Homestead Solar Project

Noise Impact Assessment

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Kiwetinohk Energy Corp.

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Executive Summary

Kiwetinohk Energy Corp. propose to install a 400 MW_{AC} photovoltaic (PV) electricity generating power plant located in the Municipal District of Willow Creek No.26, Alberta, approximately 12.5 km southeast of the town of Claresholm. The Project will consist of ground mounted PV panels, 100 inverter/transformer stations and a substation. The inverter/transformer stations and substation are the only significant noise producing project elements and these are assumed to operate at full load for the purposes of the noise assessment.

GCR reviewed aerial imagery of the site, identifying eleven receptors (9 within 1.5 km of the Project and 2 slightly outside of 1.5km project boundary) as having the potential to be affected by noise from the proposed Project. The area was also checked for other regulated third party energy-related facilities that may produce noise within the vicinity of the Project.

A software model was used to predict sound levels from the Project to determine compliance with Alberta Utilities Commission (AUC) Rule 012: Noise Control requirements. Cumulative sound levels were 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: existing regulated third party energy-related facilities; third party projects; the proposed Project; and ambient sources. Results indicate cumulative sound levels were compliant with permitted sound levels at all receptors assessed. A Low Frequency Noise (LFN) assessment determined that sound from the proposed Project was not assessed to contain any significant LFN effects.

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

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1 Introduction

Kiwetinohk Energy Corp. (KEC) retained Green Cat Renewables Canada Corporation (GCR) to conduct a noise impact assessment for the proposed Homestead Solar Project (the Project). The Project will have a capacity of 400 MW_{AC}, located in the Municipal District of Willow Creek No.26, Alberta, approximately 12.5 kilometres Southeast of the Town of Claresholm. The Project location is shown in Figure 1-1 below. The assessment considered the cumulative impact of existing and proposed noise sources on nearby receptors.

Figure 1-1 – Homestead Solar Project Location

2 Rule 012 Assessment Process

The assessment process follows 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 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 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 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 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 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 iNoise from DGMR Software (version Enterprise 2021.0). 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...'.*

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-6913
Ground Attenuation	0.5
Number of Sound Reflections	1
Receptor Height	1.5m for one-storey / 4.5m for two-storey
Operation Condition	Full load
Source Height	1.9m for Inverter/Transformer units 4.0m for Substation Transformers

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

4 Baseline

4.1 Study Area

The development site spans over 16 quarter sections of land approximately 12.5 kilometres southeast of the Town of Claresholm, Alberta. The study area includes rural/agricultural land, waterbodies, and wetlands.

Nine (9) dwellings located within the 1.5 km boundary criterion have been assessed for cumulative noise impacts from the Project and other nearby facilities, as required by Rule 012. 2 dwellings that are just outside of the 1.5km boundary have also been included in the assessment.

4.2 Project Description

The Project will encompass a large portion of 16 quarter sections of land, consisting of approximately 1,100,000 PV modules, with a total generating capacity of 400 MW_{AC}. The modules will use single-axis trackers mounted to the ground with piles, and they will feed 100 inverter/transformer stations. The inverter/transformer stations and the electrical substations, if applicable, are the only significant sources of noise from the solar development.

Daytime periods are defined between 07:00-22:00, while night-time periods fall between 22:00-07:00. The Project is anticipated to normally operate during the defined daytime hours; however, sunrise on the longest days of the year (during summer months) will occur at approximately 05:00, which falls within the night-time period. Therefore, the assessment considers both daytime and night-time 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 during a site visit conducted by GCR in November 2021. The heights of identified dwellings were also confirmed during the site visit. To provide a conservative assessment, any dwellings with the potential to be considered as higher than a one-storey dwelling were modelled at a two-storey elevation of 4.5m. Model receptors were placed at each of the dwellings within 1.5km of the Project boundary. Table 4-1 shows the location details and the height of each receptor.

