulative Sound Level (dBA)		PSL (dBA)		PSL Compliance Margin (dB)	
Dwelling ID	NT	DT	NT	DT	NT	DT	NT	DT	NT	DT
R1	35.0	45.0	22.1	22.1	35.2	45.0	40	50	5	5
R2	35.0	45.0	25.3	25.3	35.5	45.0	40	50	5	5
R3	35.0	45.0	38.8	38.8	40.3	45.9	40	50	0	4
R4	35.1	45.0	33.0	33.0	37.2	45.3	40	50	3	5
R5	35.1	45.0	31.9	31.9	36.8	45.2	40	50	3	5
R6	35.0	45.0	29.0	29.0	36.0	45.1	40	50	4	5
R7	35.0	45.0	32.9	32.9	37.1	45.3	40	50	3	5
R8	35.1	45.0	24.0	24.0	35.4	45.0	40	50	5	5
R9	35.0	45.0	22.7	22.7	35.3	45.0	40	50	5	5
R10	35.1	45.0	23.0	23.0	35.4	45.0	40	50	5	5

Table 6-2 – Cumulative Sound Level Assessment for Night-Time (NT) and Daytime (DT) Periods (Solar PV Facility and BESS)

Receptor	Baseline Sound Level (dBA)		Project Sound Level (dBA)		Cumulative Sound Level (dBA)		PSL (dBA)		PSL Compliance Margin (dB)	
Dwelling ID	NT	DT	NT	DT	NT	DT	NT	DT	NT	DT
R1	35.0	45.0	25.0	25.0	35.4	45.0	40	50	5	5
R2	35.0	45.0	27.2	27.2	35.7	45.1	40	50	4	5
R3	35.0	45.0	40.8	40.8	41.8	46.4	40	50	-2	4
R4	35.1	45.0	35.8	35.8	38.5	45.5	40	50	2	5
R5	35.1	45.0	34.3	34.3	37.7	45.4	40	50	2	5
R6	35.0	45.0	30.8	30.8	36.4	45.2	40	50	4	5
R7	35.0	45.0	34.4	34.4	37.7	45.4	40	50	2	5

Receptor	Baseline Sound Level (dBA)		Project Sound Level (dBA)		Cumulative Sound Level (dBA)		PSL (dBA)		PSL Compliance Margin (dB)	
Dwelling ID	NT	DT	NT	DT	NT	DT	NT	DT	NT	DT
R8	35.1	45.0	25.8	25.8	35.6	45.1	40	50	4	5
R9	35.0	45.0	24.9	24.9	35.4	45.0	40	50	5	5
R10	35.1	45.0	25.1	25.1	35.5	45.1	40	50	4	5

When considering the solar PV facility only, the cumulative sound levels at all receptors assessed are shown to meet the PSLs. Receptor R3 is shown to be the most impacted by noise from the solar PV facility.

If the BESS is added to the Project, assuming that the solar PV facility is operating at 100 percent output during the night-time hours, the cumulative sound levels are assessed to meet PSL at all the assessed receptors except for R3, where a 2dB exceedance of night-time PSL is shown.

R3 is the receptor most impacted by the solar PV facility, with the most significant Project sound source being the solar inverters.

6.1 Assessment of Night-time Hours Solar Production

The energy production from solar projects is typically highest during the middle of the day, with reduced generation produced during sunrise and sunset hours. Sunrise and sunset are expected to be the only hours in which solar Projects could potentially generate electricity during the night-time hours identified in Rule 012. Table 6-3 shows the average hourly energy output expected from the Project by hour and by month. This energy production data, which was provided by the proponent, was calculated using PVSyst. PVSyst is a bankable and widely accepted tool to simulate utility scale ground mount solar PV generation that models several losses such as LID, DC and AC ohmic losses, transformer losses, and several gains such as bi-facial gain to simulate the system as accurately as possible [11].

[11] The proponent obtained the equipment loss factors from the manufacturers and used typical values accepted in the industry for design related losses.

Table 6-3 – Average Hourly Energy Output expected from the proposed Project by Hour and by Month

