



GREGADOO MOD 4 - NOISE IMPACT ASSESSMENT

Project ID: 14757

18/09/2024

Release: R4



Prepared For:

Premise

Assured Environmental



DOCUMENT CONTROL PAGE

Project Title: GREGADOO MOD 4 - NOISE IMPACT ASSESSMENT

Project Reference ID: 14757

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Table 1: History of Revisions

Revision	Date	Issued to	Changes
R0	9/02/2023	D. Walker	Initial Release
R1	23/02/2023	D. Walker	Client Comments
R2	6/06/2024	D. Drum	Update to operational assessment and construction assessment
R3	01/08/2024	D. Drum	Update to operational assessment
R4	08/08/2024	D. Drum	Update to road traffic assessment
R5	18/09/2024	D. Drum	Update to Site Layout Figures

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GLOSSARY

A-Weighting	A response provided by an electronic circuit which modifies sound in such a way that the resulting level is similar to that perceived by the human ear.
dB (decibel)	This is the scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and the reference pressure (0.00002 N/m ²).
dB(A) or dBA	This is a measure of the overall noise level of sound across the audible spectrum with a frequency weighting (i.e. 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
dB(Z)	This is a measure of the overall noise level of sound across the audible spectrum with a "Z" frequency weighting which is effectively the un-weighted signal.
Free-field	Refers to a sound pressure level determined at a point away from reflective surfaces other than the ground with no significant contribution due to sound from other reflective surfaces; generally, as measured outside and away from buildings.
Hz	Hertz. Unit of frequency of a variable parameter. Units: 1/seconds
L _{Aeq}	This is the equivalent steady sound level in dB(A) containing the same acoustic energy as the actual fluctuating sound level over the given period. Noise levels often fluctuate over a wide range with time. Therefore, when a noise varies over time, the L _{Aeq} is the equivalent continuous sound which would contain the same sound energy as the time varying sound. Many studies show that human reaction to level-varying sounds tends to relate closer to the L _{Aeq} noise level than any other descriptor.
L _{A10} , L _{A90} , L _{An}	Noise level exceeded for n% of the measurement period with A-weighted, calculated by statistical analysis - where n is between 0.01% and 99.99%. For example, L _{A10} is the noise level just exceeded for 10% of the measurement period, calculated by statistical analysis and used to determine traffic noise and L _{A90} is the noise level exceeded for 90% of the measurement period, A-weighted and calculated by statistical analysis and used to determine background noise levels.
L _{AFmax}	A-weighted, fast response, maximum, sound level.
L _{AFmin}	A-weighted, fast response, minimum, sound level.
RBL	Rating background noise level – the overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period.
SWL	Sound Power Level in decibels is ten times the logarithm of the ratio of the sound power to the sound power reference level of 1 pico Watt.

ABBREVIATIONS

BOM	Bureau of Meteorology
EPA	Environmental Protection Authority (NSW)
NPfI	Noise Policy for Industry (NSW EPA, 2017)
ICNG	Interim Construction Noise Guidelines



1 INTRODUCTION

1.1 Scope of Assessment

Assured Environmental (AE) was appointed by Gregadoo Solar Farm Pty Ltd to undertake a noise and vibration impact assessment for Modification 4 to the approved Gregadoo Solar Farm at 123 Redbank Road and 50 Ashfords Road Gregadoo, being Lot 11 DP1043022 and Lot 1 DP524499 (development site).

The update of this report is to include the optimised design that has been conceived to utilise the approved development footprint more effectively by incorporating a Battery Energy Storage System ('BESS') while maintaining a power output of 65 MW(AC). The proposed BESS will have a generation capacity of 200MWAC and 400MWh. This optimisation assists to ensure the orderly and economic use of land, while assisting to achieve State and Federal renewable energy targets and objectives for renewable energy and grid firming.

In addition, Modification 4 seeks to include an additional access point and internal access track from Boiling Down Road to the approved overhead transmission line between the Gregadoo Solar Farm substation and the Transgrid substation. The access point and access track are required to ensure that the approved overhead and underground transmission line can be constructed and maintained without impacting on the Boiling Down Creek or the adjoining riparian corridor.