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	330186	5538554	One-storey	1.5	60m S
R2	330164	5538456	One-storey	1.5	150m S
R3	327043	5536648	Two-storey	4.5	470m S
R4	326927	5536514	One-storey	1.5	630m S
R5	326218	5537040	Two-storey	4.5	730m W
R6	327076	5538436	One-storey	1.5	130m W
R7	326901	5539227	Two-storey	4.5	110m W
R8	326999	5541723	Two-storey	4.5	1400m N

Receptor ID	UTM Coordinates (NAD 83, Zone 12N)		Dwelling type	Receptor height (m)	Relative location from site boundary
	Easting	Northing			
R9*	329793	5535518	One-storey	1.5	1500m S
R10**	325398	5538338	One-storey	1.5	1600m W
R11**	331775	5536958	Two-storey	4.5	1650m E

*R9 was plotted along the 1.5km boundary to represent a dwelling further away in distance.

**R10 and R11 are located slightly outside of the 1.5km boundary but have been included in the assessment.

4.4 Existing Third Party Regulated Energy-Related Facilities

A search for existing regulated facilities and pumping wells was conducted within 3km of the Project boundary. The AER's Facilities list (ST102) and Wells list (ST037) were consulted in November 2021. Table 4-2 lists the active facilities and pumping wells identified through the AER databases within 3km of the Project.

Table 4-2 – Third Party Sound Sources

Map Label	Name	AER ID	Type	Operator Name	UTM Coordinates (NAD 83, Zone 12N)	
					Easting	Northing
AER1	ACL GRANUM 15-25-11-26W4	ABBT0100906	Crude Oil Single-Well Battery	Long Term Asset Management Inc.	326551	5535409
AER2	ARGOSY 16-11-12-26W4 PRO BATTERY	ABBT0122625	Gas Multiwell Proration Outside SE Alberta Battery	Long Term Asset Management Inc.	325318	5540307
AER3	16-11 Multiwell Pro-rated	ABBT0142093	Gas Multiwell Proration Outside SE Alberta Battery	Long Term Asset Management Inc.	325318	5540307
AER4	ARGOSY ENERGY 1-11 GGS	ABGS0086607	Gas Gathering System	Long Term Asset Management Inc.	325318	5540307
AER5	CWNG GRANUM 7-25	ABBT7330001	Gas Multiwell Group Battery	Canadian Natural Resources Limited	326216	5534472
AER6	CNRL GRANUM 7-25-11-26	00/07-25-011-26W4/0	Pumping Well (Gas)	Canadian Natural Resources Limited	326551	5535409
AER7	CNRL GRANUM 2-36-11-26	00/02-36-011-26W4/0	Pumping Well (Gas)	Canadian Natural Resources Limited	326323	5534329
AER8	LTAM EASTM 9-11-12-26	00/09-11-012-26W4/0	Pumping Well (Gas)	Long Term Asset Management Inc.	326245	5535819
AER9	CNRL GRANUM 6-30-11-25	00/06-30-011-25W4/0	Pumping Well (Gas)	Canadian Natural Resources Limited	324991	5539753

Map Label	Name	AER ID	Type	Operator Name	UTM Coordinates (NAD 83, Zone 12N)	
					Easting	Northing
AER10	CNRL GRANUM 6-28-11-25	02/06-28-011-25W4/0	Pumping Well (Gas)	Canadian Natural Resources Limited	327308	5534568
AER11	CNRL GRANUM 11-25-11-26	00/11-25-011-26W4/0	Pumping Well (Gas)	Canadian Natural Resources Limited	330566	5534498
AER12	LTAM EASTM 1-11-12-26	00/01-11-012-26W4/2	Pumping Well (Gas)	Long Term Asset Management Inc.	325973	5535037
AER13	LTAM EASTM 8-2-12-26	00/08-02-012-26W4/3	Pumping Well (Gas)	Long Term Asset Management Inc.	324952	5539136
AER14	LTAM EASTM 5-12-12-26	00/05-12-012-26W4/0	Pumping Well (Gas)	Long Term Asset Management Inc.	324946	5537912
AER15	LTAM EASTM 15-2-12-26	00/15-02-012-26W4/0	Pumping Well (Gas)	Long Term Asset Management Inc.	325670	5539271