	Month											
Hour (beginning)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
0												
1												
2												
3												
4												
5						1.2%						
6				1.5%	5.7%	6.9%	6.7%	4.0%				
7			8.2%	11.8%	20.0%	21.0%	19.5%	13.5%	6.7%			
8		18.0%	31.8%	36.8%	48.0%	48.3%	46.5%	34.7%	32.3%	14.0%	13.4%	
9	16.7%	41.8%	58.8%	65.4%	73.9%	73.5%	66.7%	62.2%	60.7%	35.3%	28.3%	16.2%
10	33.4%	59.2%	77.5%	87.7%	94.9%	92.9%	95.0%	83.2%	82.6%	54.6%	43.3%	27.6%
11	41.5%	66.7%	94.6%	100.0%	100.0%	100.0%	99.9%	98.3%	98.3%	73.8%	44.5%	31.4%
12	42.9%	71.6%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	73.9%	44.0%	34.8%
13	40.6%	67.8%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	73.4%	42.9%	33.7%
14	34.5%	61.1%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	67.0%	41.7%	21.9%
15	18.8%	46.2%	96.3%	100.0%	99.9%	96.0%	98.4%	93.8%	93.8%	66.5%	32.5%	8.7%
16	1.2%	23.5%	75.2%	84.2%	83.5%	80.0%	84.0%	83.4%	77.9%	46.1%	22.5%	
17		1.5%	51.7%	59.8%	62.3%	68.7%	64.4%	56.4%	52.0%	22.5%	1.6%	
18			22.9%	29.6%	36.4%	38.6%	39.7%	32.9%	21.4%	1.7%		
19			1.2%	6.1%	11.9%	16.3%	18.3%	10.6%	3.3%			
20				0.6%	5.0%	5.2%	8.2%	4.8%				
21						0.5%	1.7%					
22												
23												

It is shown in **Table 6-3** that the Project will not generate any electricity between 10pm and 5am. The Project is expected to generate some electricity between 5am and 7am after sunrise, but the maximum energy output for these hours is calculated to be less than 20%[12] of the peak generation. As such, it is expected that the sound output from the solar PV facility will be significantly reduced during the night-time hours relative to full output.

The vendor data supplied for the Project equipment specifies the sound output of the equipment when operating at 100 percent output; however, no partial output data is available. As such, it was not possible to calculate project sound levels during the night-time hours when the energy output from the solar PV facility will be less than 20% of the peak generation.

In the absence of the partial output data, GCR assumed a 10 dB reduction in the Project sound levels from the solar PV facility at all the assessed receptors. The 10 dB reduction is a credible assumption based on the following:

- The electricity generation during the night-time hours is less than 20% of the peak generation, which is unlikely to be high enough to trigger the cooling fans for the inverters and transformers to operate.
- The ambient temperatures expected during the night-time hours of the peak summer months will be sufficiently low such that it can be assumed that the cooling fans are unlikely to trigger under representative conditions during these hours.
- The Crocker method, which is widely used in the industry to calculate the theoretical sound power levels of transformers, shows a reduction of around 10.1 dB in sound power levels when the transformer size is reduced

[12] The proponent calculated this value based on a linear interpolation of the average energy output between 6am and 7am shown in Table 6-3.

by a factor of 5. This is considered a reasonable estimate for transformer and inverter units in the absence of cooling system operation.

Table 6-4 shows the predicted sound levels for the Project, with both the PV facility and the BESS, when the Project sound levels for the solar PV facility are reduced by 10 dB during the night-time hours.

Table 6-4 – Predicted Night-Time Project Sound Levels (Solar PV facility and BESS) – Reduced Sound Levels for the Solar PV Facility

Dwelling ID	Project Sound Level – Solar PV Facility Only (dBA)	Project Sound Level – BESS Only (dBA)	Project Sound Level – Total (dBA)
R1	12.1	21.8	22.2
R2	15.3	22.6	23.3
R3	28.8	36.5	37.2
R4	23.0	32.6	33.1
R5	21.9	30.9	31.4
R6	19.0	26.0	26.8
R7	22.9	29.2	30.1
R8	14.0	21.1	21.9
R9	12.7	20.9	21.5
R10	13.0	21.0	21.6

Table 6-5 shows the results of the cumulative impact and compliance assessment for the Project, with both the PV facility and the BESS, under a scenario where the Project sound levels for the solar PV facility are reduced by 10 dB.

Table 6-5 – Cumulative Sound Level Assessment for Night-Time (NT) and Daytime (DT) Periods (Solar PV Facility and BESS) – Reduced Sound Levels for the Solar PV Facility

Receptor	Baseline Sound Level (dBA)		Project Sound Level (dBA)		Cumulative Sound Level (dBA)		PSL (dBA)		PSL Compliance Margin (dB)	
Dwelling ID	NT	DT	NT	DT	NT	DT	NT	DT	NT	DT
R1	35.0	45.0	22.2	25.0	35.2	45.0	40	50	5	5
R2	35.0	45.0	23.3	27.2	35.3	45.1	40	50	5	5
R3	35.0	45.0	37.2	40.8	39.2	46.4	40	50	1	4
R4	35.1	45.0	33.1	35.8	37.2	45.5	40	50	3	5
R5	35.1	45.0	31.4	34.3	36.6	45.4	40	50	3	5
R6	35.0	45.0	26.8	30.8	35.6	45.2	40	50	4	5
R7	35.0	45.0	30.1	34.4	36.2	45.4	40	50	4	5

Receptor	Baseline Sound Level (dBA)		Project Sound Level (dBA)		Cumulative Sound Level (dBA)		PSL (dBA)		PSL Compliance Margin (dB)	
Dwelling ID	NT	DT	NT	DT	NT	DT	NT	DT	NT	DT
R8	35.1	45.0	21.9	25.8	35.3	45.1	40	50	5	5
R9	35.0	45.0	21.5	24.9	35.2	45.0	40	50	5	5
R10	35.1	45.0	21.6	25.1	35.3	45.1	40	50	5	5

The cumulative sound levels at all assessed receptors are shown to meet PSLs with both the solar PV facility and the BESS operating when the Project sound levels for the solar PV facility are reduced by 10 dB during the night-time hours. This 10 dB reduction reflects the lower noise associated with reduced operational output during the early morning "night-time" hours before 07:00. Applying this reduction, the Project is shown to meet the PSL at all receptors assessed, including the most impacted property, R3.

