SPRINGBROOK SOLAR PROJECT

NOISE IMPACT ASSESSMENT

August 2021

Prepared By:

Green Cat Renewables Canada Corporation

Prepared For:

Saturn Power Inc.

Revision	Date	Authors	Checked By	Approved By
V1.0 Final for Issue	August 10th, 2021	Merlin Garnett Justin Lee	Cameron Sutherland	Jaimie Slana

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350 –7th Avenue SW, Suite 12, Calgary, AB T2P 3N9

EXECUTIVE SUMMARY

Saturn Power Inc. propose to install up to 20-megawatt photovoltaic electricity generating station called the Springbrook Solar Project (the Project). The Project is located approximately 2km northwest of the Settlement of Springbrook and 7km southwest of the City of Red Deer, Alberta. The Project will consist of photovoltaic modules mounted on a single-axis tracking system with 8 medium voltage transformers and up to 84 inverters. All project components that have the potential to contribute to cumulative noise levels are assumed to operate at full load 24 hours a day for the purposes of the noise impact assessment.

A software model was used to predict sound levels due to existing regulated facilities, proposed/existing third party projects, and the proposed Project to determine compliance with the Alberta Utilities Commission Rule 012 requirements.

Where applicable, cumulative sound levels incorporated sound from: existing regulated facilities; third party projects; the proposed Project; and ambient sources. Results indicate cumulative sound levels are compliant at all receptors assessed. No significant Low Frequency Noise effects were predicted.

The proposed Project is therefore assessed to meet the requirements of Rule 012.

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1. INTRODUCTION

Saturn Power Inc. (Saturn) retained Green Cat Renewables Canada Corporation (GCR) to conduct a noise impact assessment (NIA) for the proposed Springbrook Solar Project (the Project), which is a utility-scale photovoltaic (PV) project located approximately 2km northwest of the Settlement of Springbrook and 7km southwest of the City of Red Deer, Alberta. The Project will have a capacity of up to 20-megawatts (MW_{AC}) and will consist of PV modules mounted on a single-axis tracking (SAT) system with up to 84 inverters and 8 medium voltage transformers.

The assessment considered the cumulative impact of existing and proposed noise sources, where applicable, on nearby receptors.

2. RULE 012 ASSESSMENT PROCESS

The assessment process follows the Alberta Utilities Commission (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 at Appendix 9.1.

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 Alberta Energy Regulated (AER) facilities within the study area
- Identify noise receptor(s) within 1.5km of the site boundary, or along the 1.5km criterion (where no noise receptors exist)

For each noise receptor:

- Determine Basic Sound Level (BSL) and Ambient Sound Level (ASL)
- Calculate Permitted Sound Levels (PSLs)
- Predict sound level from existing AER 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 proposed Project
- Calculate cumulative sound levels
- Assess compliance with the AUC Rule 012 requirements

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3. NOISE MODEL

All noise propagation calculations were performed using iNoise from DGMR Software. This is quality assured software with full support of ISO/TR 17534-3, which provides recommendations to ensure uniformity in the interpretation of the ISO 9613 method.

DGMR provide the following information on the function of ISO/TR 17534-3[1]: '*The ISO 9613 standard from 1996 is the most used noise prediction method worldwide. Many countries refer to ISO 9613 in their noise legislation. However the ISO 9613 standard does not contain guidelines for quality assured software implementation, which leads to differences between applications in calculated results. In 2015 this changed with the release of ISO/TR 17534-3. This quality standard gives clear recommendations for interpreting the ISO 9613 method. iNoise fully supports these recommendations. The models and results for the 19 test cases are included in the software...'.*

iNoise version Enterprise 2021.0 was used for this assessment.

3.1. MODEL PARAMETERS

Summer-time climatic conditions were assumed as required by 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	10m Height Contours[2]	
Barrier Effects Included	None	
Temperature	10°C	
Relative Humidity	70%	
Wind	1 – 5ms^{-1} from facility to receptor as per ISO-9613	
Ground Attenuation	0.5	
Number of Sound Reflections	1	
Receptor Height	4.5m for two-storey/ 7.5m for three-storey	
Operation Condition	Full load	
Source Height	0.7m inverter	2.2m MV transformer

[1] https://dgmrsoftware.com/products/inoise/
[2] Data obtained from AltaLIS.

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4. BASELINE

4.1. STUDY AREA

The development site spans a portion of three quarter sections and is largely made up of agricultural land. The site is west of Highway 2A. The study area is shown in **Figure 4-1**, on page 5.

Seventeen dwellings located within the 1.5km boundary criteria area have been assessed for noise impacts as required by Rule 012. Results for any other properties located within the 1.5km boundary are not contained within this report.

4.2. PROJECT DESCRIPTION

The Project will cover an area of approximately 92 acres with a total generating capacity of up to 20 MW_{AC}. The PV modules will be mounted on SATs secured to the ground using piles.

The array will contain up to 84 inverters and 8 medium voltage transformers, which are the only significant noise sources from the solar development. The 84 inverters include four potential inverter locations that may be required per Saturn's consultation with the distribution facilities owner. As such, this assessment considers 84 inverters to produce a conservative assessment. If these four inverters are not included in the final Project design, the predicted Project sound levels will be less than or equal to the reported results. The 80 inverter locations and four potential inverter locations are included in **Figure 4-1**.