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

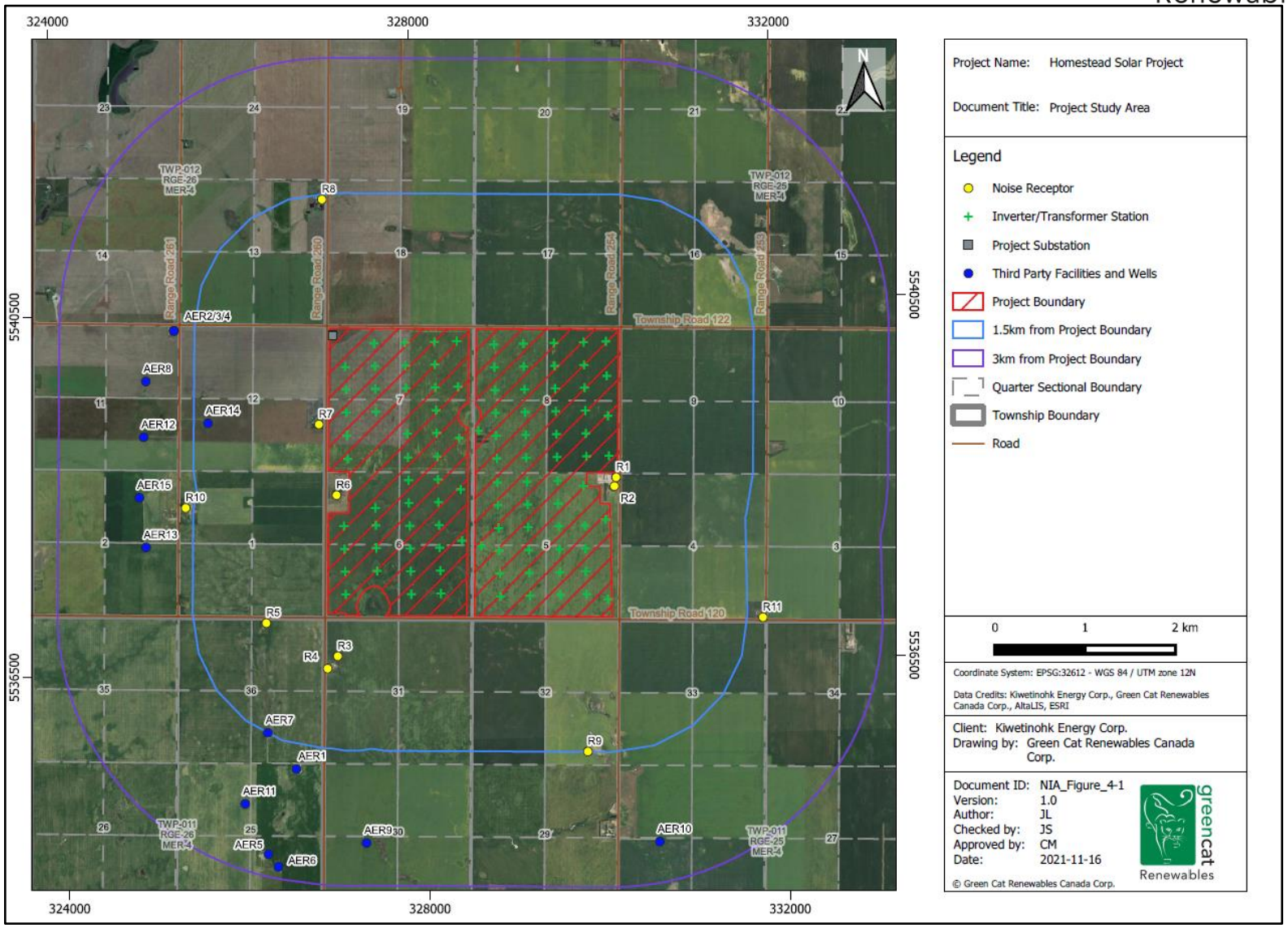


Figure 4-1 – Project Study Area

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 4-3.