While a 10 dB reduction in sound levels from the solar PV equipment can be reasonably expected, **a sound level reduction from the PV facility of only 5 dB would be sufficient to bring the full combined project into compliance with PSL at all receptors.**

The 10 dB reduction in solar PV facility sound levels during the night-time hours is an estimated figure rather than one based on firm sound power level data. It is recommended that the proponent conduct sound measurements of the Solar PV equipment and post-construction noise monitoring at R3 as a pre-commencement condition to installation of the BESS. This will verify that the solar PV facility does indeed exhibit the required reduction in sound output relative to that assumed for full operation during the night-time hours, and therefore, that the addition of the BESS equipment will not cause the PSL to be exceeded at R3.

7 Conclusions

Ten receptors located within 1.5km of the Project site boundary were assessed to determine potential noise impacts arising from the Project. **Noise levels from the Solar PV facility are compliant with daytime and night-time PSL at all 10 receptors as modelled with worst case (full output) operation**.

While the BESS may operate at any time, the solar PV electricity generating facility will only operate when the sun is out during daylight hours; since the sun rises prior to 07:00 during summer months, the solar PV electricity generating facility may operate during the defined night-time period of 22:00 to 07:00.

When the BESS equipment was included in the initial, worst case noise model, PSLs were predicted to be met at all but R3, where a 2dB exceedance was shown for night hours.

To more realistically estimate the maximum night-time period noise level, partial output PV operation noise levels were assessed. Energy production data provided by the proponent shows that the maximum energy output from the solar PV facility during the defined night-time period is expected to be less than 20% of peak generation. As such, the maximum sound output from the solar PV facility during the night-time hours can be expected to be significantly lower than the sound at full output, as initially modelled. With this more realistic model, the Project inclusive of BESS was shown to meet the required PSLs at all properties at all times of day or night.

Given that firm, manufacturer's sound power data was not available for the more realistic estimate and to ensure that the addition of the BESS equipment does not cause the PSL at R3 to be exceeded, it is recommended that the proponent conduct sound measurements of the Solar PV equipment and conduct post-construction noise monitoring at R3 as a pre-commencement condition to installation of the BESS.

A LFN assessment determined that sound from the proposed Project, with or without BESS, is not expected to produce any significant LFN effects.

It is therefore concluded that the solar PV portion of the Eastervale Solar Project would operate in compliance with AUC Rule 012 requirements at the assessed receptors, and following completion of post-construction monitoring to verify that a 5 dB reduction in sound levels of the solar PV facility is observed, the remaining BESS portion of the Eastervale Solar Project would also operate in compliance with AUC Rule 012 requirements at the assessed receptors.

8 Acoustic Practitioners' Information

Table 8-1 summarizes the information of the authors and technical reviewer.

Table 8-1 – Summary of Practitioners' Information

Name	Justin Lee	Merlin Garnett	Cameron Sutherland
Title	Renewable Energy E.I.T.	Principal Noise Consultant	Technical Director
Role	• Acoustic noise modelling • Noise Impact Assessment (NIA) author	• Discipline lead • Acoustic noise modelling • Fieldwork lead • Noise Impact Assessment (NIA) Technical Reviewer	• Technical Assessment Lead • Noise Impact Assessment (NIA) Technical Reviewer and Approver
Experience	• Experience with acoustic modelling (iNoise & CadnaA) of renewable energy projects in Alberta. • Analyst on multiple noise assessments for renewable energy projects in Alberta. • Current INCE associate.	• Over 11 years of acoustic and environmental consultancy for projects in the U.K. and Alberta. • Completed the UK Institute of Acoustics (IOA) diploma in 2015. • Full member of the IOA. • Author and reviewer of NIAs for multiple renewable energy projects in Alberta (2020-Present).	• 19 years of acoustic and environmental consultancy. • Acoustics (IOA) diploma (2012). • Expert witness experience in wind turbine noise in the UK (2017/18). • Expert witness experience in technical wind and solar development in Canada (2019-23).

Appendix A: Rule 012 Glossary

Ambient sound level (ASL)

The sound level that is a composite of different airborne sounds from many sources far away from and near the point of measurement. The ambient sound level does not include noise from any energy-related facilities or from wind and must be determined without it. The average night-time ambient sound level in rural Alberta is 35 dBA. The ambient sound level can be measured when the sound level in an area is not believed to be represented by the basic sound levels in Table 1[13]. The ambient sound level must be determined under representative conditions and does not constitute absolute worst-case conditions (e.g., an unusually quiet day) but conditions that portray typical conditions for the area.