The site will normally operate during daytime hours of 07:00 – 22:00, however, sunrise on the longest days of the year (during summer months) will occur at approximately 05:00 (within night hours), therefore the assessment considers both night-time and daytime operational impacts (i.e., operating 24/7).

4.3. SENSITIVE RECEPTORS

Residential dwellings regarded as having the potential to be the most impacted were identified. Assessment position was taken at each of the assessed dwellings within 1.5km of the Project boundary. **Table 4-1** shows the location details and the height of each receptor. To provide a conservative assessment, all receptors were modelled at a two-storey elevation of 4.5m except for R14, which was modelled at a three-storey elevation of 7.5m representing a townhouse.

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Table 4-1 Receptor Details

ID reference	UTM Coordinates (NAD 83, Zone 12N)		Relative location from Project boundary	Dwelling type	Receptor height (m)
	x	y			
R1	302227	5787470	80m N	Two-storey	4.5
R2	302774	5787747	700m NE	Two-storey	4.5
R3	303600	5787410	1450m E	Two-storey	4.5
R4	302722	5787984	850m NE	Two-storey	4.5
R5	301978	5787625	220m N	Two-storey	4.5
R6	301838	5787357	200m N	Two-storey	4.5
R7	301614	5787376	400m N	Two-storey	4.5
R8	301713	5787667	430m NW	Two-storey	4.5
R9	301647	5786952	100m W	Two-storey	4.5
R10	301197	5786610	400m W	Two-storey	4.5
R11	301105	5786275	600m W	Two-storey	4.5
R12	300956	5786300	730m W	Two-storey	4.5
R13	301201	5784715	1350m SW	Two-storey	4.5
R14	303064	5784784	1400m SE	Three-storey	7.5
R15	303336	5785081	1450m SE	Two-storey	4.5
R16	301062	5786172	700m W	Two-storey	4.5
R17	301089	5786702	500m W	Two-storey	4.5

4.4. EXISTING REGULATED FACILITIES

A search for existing regulated facilities and pumping wells was conducted within the study area. AER's Facilities list (ST102) and AER's Wells list (ST037), updated in June 2021, were consulted.

One regulated facility was identified that was considered to have the potential to influence cumulative sound levels. This facility is a single gas well battery (AER1) and located approximately 2.3km northwest of the Project. Additionally, there are five pumpjacks located within 3km of the proposed site. The pumpjacks have been verified through the use of the AER wells list (with the status of neither suspended nor abandoned).

All third party noise sources, the 1.5km (receptor) and 3km (3rd party facility) boundaries are noted in **Figure 4-1.**

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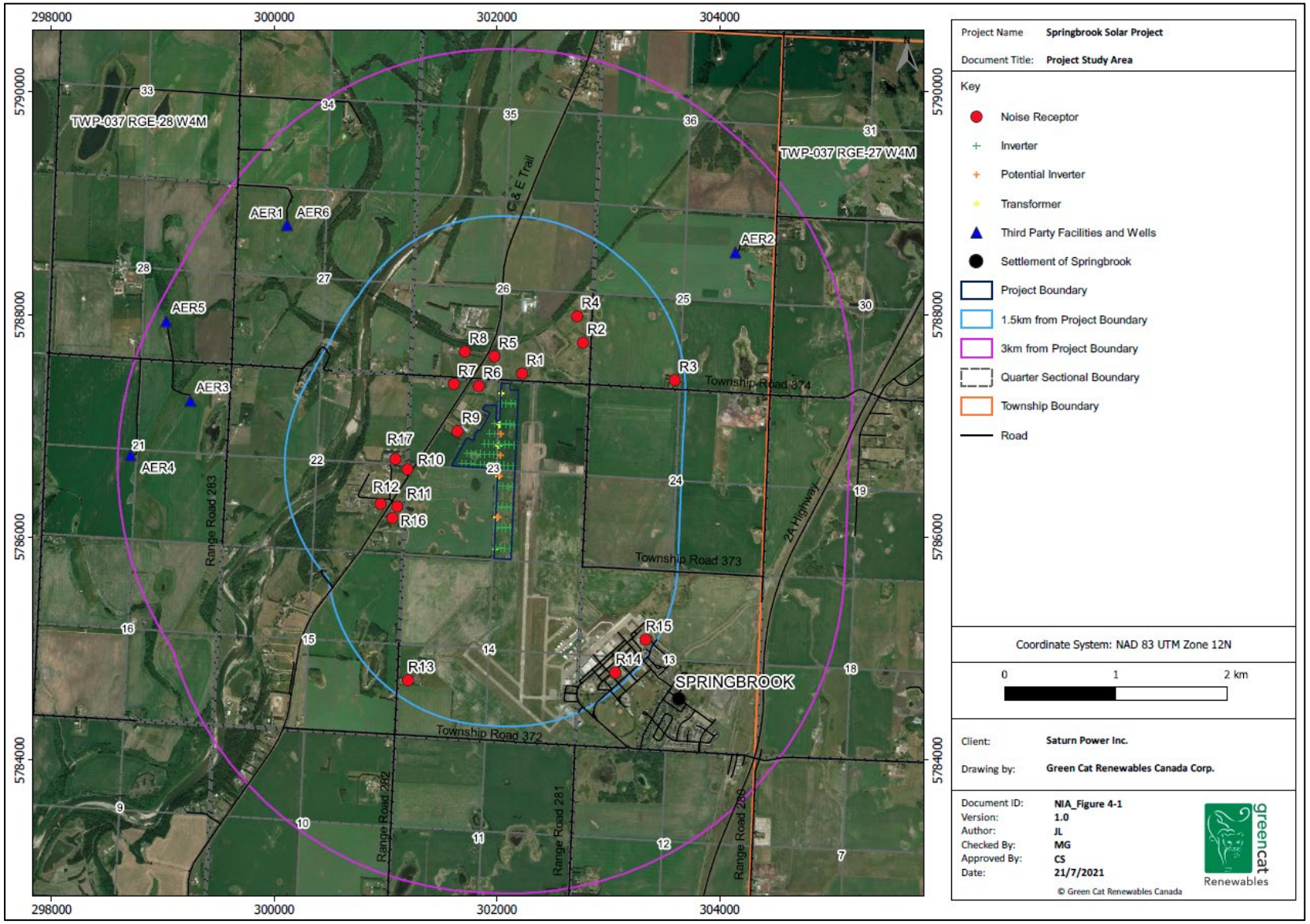