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[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 dwelling density and proximity to transportation. Table 4-4 identifies the categories for each receptor.

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). Therefore, the Ambient Sound Level was assessed to be 5dB(A) less than the applicable BSL for night-time and 5dB(A) more than the applicable BSL for daytime.[6] This results in a night-time ASL of 35dB(A) and a daytime ASL of 45dB(A) for all receptors. BSLs and ASLs for night-times and daytimes for each location 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 each location are given in Table 4-4.

[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.
[6] 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
R11	1	1	40	35	45	40	50

4.5.4 Third Party Sound Power Levels

Sound power levels for AER1, AER6, AER7, and AER 11 were calculated based on field measurements conducted during the site visit in November 2021. While on site, GCR did not identify any noise emitting sources for AER2, AER3, and AER4. GCR contacted the field operator (Long Term Asset Management Inc) and was informed that these facilities have been relocated and are now in the reclamation process. Similarly, no significant noise producing source was identified at the location for AER 5 other than a gas pumping well (AER6). A consultation with the operator (Canadian Natural Resources) was made but the field operator was not aware of any gas battery facility in the near vicinity[7]. Most of the gas pumping wells GCR identified were inaudible at the facility locations during the site visit. AER6, AER7, and AER 11 produced noise, but the noise detected was relatively quiet and also intermittent. For the purpose of this assessment, all noise producing facilities were deemed to operate at full load and produce noise continuously.

Table 4-5 lists octave band sound power levels for the noise producing AER regulated energy-related facility

Table 4-5 Octave Band Sound Power Levels for Noise Producing AER Regulated Energy-Related Facilities

Map Label	Octave Band Centre Frequency, Hz									Total	
	32	63	125	250	500	1000	2000	4000	8000	dB(A)	dB
AER1	101.2	93.8	80.4	82.5	78.5	77.3	76.1	72.7	68.8	83.1	102.0
AER6	65.3	63.2	51.9	44.1	48.7	50.0	48.0	47.2	43.7	55.0	67.7
AER7	71.9	71.9	57.5	52.6	55.8	49.3	47.7	46.8	48.9	57.3	75.1
AER11	52.4	48.2	40.2	35.9	40.9	40.4	45.2	49.3	45.5	52.9	56.4

[7] The closest gas battery the operator could recall was at least a mile away

4.6 Modelling Results

Table 4-6 shows the predicted sound levels at each receptor from existing AER regulated Energy-Related Facilities. Predicted levels less than zero dB(A) are denoted by a dash in the below table.

Table 4-6 Predicted Sound Levels from Existing AER Regulated Energy-Related Facilities

Dwelling ID	Total Existing Third Party Regulated Energy-Related Facilities Sound levels dB(A)
R1	-
R2	-
R3	5.8
R4	6.7
R5	3.2
R6	-
R7	-
R8	-
R9	-
R10	-
R11	-

4.7 Total Baseline Sound Levels

Baseline sound levels include the noise contributions from existing adjacent sound sources and the ambient sound level considered typical of 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 Levels for Night-Time and Daytime Periods

Receptor	Total Regulated Facilities Sound Level (dBA)		Ambient Sound Level (dBA)		Total Baseline Sound Level (dBA)	
Dwelling ID	NT	DT	NT	DT	NT	DT
R1	-	-	35	45	35.0	45.0
R2	-	-	35	45	35.0	45.0
R3	5.8	5.8	35	45	35.0	45.0
R4	6.7	6.7	35	45	35.0	45.0
R5	3.2	3.2	35	45	35.0	45.0
R6	-	-	35	45	35.0	45.0
R7	-	-	35	45	35.0	45.0
R8	-	-	35	45	35.0	45.0
R9	-	-	35	45	35.0	45.0
R10	-	-	35	45	35.0	45.0
R11	-	-	35	45	35.0	45.0