In the absence of measurement, the night-time ambient sound level is assumed to be 5 dBA less than the basic sound level and the daytime ambient sound level is assumed to be 5 dBA less than the basic sound level plus the daytime adjustment.

A-weighted sound level

The sound level as measured on a sound level meter using a setting that emphasizes the middle frequency components similar to the frequency response of the human ear at levels typical of rural backgrounds in mid frequencies. Sound levels are denoted: dB(A).

Basic sound level (BSL)

The night-time A-weighted Leq sound level commonly observed to occur in the designated land-use categories with industrial presence and is assumed to be five dB(A) above the ambient sound level, as set out in Table 1 of Rule 012.

Comprehensive sound level

The comprehensive sound level includes ambient sound level, noise from existing facilities and energy-related facilities.

Cumulative sound level

The cumulative sound level includes the comprehensive sound level, noise from proposed facilities, energy-related facilities approved but not yet constructed, and the predicted noise from the applicant's proposed facility.

C-weighted sound level

The C-weighting approximates the sensitivity of human hearing at industrial noise levels (above about 85 dBA). The C-weighted sound level (e.g., measured with the C-weighting) is more sensitive to sounds at low frequencies than the A-weighted sound level and is sometimes used to assess the low-frequency content of complex sound environments.

Daytime

Defined as the hours from 7 a.m. to 10 p.m.

Daytime adjustment

An adjustment that allows a 10 dBA increase because daytime ambient sound levels are generally about 10 dBA higher than night-time values.

[13] Table 1. Basic sound levels (BSL) for night-time (AUC Rule 12, Page 5, http://www.auc.ab.ca/Shared%20Documents/Rules/Rule012.pdf)

Density per quarter section

Refers to a quarter section with the affected dwelling at the centre (a 451-metre radius). For quarter sections with various land uses or with mixed densities, the density chosen must be factored for the area under consideration.

Down wind

The wind direction from the noise source towards the receiver (± 45 degrees), measured at either dwelling height or source height. The 45 degrees requirement is consistent with the definition for downwind conditions, as included in ISO 9613-1996, Attenuation of Sound During Propagation Outdoors – Part 2: general method of calculation.

Dwelling

Any permanently or seasonally occupied structure used for habitation for the purpose of human rest; including a nursing home or hospital with the exception of an employee or worker residence, dormitory, or construction camp located within an energy-related industrial plant boundary. Trailer parks and campgrounds may qualify as a dwelling if it can be demonstrated that they are in regular and consistent use.

A permanent dwelling is a fixed residence occupied on a full-time basis.

The most impacted dwelling(s) are those subject to the highest average weighted sound level relative to the permissible sound level.

Energy equivalent sound level (Leq)

The Leq is the average weighted sound level over a specified period of time. It is a single-number representation of the cumulative acoustical energy measured over a time interval. The time interval used should be specified in brackets following the Leq—e.g., Leq (9 hours) is a nine-hour Leq.

Energy-related facility

A facility under the jurisdiction of the Commission or other regulatory agency, used for energy generation, transport (except by road or rail line) and resource extraction. These include mining, extraction, processing, and transportation (except by road or rail line) as well as federally regulated electrical transmission lines and pipelines.

Far field

The far field is that area far enough away from the noise source that the noise emissions can be treated as if they come from a single point or line source and the individual components of the noise source are not apparent as separate sources. This is typically at a distance of at least three to five times the major dimensions of the noise source, such as length, width, height, or diameter.

Heavily travelled road

Includes highways and any other road where 90 or more vehicles travel during the nine-hour night-time period consistently for any one-month period in a year. The following methods to validate the travel volume are acceptable:

Alberta Transportation's Average Annual Summer Daily Traffic (ASDT) value. If the ASDT is not available, the Alberta Transportation's Average Annual Daily Traffic (AADT) value can be used. In the case of using the ASDT or AADT, 10 per cent of the daily traffic volume can be assumed to be the night-time period traffic.

Linear weighting (or Z-weighting)

The sound level measured without any adjustment for the sensitivity of human hearing. It is a direct measure in decibels of the variation in air pressure and is often referred to as the "sound pressure level". This level is sometimes called the “linear weighted level” or “the unweighted level,” as it includes no frequency weighting beyond the tolerances and limits of the sound level meter being used for the measurements.

Low frequency noise

Where a clear tone is present below and including 250 Hz and the difference between the overall C-weighted sound level and the overall A-weighted sound level exceeds 20 dB.

Night-time

Defined as the hours from 10 p.m. to 7 a.m.

No net increase

The concept of no net increase in relation to noise impact assessments may arise when the sound added by an incremental project to the baseline sound level results in a negligible sound level increase.