The noise and vibration study has been undertaken to assess the potential impacts of the construction and operation of the development site, on nearby sensitive receptors in accordance with the following NSW policies and guidelines:

- NSW Noise Policy for Industry (NPfI) (EPA, 2017);
- NSW Assessing Vibration: a technical guideline (DEC, 2006);
- NSW Road Noise Policy (DECCW, 2011); and
- Interim Construction Noise Guideline (ICNG) (DECC, 2009).
- Draft Construction Noise Guideline (EPA, 2017)

In accordance with the requirements of the above guidelines, computational modelling and first principal calculations have been undertaken to support the assessment of the potential for adverse amenity impacts as a result of Modification 4.

1.2 This Report

This report summarises the methodology, results, and conclusions of the noise and vibration impact assessment.



2 PROPOSED DEVELOPMENT SITE

2.1 Development Site

The development site for the Gregadoo Solar Farm is located in the Wagga Wagga Local Government Area (LGA) approximately 13 kilometres south-east of the Wagga Wagga Central Business District (CBD)

Specifically, the development site includes 123 Redbank Road and 50 Ashfords Road, Gregadoo, being Lot 11 on DP1043022 and Lot 1 DP524499 as shown in Figure 1. The area surrounding the proposed development includes;

- Primary production;
- Special activities to the south of the development site;
- Large lot residential to the north; and
- Primary production small lots with associated rural dwellings.

2.2 Receptors

Sensitive receptors have been selected as per the NPfI (2017). Table 2 and Figure 1 outline the closest sensitive receptors to the development site based on land use as defined in NPfI (2017). Additional sensitive receptors further afield have not been included; where compliance is achieved at the receptors listed in Table 2, compliance would also be achieved further afield.

Table 2: Sensitive Receptors

ID	Location (UTM Zone 55)		Land Use	Distance to Site Boundary (m)
	X	Y		
R1	534315	6105838	Primary Production	72
R2	535307	6106229	Large Lot Residential	597
R3	535399	6106214	Large Lot Residential	597
R4	535450	6106233	Large Lot Residential	624
R5	535506	6106224	Large Lot Residential	624
R6	535570	6106219	Large Lot Residential	628
R7	535637	6106217	Large Lot Residential	636
R8	535874	6106160	Large Lot Residential	620
R9	536026	6106154	Large Lot Residential	672
R10	536405	6106169	Primary Production Small Lots	920
R11	536417	6106052	Primary Production Small Lots	860
R12	536374	6105788	Primary Production Small Lots	680
R13	536444	6105628	Primary Production Small Lots	735
R14	536370	6105469	Primary Production Small Lots	590
R15	536348	6105368	Primary Production Small Lots	576
R16	536381	6105213	Primary Production Small Lots	510
R17	536132	6104288	Primary Production	181
R18	535836	6103490	Primary Production	910
R19	535607	6103175	Primary Production	1256
R20	533400	6103883	Primary Production	1107



ID	Location (UTM Zone 55)		Land Use	Distance to Site Boundary (m)
	X	Y		
R21	534294	6106319	Primary Production	550
R22	534516	6106423	Large Lot Residential	662
R23	534549	6106492	Large Lot Residential	740
R24	534681	6106468	Large Lot Residential	736
R25	534736	6106470	Large Lot Residential	744
R26	534775	6106553	Large Lot Residential	834
R27	535344	6106356	Large Lot Residential	730
R28	535490	6106321	Large Lot Residential	720
R29	535502	6106410	Large Lot Residential	805
R30	535508	6106469	Large Lot Residential	866
R31	535508	6106535	Large Lot Residential	936
R32	535532	6106593	Large Lot Residential	990
R33	535535	6106650	Large Lot Residential	1050
R34	535555	6106319	Large Lot Residential	722
R35	535585	6106402	Large Lot Residential	811
R36	535564	6106451	Large Lot Residential	855
R37	535584	6106523	Large Lot Residential	932
R38	535717	6106442	Large Lot Residential	870
R39	535794	6106458	Large Lot Residential	900
R40	535885	6106460	Large Lot Residential	917
R41	535975	6106405	Large Lot Residential	885
R42	535901	6106314	Large Lot Residential	775
R43	535888	6106260	Large Lot Residential	723
R44	536084	6106447	Large Lot Residential	962
R45	536027	6106372	Large Lot Residential	870
R46	536020	6106294	Large Lot Residential	796
R47	536040	6106232	Large Lot Residential	746
R48	536710	6105579	Primary Production Small Lots	936
R49	536902	6105562	Primary Production Small Lots	1125
R50	536641	6105466	Primary Production Small Lots	862
R51	536581	6105461	Primary Production Small Lots	800
R52	536539	6105187	Primary Production Small Lots	610
R53	536539	6104894	Primary Production	490
R54	534411	6105688	Primary Production	- a)

a) R54 is a landowner associated with the proposed development and is located within the development boundary. As such it has been excluded from the assessment.