Figure 4-1 Study Area

4.5. BASELINE SOUND LEVELS

Baseline sound levels for each receptor should 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 4-2.

Table 4-2 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[3]	40	43	46
Category 2[4]	45	48	51
Category 3[5]	50	53	56

All assessed receptors in the study area have been evaluated as category one for proximity to transportation. Ten receptors are also category one for dwelling density.

Receptors R10 to R12 and R14 to R17 are located in areas with 9 to 160 dwellings per quarter section of land and therefore, have been set at category two for dwelling density.

4.5.2. Determination of Ambient Sound Level (ASL)

Rule 012 suggests that the ASL should normally be 5dB below BSL for night hours and 10dB above the night hours' level for daytimes. The area immediately surrounding the site consists of a rural farmland environment and a regional airport, with some localised areas of Category 2 dwelling density. As such, the area is not considered pristine. Overall, the ASL is assessed to be as suggested by Rule 012.

[3] 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.

[4] 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.

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

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4.5.3. Determination of Permitted 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, ASLs, and PSLs for night-times and daytimes and for each location are given in **Table 4-3**.

Table 4-3 Daytime and Night-time BSL, ASL and PSL

Dwelling ID	Transportation Category	Dwelling Category	BSL	ASL (NT)	ASL (DT)	PSL (NT)	PSL (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	2	43	38	48	43	53
R11	1	2	43	38	48	43	53
R12	1	2	43	38	48	43	53
R13	1	1	40	35	45	40	50
R14	1	2	43	38	48	43	53
R15	1	2	43	38	48	43	53
R16	1	2	43	38	48	43	53
R17	1	2	43	38	48	43	53

4.5.4. AER Facilities Sound Power Levels

Sound power data for the AER facilities in the study area were represented by third party measurements made of similar facilities. **Table 4-4** shows facilities and wells license numbers along with their operators' names.

Table 4-4 Third party sound sources

Label	Facility/Well	AER ID	Location		Operator Name
			x	y	
AER 1	GNE CYGNET 14-27	ABBT0040658	300116	5788805	DEL Canada GP Ltd.
AER 2	WESTRIDGE CYGNET 16-25-37-28	W 108251	304144	5788558	TQN
AER 3	SHINEBK SCEPTRE CYGNET 16-21-37-28	W 132105	299247	5787225	VESTA
AER 4	SHINEBK ET AL CYGNET 6-21-37-28	W 131003	298710	5786736	VESTA
AER 5	SHINEBK ET AL CYGNET 2-28-37-28	W 141769	299029	5787940	VESTA
AER 6	DEL CYGNET 14-27-37-28	W 109516	300116	5788805	DEL Canada GP Ltd.

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Table 4-5 displays octave band sound power levels for AER facilities within the 3km criteria.

Table 4-5 Octave band sound power levels for regulated AER facilities

Label	Facility/Well	Octave Band Centre Frequency, Hz									Total	
		31.5	63	125	250	500	1000	2000	4000	8000	SUM dB	SUM dB(A)
AER 1	GNE CYGNET 14-27	104.9	98.2	95.3	93.6	95.2	87.6	86.0	85.8	80.1	106.8	95.6
AER 2	WESTRIDGE CYGNET 16-25-37-28	100.6	93.7	89.0	80.2	74.0	71.0	73.5	80.9	74.8	101.7	84.4
AER 3	SHINEBK SCEPTRE CYGNET 16-21-37-28	100.6	93.7	89.0	80.2	74.0	71.0	73.5	80.9	74.8	101.7	84.4
AER 4	SHINEBK ET AL CYGNET 6-21-37-28	100.6	93.7	89.0	80.2	74.0	71.0	73.5	80.9	74.8	101.7	84.4
AER 5	SHINEBK ET AL CYGNET 2-28-37-28	100.6	93.7	89.0	80.2	74.0	71.0	73.5	80.9	74.8	101.7	84.4
AER 6	DEL CYGNET 14-27-37-28	100.6	93.7	89.0	80.2	74.0	71.0	73.5	80.9	74.8	101.7	84.4

For the purposes of this assessment, all sound sources were deemed to operate continuously and at full load.