In cases where an applicant is proposing development of a facility where it is not practical or efficient to characterize baseline sound levels, the applicant may assume baseline compliance with the permissible sound level and use no net increase to justify that the proposed facility will have a negligible impact on cumulative sound levels. However, the predicted cumulative sound level must not exceed the permissible sound level by more than 0.4 dB.

When baseline sound levels are predicted to exceed the permissible sound level by 0.4 dB or less, the applicant is required to assess compliance for its proposed facility by adding noise contribution from its proposed facility to baseline sound levels.

Noise

The unwanted portion of sound.

Permissible sound level (PSL)

The maximum daytime or night-time sound level as determined in Table 1 at a point 15 m from the dwelling(s) in the direction of the facility. The permissible sound level is the sum of the basic sound level, daytime adjustment, Class A adjustments and Class B adjustment, or Class C adjustments.

Proposed facility

A proposed facility is a facility for which an application has been deemed complete by the Commission but is not yet approved or for which an approval has been issued, but is not yet constructed.

Sound power level

The decibel equivalent of the rate of energy (or power) emitted in the form of noise. The sound power level is an inherent property of a noise source.

Sound pressure level

The decibel equivalent of the pressure of sound waves at a specific location, which is measured with a microphone. Since human reaction and material behaviours vary with frequency, the sound pressure level may be measured using frequency bands or with an overall weighting scale such as the A-weighting system. The sound pressure level depends on the noise sources, as well as the location and environment of the measurement path.

Summertime conditions

Ground cover and temperatures that do not meet the definition for wintertime conditions. These can occur at any time of the year.

Tonal components

The test for the presence of tonal components consists of two parts. The first must demonstrate that the sound pressure level of any one of the slow-response, linear, one-third octave bands between 20 and 250 Hz is 10 dBA or more than the sound pressure level of at least one of the adjacent bands within two one-third octave bandwidths. In addition, there must be a minimum of a 5 dBA drop from the band containing the tone within two bandwidths on the opposite side.

The second part is that the tonal component must be a pronounced peak clearly obvious within the spectrum.

Wind speed

The speed of the wind, expressed in metres per second (m/s), measured in and averaged over 10-minute intervals at the same height as the microphone, but not more than 10 metres above ground level.

Appendix B: Supplemental Noise Source Information

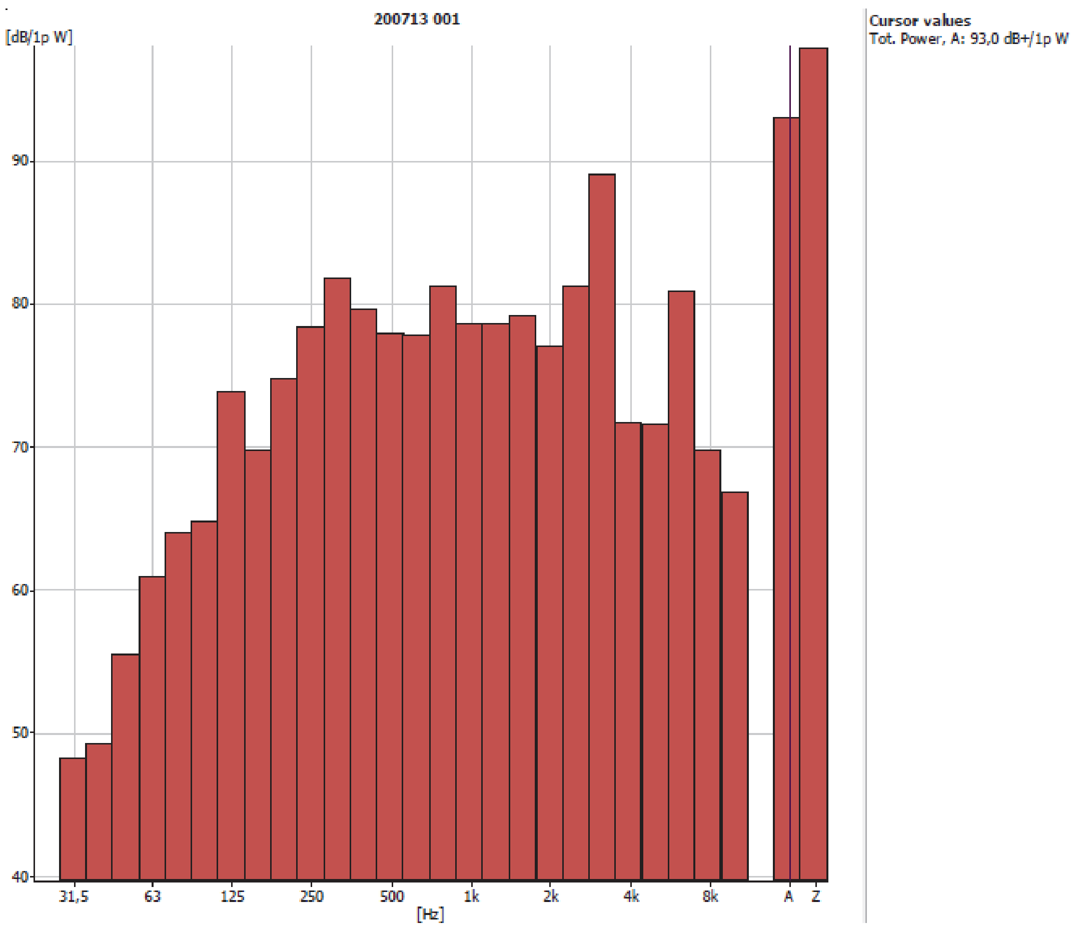
Dwelling ID	Project		Third-Party	
	Nearest Significant Project Noise Source	Distance to Nearest Significant Project Noise Source	Nearest Third-Party Facility Noise Source	Distance to Nearest Third-Party Facility Noise Source
R1	Inverter/Transformer Station	1000m S	AER8	1340m W
R2	Inverter/Transformer Station	600m S	AER8	1380m W
R3	Inverter/Transformer Station	230m NE	AER6	1740m W
R4	Inverter/Transformer Station	780m W	AER6	640m NE
R5	Inverter/Transformer Station	820m W	AER6	560m NE
R6	Inverter/Transformer Station	910m S	AER6	1290m N
R7	Inverter/Transformer Station	420m NE	AER1	1970m SW
R8	Inverter/Transformer Station	1400m NE	AER1	860m SW
R9	Inverter/Transformer Station	1370m NE	AER1	880m SW
R10	Inverter/Transformer Station	1540m NE	AER1	710m SW