5 Project Sound Levels

The Project will consist of solar PV arrays using ground-mounted single-axis trackers. The arrays will be connected to 100 inverter/transformer stations with a total capacity of 400 MW_{AC}. Additionally, a substation has been proposed to be added within the Project boundary and will consist of two 232MVA high voltage transformer. The inverter/transformer stations and the substation transformers are the only noise producing project elements and are assumed to operate at full load 24 hours a day in this assessment. The sound power data for these inverter/transformer stations were used to model sound emissions for both daytime and night-time periods.

5.1 Inverter/Transformer Stations

5.1.1 Inverters

The inverter proposed for the Project are the SMA SC 4600 UP-US units. The sound data measurements for these inverters provided by the equipment manufacturer are shown in Appendix B.

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

Table 5-1 One Third Octave Band Inverter Sound Power Levels

Octave band Frequency (Hz)	Sound Power (dB)	Sound Power (dBA)	Sound Power (dBC)
31.5	64.1	24.7	61.1
40	81.4	46.8	79.4
50	81.2	51.0	79.9
63	79.8	53.6	79.0
80	81.3	58.8	80.8
100	80.7	61.6	80.4
125	80.3	64.2	80.1
160	83.8	70.4	83.7
200	77.8	66.9	77.8
250	80.7	72.1	80.7
315	83.4	76.8	83.4
400	85.9	81.1	85.9
500	80.9	77.7	80.9
630	79.0	77.1	79.0
800	76.9	76.1	76.9
1000	78.8	78.8	78.8
1250	76.1	76.7	76.1

Octave band Frequency (Hz)	Sound Power (dB)	Sound Power (dBA)	Sound Power (dBC)
1600	75.1	76.1	75.0
2000	75.1	76.3	74.9
2500	73.7	75.0	73.4
3150	77.8	79.0	77.3
4000	84.7	85.7	83.9
5000	68.7	69.2	67.4
6300	71.0	70.9	69.0
8000	82.1	81.0	79.1
10000	71.3	68.8	66.9
Sum	**94.4**	**90.8**	**93.9**

5.1.2 Transformers

The proposed medium voltage transformers are 4,180 kVA 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 spectra for the MV transformers used in this project are shown in Table 5-2.

Table 5-2 Octave Band Transformer Sound Levels[8]

Octave band Frequency (Hz)	Sound Power (dB)	Sound Power (dBA)	Sound Power (dBC)
31.5	86.7	47.3	83.7
63	81.7	55.5	80.9
125	83.7	67.6	83.5
250	79.7	71.1	79.7
500	78.7	75.5	78.7
1000	67.7	67.7	67.7
2000	60.7	61.9	60.5
4000	55.7	56.7	54.9
8000	49.7	48.6	46.7
Sum	**90.1**	**78.0**	**88.8**

[8] Based on theoretical prediction method (Croker,2007).

5.2 Substation

The substation will be comprised of two 232 MVA high voltage (HV) transformer that will be used to transform the electricity generated from the PV system to grid voltage. The transformers have been modelled in 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, shown in Table 5-3

Table 5-3 Octave Band Sound Power Levels for the Project's Substation[9]

Octave band Frequency (Hz)	Sound Power (dB)	Sound Power (dBA)	Sound Power (dBC)
31.5	98.1	58.7	95.1
63	102.1	75.9	101.3
125	105.1	89.0	104.9
250	103.1	94.5	103.1
500	103.1	99.9	103.1
1000	97.1	97.1	97.1
2000	92.1	93.3	91.9
4000	87.1	88.1	86.3
8000	79.1	78.0	76.1
Sum	**110.1**	**103.3**	**109.8**

5.3 Modelling Results

Predicted sound levels for the Project are shown in Table 5-4. The results assume full operation 24 hours a day, and they are applicable to night-time and daytime periods.