4.6. MODELLING RESULTS

Table 4-6 shows the predicted sound levels at each receptor from existing regulated facilities.

Table 4-6 Predicted Sound levels from existing regulated AER facilities

Dwelling ID	Total AER Facility Sound Levels dB(A)
R1	11.6
R2	10.3
R3	8.3
R4	10.8
R5	13.1
R6	12.7
R7	13.8
R8	14.4
R9	12.0
R10	11.9
R11	10.6
R12	11.0
R13	4.7
R14	2.6
R15	2.6
R16	10.2
R17	12.5

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4.7. TOTAL BASELINE SOUND LEVELS

Baseline sound levels include the noise contributions from existing adjacent sound sources, and the ambient sound level assessed for the local environment.

Table 4-7 shows cumulative baseline sound level for night-time (NT) and daytime (DT) periods.

Table 4-7 Cumulative baseline sound level for night-time and daytime periods

Receptor	Third Party Facilities		ASL		Baseline	
Dwelling ID	NT	DT	NT	DT	NT	DT
R1	11.6	11.6	35	45	35.0	45.0
R2	10.3	10.3	35	45	35.0	45.0
R3	8.3	8.3	35	45	35.0	45.0
R4	10.8	10.8	35	45	35.0	45.0
R5	13.1	13.1	35	45	35.0	45.0
R6	12.7	12.7	35	45	35.0	45.0
R7	13.8	13.8	35	45	35.0	45.0
R8	14.4	14.4	35	45	35.0	45.0
R9	12.0	12.0	35	45	35.0	45.0
R10	11.9	11.9	38	48	38.0	48.0
R11	10.6	10.6	38	48	38.0	48.0
R12	11.0	11.0	38	48	38.0	48.0
R13	4.7	4.7	35	45	35.0	45.0
R14	2.6	2.6	38	48	38.0	48.0
R15	2.6	2.6	38	48	38.0	48.0
R16	10.2	10.2	38	48	38.0	48.0
R17	12.5	12.5	38	48	38.0	48.0

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5. PROJECT SOUND LEVELS

The Project will consist of up to 84 inverters and 8 medium voltage transformers. The sound power levels of these components were used to model sound emissions for both daytime and night-time periods.

5.1. INVERTERS

The inverters tentatively selected for the Project are the Sungrow SG250HX units at rated working condition. Measurements were conducted on the front, back, left, and right sides of the inverter at a distance of 1m in a semi-anechoic chamber. Details of the measurements for the SG250HX inverter are attached in Appendix 9.2. A-weighted sound pressure of 73.5 dB(A) was obtained from logarithmically averaging the four side measurements at 1m. A semi-anechoic correction of 8 dB(A) was added to derive the sound power level. Octave band levels were not provided with the specification sheet. An octave band spectrum was developed by linearly matching with a measurement spectrum of a similarly performing inverter and linearly scaled to provide a sound power level of 81.5 dB(A).

Table 5-1 shows linear, 'A' and 'C' frequency weighted octave band sound power for the SG250HX inverter.

Table 5-1 Third octave band inverter sound power levels

Octave band frequency (Hz)	Maximum Sound Power (dB)	Maximum Sound Power (dBA)	Maximum Sound Power (dBC)
31.5	79.4	40.0	76.4
63	76.0	49.8	75.2
125	75.2	59.1	75.0
250	81.7	73.1	81.7
500	79.2	76.0	79.2
1000	76.9	76.9	76.9
2000	72.6	73.8	72.4
4000	66.8	67.8	66.0
8000	59.4	58.3	56.4
Sum	**86.7**	**81.5**	**86.1**

5.2. MEDIUM VOLTAGE TRANSFORMERS

The proposed medium voltage transformers are 2.75MVA in size and the manufacturer is yet to specify transformer sound level. Transformer sound levels are expected to be more than one order of magnitude lower than the equivalent inverters, thereby contributing a negligible amount to cumulative sound levels. As such, a typical transformer of a suitable type was modelled.

The linear 'A' and 'C' frequency weighted octave band sound power for the MV transformers used in this Project are shown in Table 5-2 on the following page.

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Table 5-2 Octave band transformer sound levels[6]

Octave band frequency (Hz)	Maximum Sound Power (dB)	Maximum Sound Power (dBA)	Maximum Sound Power (dBC)
31.5	70.4	30.8	67.4
63	74.4	48.0	73.6
125	77.4	61.1	77.2
250	75.4	66.6	75.4
500	75.4	72.0	75.4
1000	69.4	69.2	69.4
2000	64.4	65.4	64.2
4000	59.4	60.2	58.6
8000	51.4	50.1	48.4
Sum	**82.4**	**75.4**	**82.1**

5.3. MODELLING RESULTS

Project sound levels are shown in **Table 5-3**, assume full operation 24 hours a day, and are applicable to night-time and daytime periods.