Appendix C: Vendor's Sound Power Data (SMA SC 4600)

Overview of the Sound Power

Third octave band center frequency [Hz]	Sound - Power- level LwA [dBA/pW] 4600 kW
25 Hz	39,67
31,5 Hz	48,26
40 Hz	49,23
50 Hz	55,43
63 Hz	60,84
80 Hz	63,99
100 Hz	64,8
125 Hz	73,85
160 Hz	69,77
200 Hz	74,69
250 Hz	78,35
315 Hz	81,8
400 Hz	79,65
500 Hz	77,95
630 Hz	77,77
800 Hz	81,19
1 kHz	78,55
1,25 kHz	78,63
1,6 kHz	79,14
2 kHz	76,95
2,5 kHz	81,15
3,15 kHz	88,98
4 kHz	71,66
5 kHz	71,56
6,3 kHz	80,81
8 kHz	69,7
10 kHz	66,83
A	92,97
Z	97,82

Sound Power Levels of the Third Octave Band Frequencies according to EN ISO 9614-2



Appendix D: Vendor's Sound Power Data (EVLO Batteries)

SOUND RATINGS TABLE

RGV/RAV UNIT	COOLING STAGES	OUTDOOR SOUND (DB) AT 60 Hz								
		A-WEIGHTED	63	125	250	500	1000	2000	4000	8000
036	1	79	85.6	84.7	80.5	76.0	72.4	68.0	62.8	59.3
048	1	79	85.6	84.7	80.5	76.0	72.4	68.0	62.8	59.3
060	1	79	85.6	84.7	80.5	76.0	72.4	68.0	62.8	59.3
072	2	79	85.6	84.7	80.5	76.0	72.4	68.0	62.8	59.3

LEGEND

dB — Decibel

NOTES:
1. Outdoor sound data is measured in accordance with AHRI.
2. Measurements are expressed in terms of sound power. Do not compare these values to sound pressure values because sound pressure depends on specific environmental factors which normally do not match individual applications. Sound power values are independent of the environment and therefore more accurate.
3. A-weighted sound ratings filter out very high and very low frequencies, to better approximate the response of "average" human ear. A-weighted measurements for units are taken in accordance with AHRI.

Appendix E: Vendor's Sound Power Data (EPC CAB1000)

HMMT Partners Oy **H03-0043-02** 1(1)

M.Sc. (Tech.) Mika Hanski, M.Sc. (Tech.) Timo Markula 2022-11-24

EPC Power

INVERTER NOISE LEVELS

Applicable device: CAB1000 at 1500 kVA apparent power

Client: EPC Power Oy
Contact: Antti Eerola

Sound pressure level measurements were conducted according to IEC 60076-10:2016 in the TVO Olkiluoto BESS site on 2022-10-03.

The operating conditions of the unit during measurements, measurement details and measured A-weighted equivalent noise levels L_{Aeq} [dB] are presented in *Figure 1*.

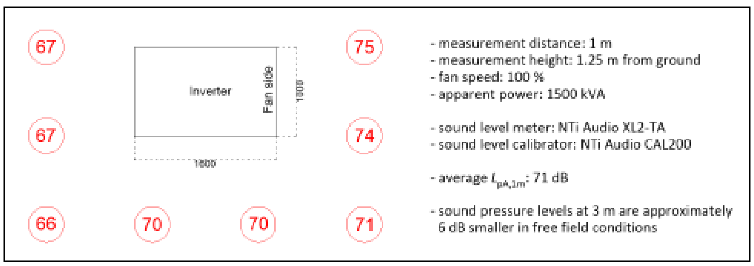


Figure 1. Measured L_{Aeq} [dB] (within red circles), operating condition during the measurements and measurement details.