Table 5-4 Predicted Project Case Sound Levels

Dwelling ID	Project Sound Level (dBA)
R1	34.5
R2	34.1
R3	27.9
R4	24.9
R5	26.2
R6	33.8

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

Dwelling ID	Project Sound Level (dBA)
R7	37.4
R8	30.9
R9	20.7
R10	21.6
R11	21.6

The maximum sound pressure level predicted to be received is 37.4 dB(A) at R7. Project sound level contours are shown in Appendix C.

5.4 Low Frequency Assessment

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

Table 5-5 Low Frequency Noise Assessment

Dwelling ID	Predicted Sound Level (dBA)	Predicted Sound Level (dBC)	Difference dBC – dBA
R1	34.5	43.9	9.4
R2	34.1	43.7	9.6
R3	27.9	38.8	10.9
R4	24.9	37.5	12.6
R5	26.2	37.6	11.4
R6	33.8	43.9	10.0
R7	37.4	45.8	8.4
R8	30.9	40.4	9.5
R9	20.7	35.0	14.2
R10	21.6	34.4	12.8
R11	21.6	34.7	13.1

Results in Table 5-5 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 6-1 shows the results of the cumulative impact and compliance assessment.

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)		PSL (dBA)		PSL Compliance Margin (dB)	
Dwelling ID	NT	DT	NT	DT	NT	DT	NT	DT	NT	DT
R1	35.0	45.0	34.5	34.5	38	45	40	50	2	5
R2	35.0	45.0	34.1	34.1	38	45	40	50	2	5
R3	35.0	45.0	27.9	27.9	36	45	40	50	4	5
R4	35.0	45.0	24.9	24.9	35	45	40	50	5	5
R5	35.0	45.0	26.2	26.2	36	45	40	50	4	5
R6	35.0	45.0	33.8	33.8	37	45	40	50	3	5
R7	35.0	45.0	37.4	37.4	39	46	40	50	1	4
R8	35.0	45.0	30.9	30.9	36	45	40	50	4	5
R9	35.0	45.0	20.7	20.7	35	45	40	50	5	5
R10	35.0	45.0	21.6	21.6	35	45	40	50	5	5
R11	35.0	45.0	21.6	21.6	35	45	40	50	5	5

The cumulative sound levels at all assessed receptors are shown to meet PSLs with the Project operating at full capacity. Receptor R7 is the most affected by the Project sound levels. Worst case Project sound levels are determined to be compliant with the requirements of AUC Rule 012.

7 Conclusions

Eleven 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 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 has 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 all receptors. R7 has been identified as the most impacted receptor. 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 Homestead Solar Project would operate in compliance with AUC Rule 012 requirements at all 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	Jason Mah	Merlin Garnett	Cameron Sutherland
Title	Assistant Noise Consultant	Assistant Noise Consultant	Principal Noise Consultant	Technical Director
Role	• Acoustic noise modelling • Noise Impact Assessment (NIA) co-author	• 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 noise assessments for renewable energy projects in Alberta.	• Experience with acoustic modelling in iNoise. • Analyst on multiple noise assessments for renewable energy projects in Alberta.	• Over 9 years of acoustic and environmental consultancy. • Completed the UK Institute of Acoustics (IOA) diploma in 2015. • Full member of the IOA. • Author on multiple NIAs for renewable energy projects in Alberta.	• 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 (2019/20).

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[10]. 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.

[10] 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 two 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 logarithmic addition of sound pressure levels when predicting noise where the sum does not exceed the permissible sound level by 0.4 dBA.

Noise

The unwanted portion of sound.

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.