Table 5-3 Predicted project case sound levels

Dwelling ID	Predicted sound level (dBA)
R1	31.0
R2	23.1
R3	18.7
R4	21.7
R5	28.3
R6	32.2
R7	29.2
R8	26.5
R9	34.7
R10	27.8
R11	25.8
R12	24.3
R13	16.4
R14	16.6
R15	16.9
R16	25.1
R17	26.4

Project sound level contours are shown in **Appendix 9.3**.

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

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5.4. LOW FREQUENCY ASSESSMENT (LFN)

Table 5-4 shows the difference between A and C weighted predicted sound levels at each of the receptors being modelled.

Table 5-4 Low Frequency Noise assessment

Dwelling ID	Predicted sound level (dBA)	Predicted sound level (dBC)	Difference dBC – dBA
R1	31.0	38.5	7.5
R2	23.1	32.5	9.4
R3	18.7	29.4	10.7
R4	21.7	31.4	9.7
R5	28.3	36.5	8.2
R6	32.2	39.6	7.4
R7	29.2	37.2	8.0
R8	26.5	35.1	8.6
R9	34.7	41.7	7.0
R10	27.8	36.2	8.4
R11	25.8	34.7	8.9
R12	24.3	33.5	9.2
R13	16.4	27.5	11.1
R14	16.6	27.7	11.1
R15	16.9	28.0	11.1
R16	25.1	34.1	9.0
R17	26.4	35.1	8.7

One-third octave band data were not available for analysis of low frequency tones. However, the C vs A-weighted receptor levels shown above have differences well below the Rule 012 criteria of 20dB. This indicates that low frequency noise is not expected to be an issue.

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6. CUMULATIVE IMPACT ASSESSMENT

The cumulative impact assessment incorporates sound level contributions from the baseline and Project case assessments. As no Class A, B, or C adjustments were made, the permitted sound levels (PSLs) for night-time hours equals the basic sound levels[7]. Daytime PSL is defined as the basic sound level plus a daytime adjustment of 10dB. Compliance with AUC Rule 012 is determined through a comparison of cumulative sound levels with PSLs. These assessments are shown in Table 6-1.

Table 6-1 Cumulative sound level assessment for night-times (NT) and daytimes (DT)

Receptor	Baseline sound level (dBA)		Project sound level (dBA)		Cumulative sound level (dBA)		Permitted sound level (dBA)		PSL compliance margin (dB)	
Dwelling ID	NT	DT	NT	DT	NT	DT	NT	DT	NT	DT
R1	35.0	45.0	31.0	31.0	36.5	45.2	40	50	3.5	4.8
R2	35.0	45.0	23.1	23.1	35.3	45.0	40	50	4.7	5.0
R3	35.0	45.0	18.7	18.7	35.1	45.0	40	50	4.9	5.0
R4	35.0	45.0	21.7	21.7	35.2	45.0	40	50	4.8	5.0
R5	35.0	45.0	28.3	28.3	35.9	45.1	40	50	4.1	4.9
R6	35.0	45.0	32.2	32.2	36.8	45.2	40	50	3.2	4.8
R7	35.0	45.0	29.2	29.2	36.0	45.1	40	50	4.0	4.9
R8	35.0	45.0	26.5	26.5	35.6	45.1	40	50	4.4	4.9
R9	35.0	45.0	34.7	34.7	37.9	45.4	40	50	2.1	4.6
R10	38.0	48.0	27.8	27.8	38.4	48.0	43	53	4.6	5.0
R11	38.0	48.0	25.8	25.8	38.3	48.0	43	53	4.7	5.0
R12	38.0	48.0	24.3	24.3	38.2	48.0	43	53	4.8	5.0
R13	35.0	45.0	16.4	16.4	35.1	45.0	40	50	4.9	5.0
R14	38.0	48.0	16.6	16.6	38.0	48.0	43	53	5.0	5.0
R15	38.0	48.0	16.9	16.9	38.0	48.0	43	53	5.0	5.0
R16	38.0	48.0	25.1	25.1	38.2	48.0	43	53	4.8	5.0
R17	38.0	48.0	26.4	26.4	38.3	48.0	43	53	4.7	5.0

The most impacted receptor, R9, complies with the PSL at both night-time and daytime levels with the Project operating at full capacity.

Worst case Project sound levels are therefore determined to be compliant with the requirements of AUC Rule 012.

[7] AUC Rule 012: Section 2(7)

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7. CONCLUSIONS

Seventeen receptors were identified as having the potential to be impacted by sound emitted from the proposed Project and/or cumulative sound levels. Worst case sound power levels were used to model sound emissions from the Project during day and night periods from the proposed Springbrook Solar Project.