The sound level meter complies with IEC 61672-1:2013 Class 1 requirements. The sound level calibrator complies with IEC 60942 Class 1 requirements.

The calculated total A-weighted sound power level L_{WA} for this load condition is **88 dB**. The unweighted spectrum of the sound power level in 1/3-octave bands is presented below. The sound power level has been determined according to the spatial average sound pressure level ($L_{pA,1m}$ 71 dB) according to the sound pressure level method defined in IEC 60076-10:2016. The relative sound pressure level differences between the sides shown in *Figure 1* can be used as directivity information in noise mapping.

f [Hz]	50	63	80	100	125	160	200	250	315	400	500	630
L_W [dB]	73.3	70.0	74.2	82.1	76.4	75.7	87.9	79.0	81.2	78.6	78.0	79.3

f [Hz]	800	1k	1.25k	1.6k	2k	2.5k	3.15k	4k	5k	6.3k	8k	10k
L_W [dB]	78.0	77.5	75.9	73.4	72.2	75.7	75.7	67.5	73.2	74.5	71.3	69.3

Mika Hanski
Acoustician, M.Sc. (Tech.)

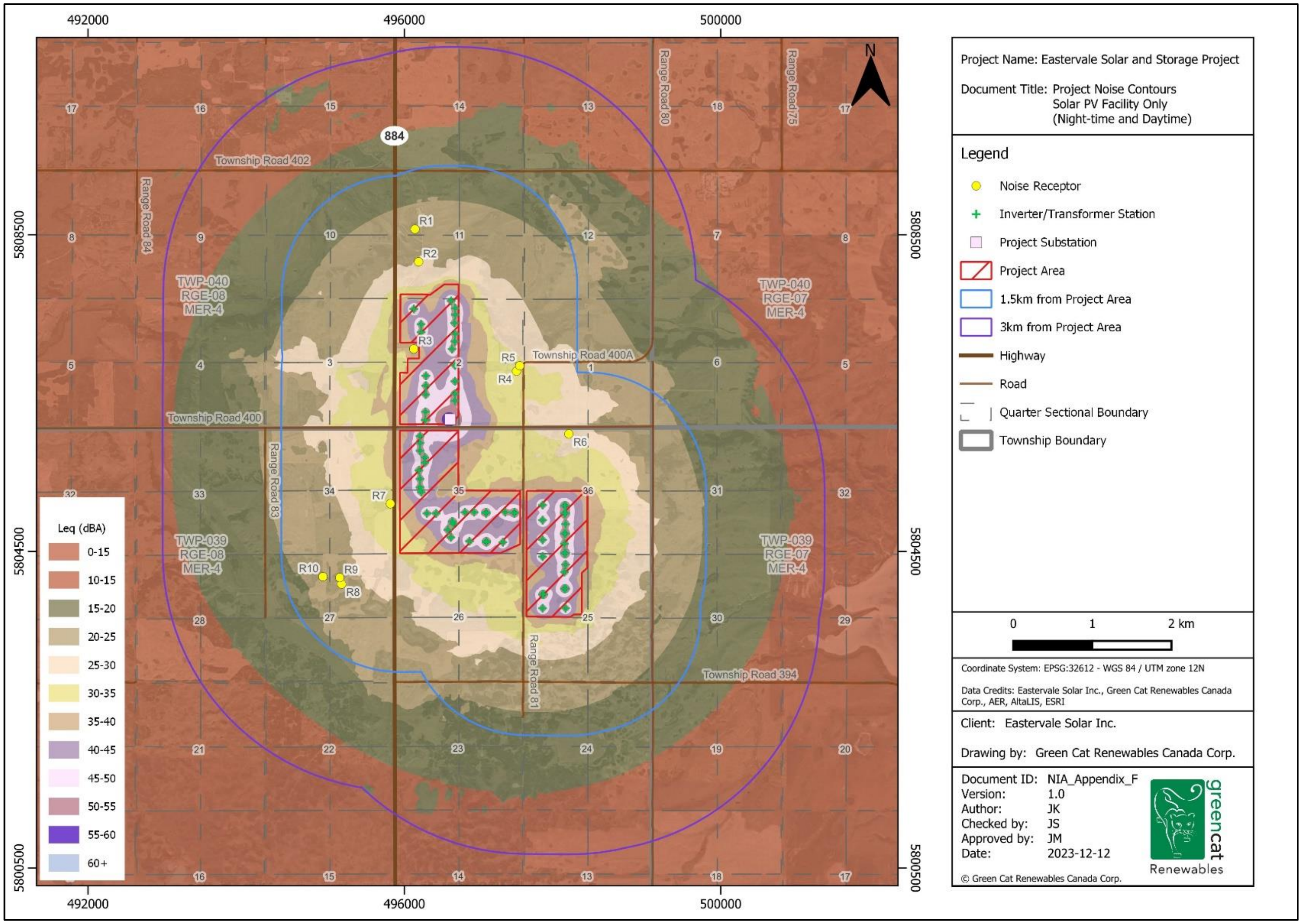
Timo Markula
Acoustician, M.Sc. (Tech.)
FISE V+ (acoustics)