2.3 Terrain

Figure 2 illustrates the local topography, as obtained from NSW Six Maps.

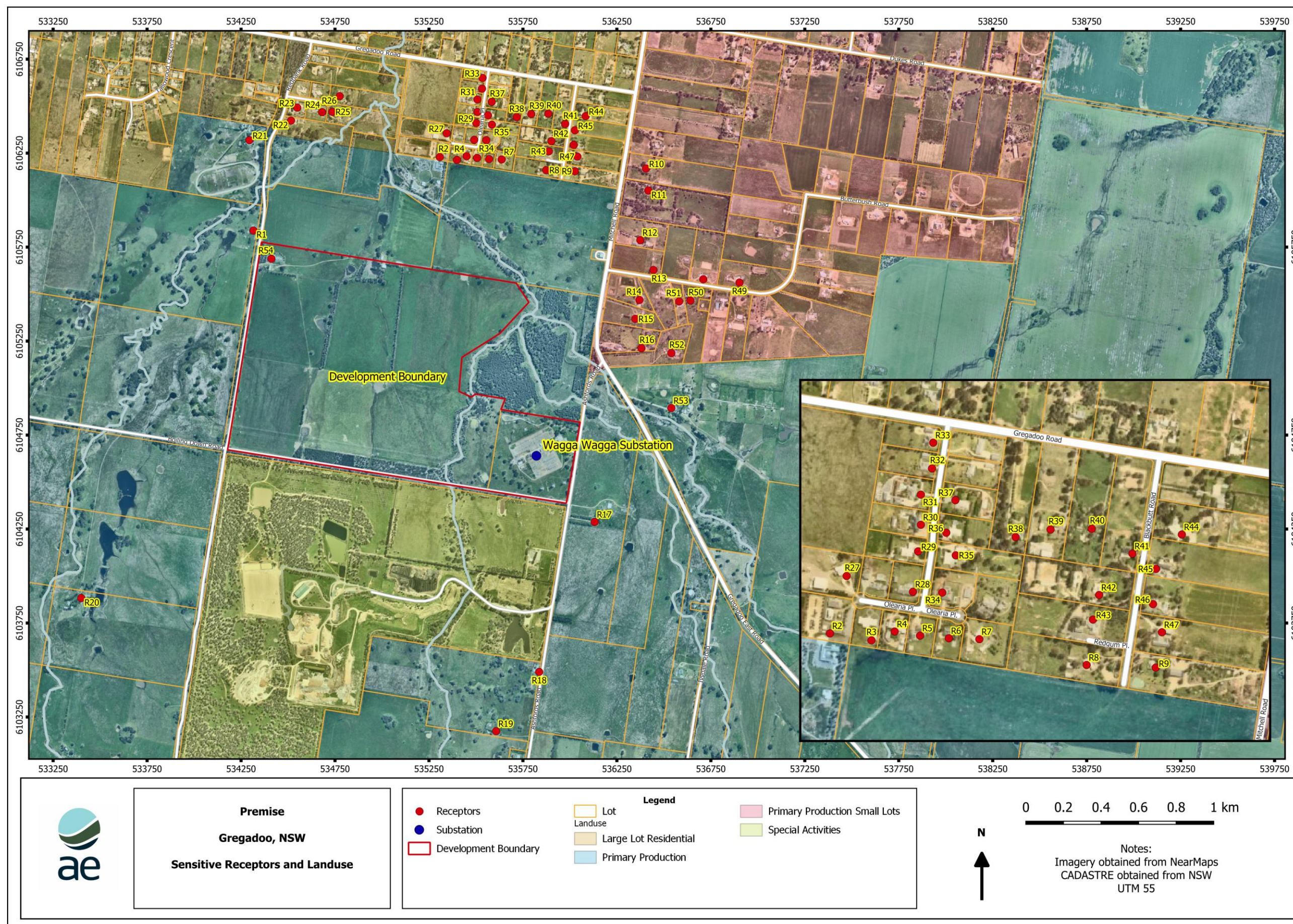