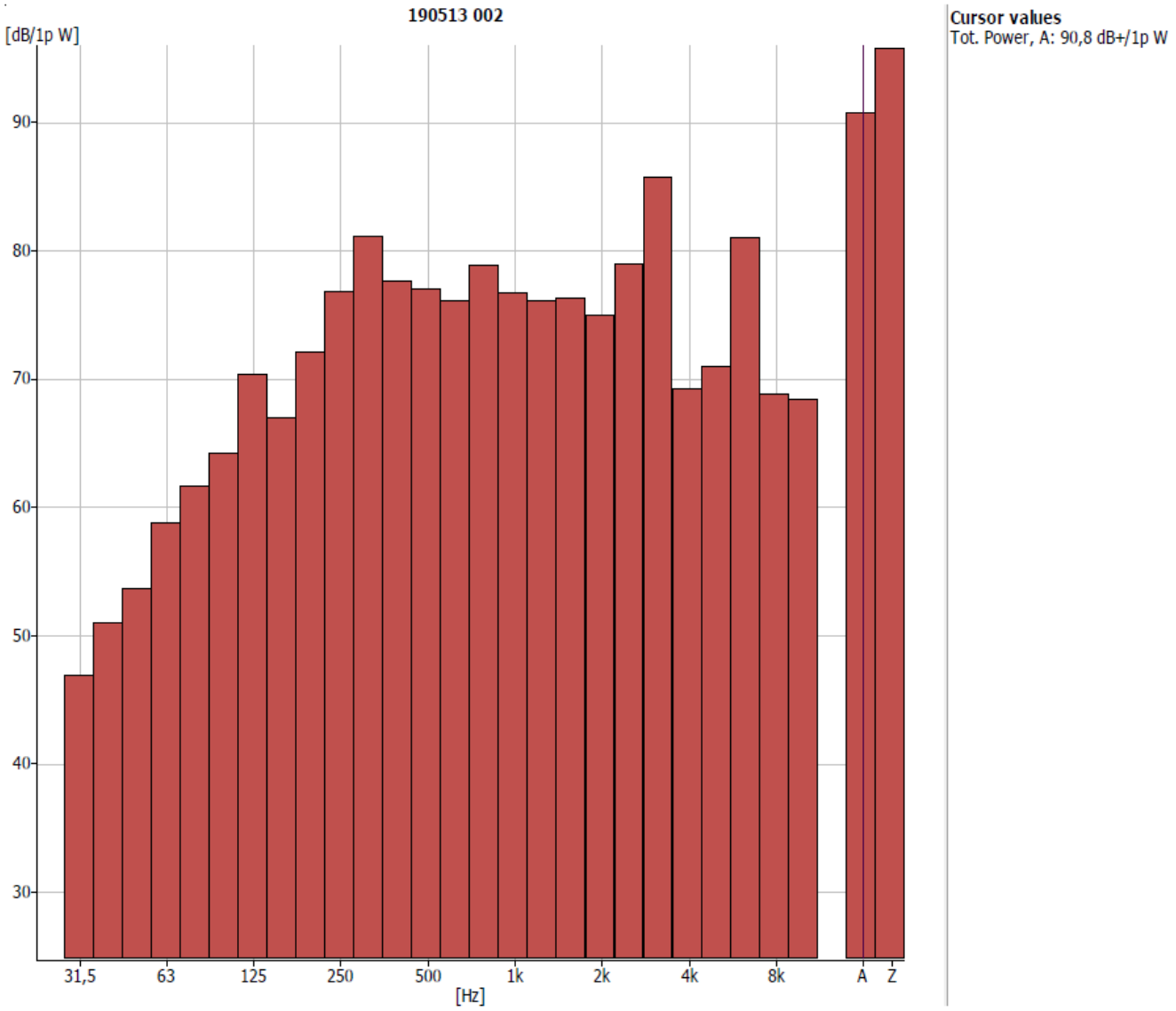
The second part is that the tonal component must be a pronounced peak clearly obvious within the spectrum.

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.