The Project will be in operation when the sun is out during daytime hours. Rule 012 states night-time hours to be from 22:00 to 07:00 all year long. Due to the sun rising prior to 07:00 during the summer months, the Project may operate during the night-time period, as defined by Rule 012. Therefore, assessing worst case (full operation) noise emission levels for night-time periods have been considered. The solar development will otherwise operate on standby mode where sound emission is much reduced relative to the peak output sound levels assumed throughout this assessment.

Cumulative sound levels were assessed to be below PSLs at the assessed receptors. A LFN assessment determined that sound from the proposed Project is not expected to contain significant LFN levels as defined by AUC Rule 012 Part 4.5.

It is therefore concluded that the proposed Springbrook Solar Project will operate in compliance with the AUC Rule 012 requirements at all assessed receptors.

8. ACOUSTIC PRACTITIONERS' INFORMATION

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

Table 8-1 Summary of practitioner's information

Name	Justin Lee	Merlin Garnett	Cameron Sutherland
Title	Assistant Noise Consultant	Principal Noise Consultant	Technical Director
Role	➢ Acoustic noise modelling ➢ Noise Impact Assessment (NIA) co-author	➢ Discipline lead ➢ Acoustic noise modelling ➢ Fieldwork lead ➢ Noise Impact Assessment (NIA) co-author	➢ Technical Assessment Lead ➢ Noise Impact Assessment (NIA) Reviewer
Experience	Experience with acoustic modelling in iNoise. Analyst on multiple assessments for renewable energy projects in Alberta.	Over 8 years of acoustic and environmental consultancy. Completed the UK Institute of Acoustics (IOA) diploma in 2015. Full member of the IOA.	16 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 solar development in Canada (2019).

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9. APPENDICES

9.1. RULE 012 GLOSSARY

Acoustical practitioner

An acoustical practitioner is an individual with acoustical expertise and knowledge capable of preparing assessments, surveys and reports in accordance with this rule.

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[8]. 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).

Baseline sound level

Baseline sound level includes:

- ambient sound level,
- noise contribution from existing energy-related facilities,
- predicted noise contribution from approved energy-related facilities that have not yet been constructed, and
- predicted noise contribution from facilities proposed in an application to the AUC that the AUC has deemed complete under AUC Rule 007.

The baseline sound level must include instances of the facility types listed above that are located close enough to the applicant's proposed facility to potentially influence sound levels at affected dwellings.

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

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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.

Category

A classification of a dwelling in relation to transportation routes used to arrive at a basic sound level, using Table 1 in this rule.

Category 1

Dwelling(s) distance is more than or equal to 500 m from heavily travelled roads or rail lines and not subject to frequent aircraft flyovers.

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.

Category 3

Dwelling(s) distance is less than 30 m from heavily travelled roads or rail lines or subject to frequent aircraft flyovers.

Comprehensive sound level

The comprehensive sound level includes the ambient sound level, and noise contribution from existing energy-related facilities. The comprehensive sound level should be collected under representative conditions and should exclude abnormal noise events.

Cumulative sound level

The cumulative sound level includes:

- ambient sound level
- noise contribution from existing energy-related facilities
- predicted noise contribution from approved energy-related facilities that have not yet been constructed
- predicted noise from facilities proposed in an application to the AUC that the AUC has deemed complete under AUC Rule 007
- predicted noise contribution from the applicant's proposed facility

The cumulative sound level must include facilities listed above that are located close enough to the applicant's proposed facility to potentially influence sound levels at affected dwellings.

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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.

dBA

The decibel (dB) sound pressure level filtered through the A filtering network that approximates human hearing response at low intensities. Also see dB and A-weighted sound level.

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.

In the case of a condominium or apartment complex, each unit is considered a dwelling.

A seasonally occupied dwelling is a fixed residence that, while not being occupied on a full-time basis, is occupied on a regular basis. A regular basis does not imply a scheduled occupancy but implies use of six weeks per year or more. The dwelling must not be mobile and should have some sort of foundation or features of permanence (e.g., electrical power, domestic water supply, septic system) associated with it.

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Summer cottages or manufactured homes are examples of seasonally-occupied dwellings, while a holiday trailer simply pulled onto a site is not.

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

The nearest dwelling may not necessarily be the one most affected by noise because of factors such as topography or man-made features. For example the nearest dwelling to a facility may be behind an intervening ridge, while a more distant dwelling may be in direct line of sight of the facility and experience louder noise.

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.

Existing facility

A facility that has been approved by the Commission, or other regulatory agency, for which construction is complete and operations have commenced.

Facility

Facility means a gas utility pipeline, hydro development, power plant, substation or transmission line.

Facility property

The facility property is used to establish the 1.5 km compliance distance from a facility. The boundary of the facility property is defined by the legal interest in the land (e.g., property line, right-of-way, easement or lease), and from the centre point of the tower for wind turbines. Lands optioned for future developments or for wind power projects may not be used to define the boundary.

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.

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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 two month period in a year. The following methods to validate the travel volume are acceptable:

- traffic count by attended technician for the entire nighttime period with the dates documented
- traffic count by audio recording during the sound monitoring period with the dates documented
- hourly traffic volume data from Alberta Transportation or other municipalities
- 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 nighttime period traffic.
- 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.