HMMT Partners Oy
Suomalaistentie 7
02270 Espoo, Finland
VAT ID: FI29958677

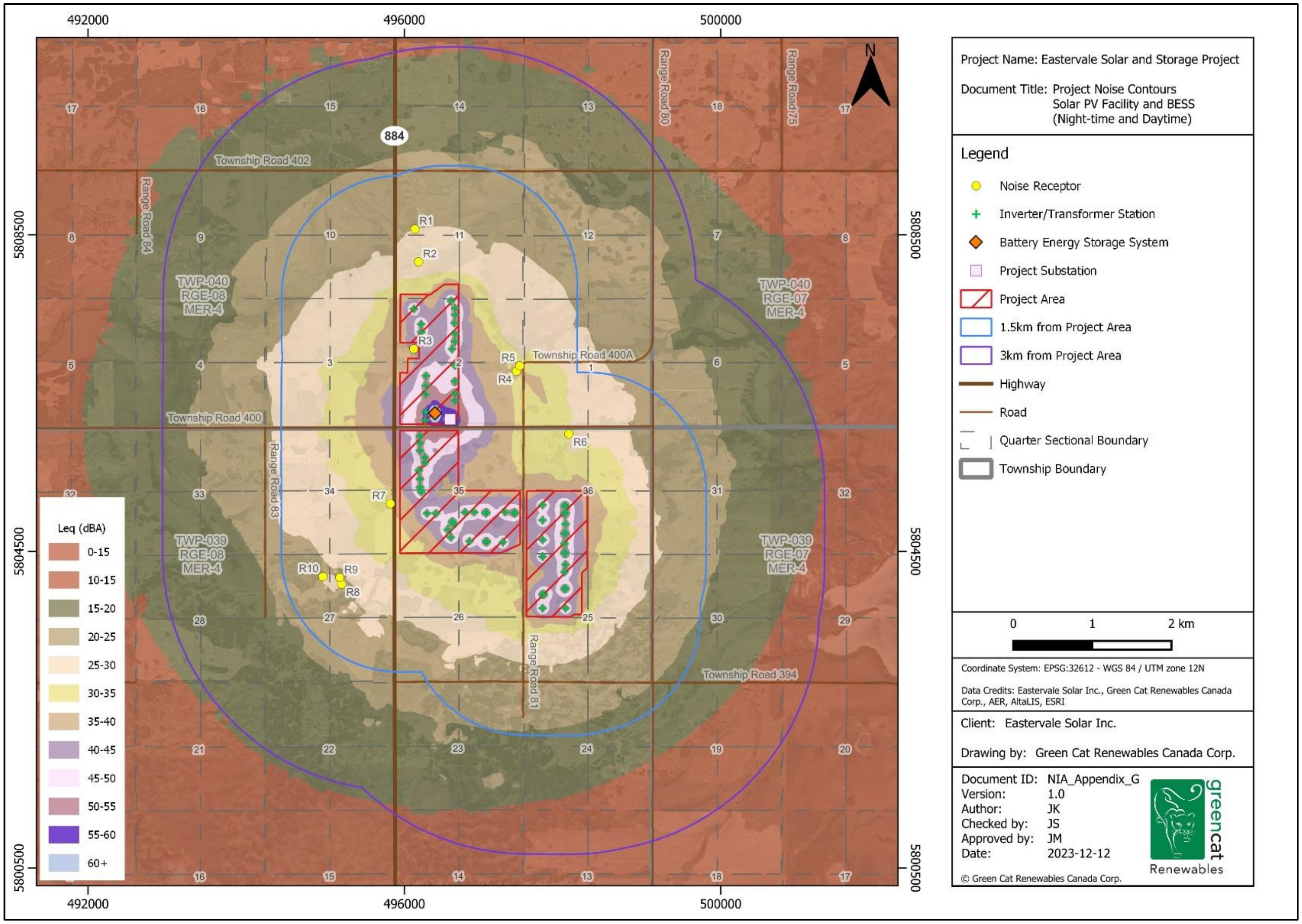
Mika Hanski
+358 44 997 9595
mika.hanski@hmmt.fi

Timo Markula
+358 50 303 2404
timo.markula@hmmt.fi

Appendix F: Project Sound Level Contours (Solar PV Facility only)



Appendix G: Project Sound Level Contours (Solar PV Facility and BESS)



greencat
Renewables

Registered Office
Green Cat Renewables Canada Corporation
#855 – 401 9th Avenue SW
Calgary, Alberta
T2P 3C5

+1 866 216 2481

info@greencatrenewables.ca
www.greencatrenewables.ca