Appendix B: Vendor's Sound Power Data

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



Appendix C: Project Sound Level Contours

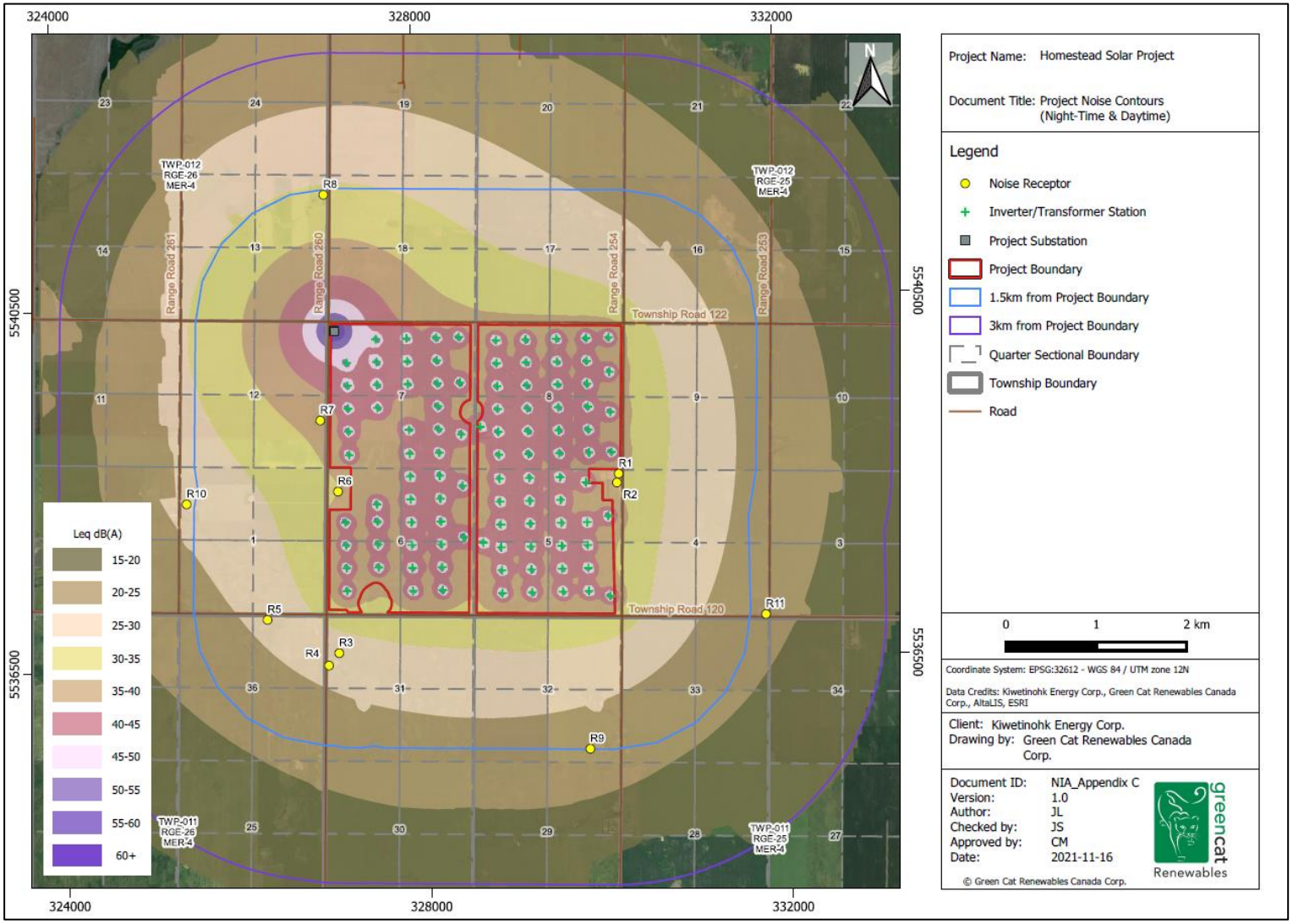


Figure C-1 – Project Sound Level Contours

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