Noise

The unwanted portion of sound.

Noise impact assessment (NIA)

A noise impact assessment predicts the expected sound level emanating from a facility as measured 15 m from the most affected dwelling(s). It also identifies what the permissible sound level is and how it was calculated. This rule requires that a noise impact assessment predict compliance for a facility by comparing cumulative sound levels with permissible sound levels applicable at affected dwellings.

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Permissible sound level (PSL)

The maximum daytime or nighttime 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.

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9.2. MANUFACTURER'S MEASURED SOUND PRESSURE DATA

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1. Noise Test

1.1 Prototype information

Name	PV inverter	**Model**	SG250HX
Serial No.	GX19062501-08	**Quantity**	1
Submission Date	2019-09-29		
Status	Good		

1.2 Testing information

Applicant	Wang Peng	**Applicant Dept.**	PV & Storage Division
Item	Noise		
Date	2019-09-29	**Testing engineers**	Yan Zhan
Environment	Tmperature:6.5℃ Hmidity:6.5% RH	**Testing site**	Aechoic chamber
Standard	NB/T 32004-2018 technical specification for photovoltaic grid connected inverter		

1.3 Testing instrument

Equipment	Manufacturer	Model	No.	Calibration date	Expiry date
Noise meter	Hangzhou Aihua Instruments Co., Ltd	AWA6218C	YQ-026	2018-10-25	2019-10-24

1.4 Testing conclusion

Test location	Test value（dB）		Standard limits（dB）	Conclusion
	Background noise	Measured noise		
Front side	43	73.2	≤78dB	Pass
Left side	47.7	74.4		Pass
Right side	50.9	72.5		Pass
Back side	46	73.5		Pass

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1.5 Testing details

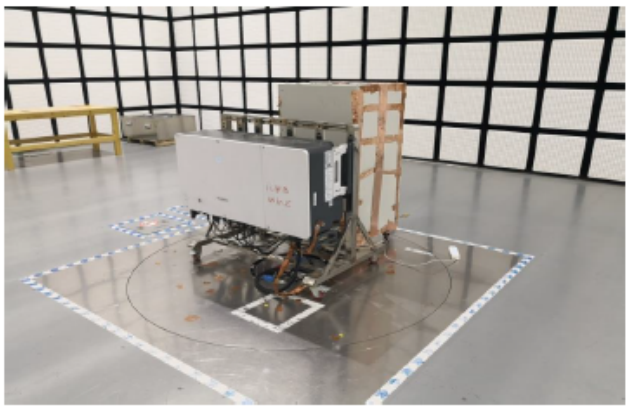

Fig.1 Testing Condition

Test method:

① The inverter operates under the maximum noise condition (fan at full speed).
② Take a distance of 1m from the center of the front, back, left and right four surfaces of the inverter for test.
③ Take the maximum noise value for continuous test for more than 1 minute. The sound meter adopts A-weighted measurement method.

1.6 Testing records

	Background noise	Running noise
Front side	 Testing data	 Testing data

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Back side	 Testing data	 Testing data
Left side	 Testing data	 Testing data
Right side	 Testing data	 Testing data

1.7 Accessory

None.

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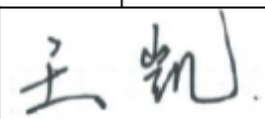
Sungrow Power Supply Co., Ltd.
Add: No. 1699 Xiyou Road, Hefei, China
Tel: +86 551 6532 7834
Email: info@sungrow.cn
Website: www.sungrowpower.com

Noise Test Report

TYPE TEST SHEET

This Type Test sheet shall be used to record the results of the type testing of Generating Unit			
Type Tested reference number		SG250HX	
Generating Unit technology		Grid-connected PV Inverter	
System supplier name		Sungrow Power Supply Co., Ltd.	
Address		No.1699 Xiyou Rd., New & High Technology Industrial Development Zone, Hefei, P.R. China	
Tel	+86 551 65327834	Fax	+86 551 6532 7800
E:mail	info@sungrow.cn	Web site	www.sungrowpower.com
Maximum export capacity, use separate sheet if more than one connection option.	N/A	kW single phase, single, split or three phase system	
	225	kW three phase	
	N/A	kW two phases in three phase system	
	N/A	kW two phases split phase system	
Compiled by		On behalf of	Sungrow Power Supply Co., Ltd.
		Test Date	2020-06-08
Note that testing can be done by the manufacturer of an individual component, by an external test house, or by the supplier of the complete system, or any combination of them as appropriate. Where parts of the testing are carried out by persons or organisations other than the supplier then the supplier shall keep copies of all test records and results supplied to them to verify that the testing has been carried out by people with sufficient technical competency to carry out the tests.			

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Email: info@sungrow.cn
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The aim of this test is to determine the noise level when the PV Grid inverter in rated working condition

Used settings of the measurement device for Noise measurement

Measurement device	Date of measurement
AWA6228	2020-03-05

The condition s during testing are specified below:

PGU operation mode	Rated Working Condition
Voltage range	860-1300V
Grid frequency range	50Hz/ 45-55Hz
Distance	1m
Date	2020-06-08

The system noise level please check the table below.

Orientation	Noise (dB)
Front	74.4
Behind	73.9
Sidepiece	72.6
Average Noise	73.6

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Front Test :

Test Record			
Frequency(Hz)	Noise(dB)	Frequency(Hz)	Noise(dB)
16	72.8	1k	70.8
31.5	71.5	2k	65.8
63	68.3	4k	60.6
125	67.6	8k	53.9
250	73.5	16k	57.4
500	72.1	**W_A**	**74.4**

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Behind:

Test Record			
Frequency(Hz)	Noise(dB)	Frequency(Hz)	Noise(dB)
16	67.4	1k	68.6
31.5	72.3	2k	64.7
63	69.0	4k	58.6
125	68.7	8k	50.2
250	75.1	16k	41.4
500	72.5	W_A	73.9

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Sidepiece:

Test Record

Frequency(Hz)	Noise(dB)	Frequency(Hz)	Noise(dB)
16	65.3	1k	67.9
31.5	71.7	2k	64.4
63	67.7	4k	57.8
125	66.3	8k	50.0
250	73.6	16k	39.1
500	69.7	W_A	72.6

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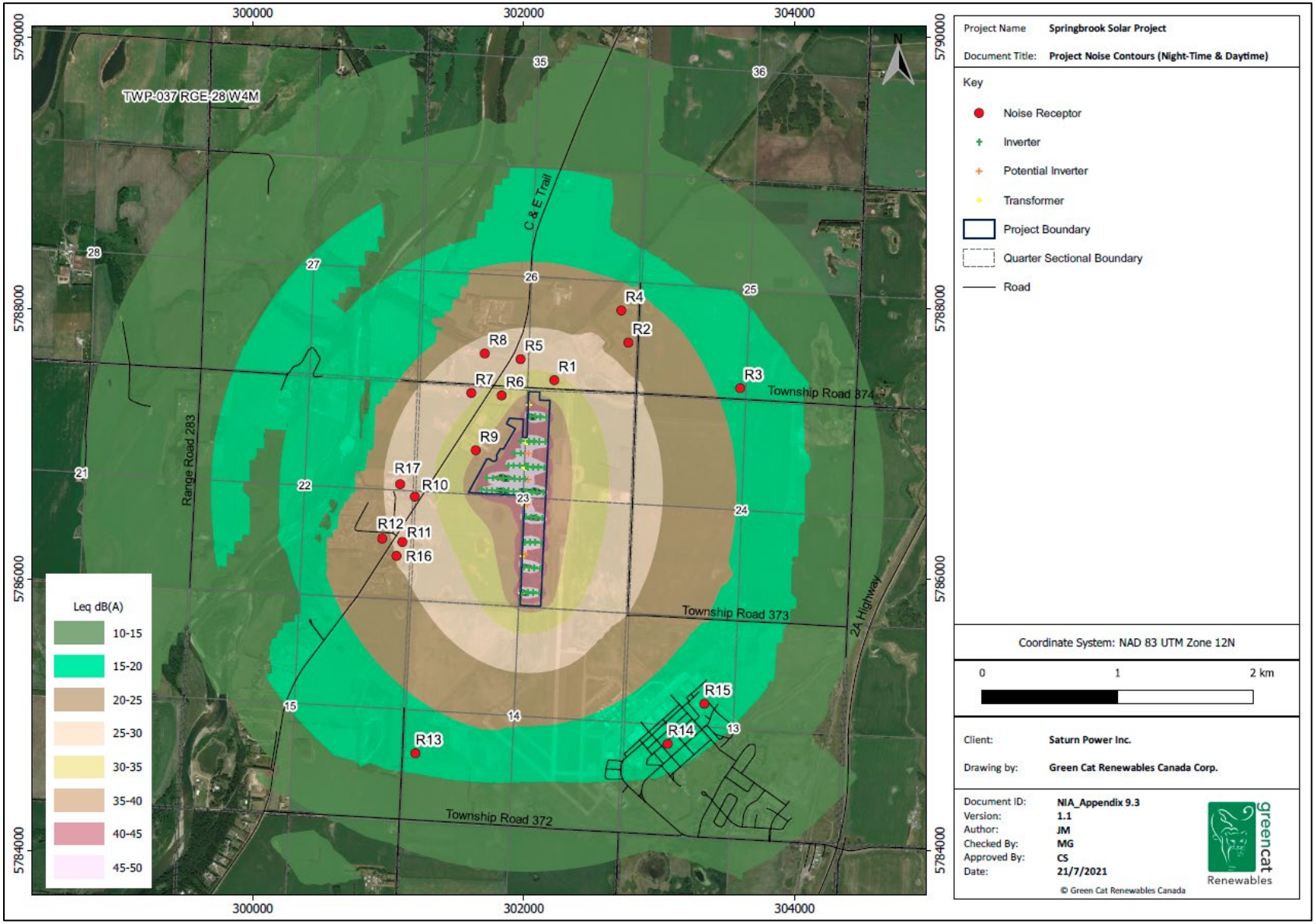
9.3. PROJECT SOUND LEVEL CONTOURS



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