Figure 1: Site Location, Receptors and Surrounding Land Use

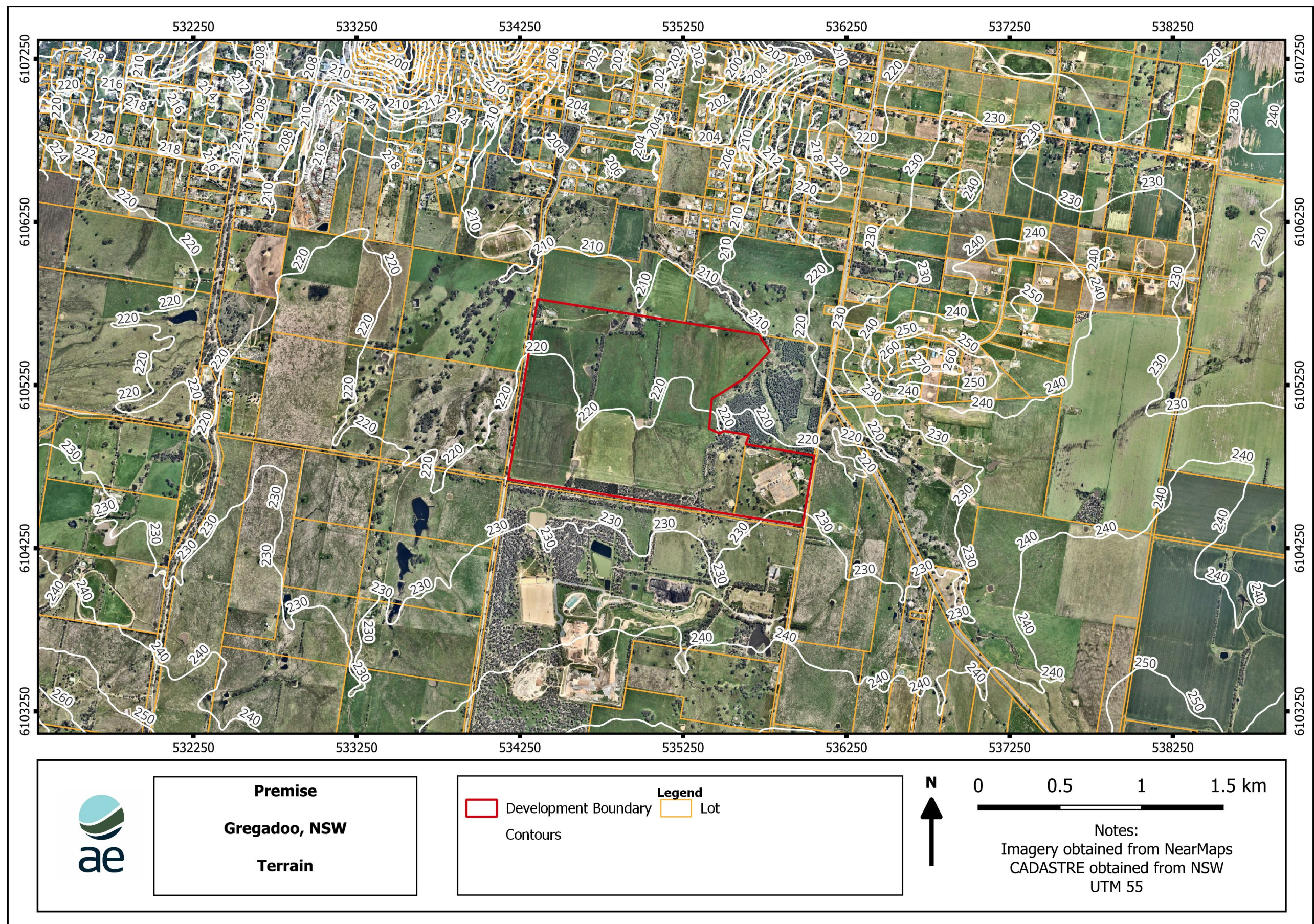
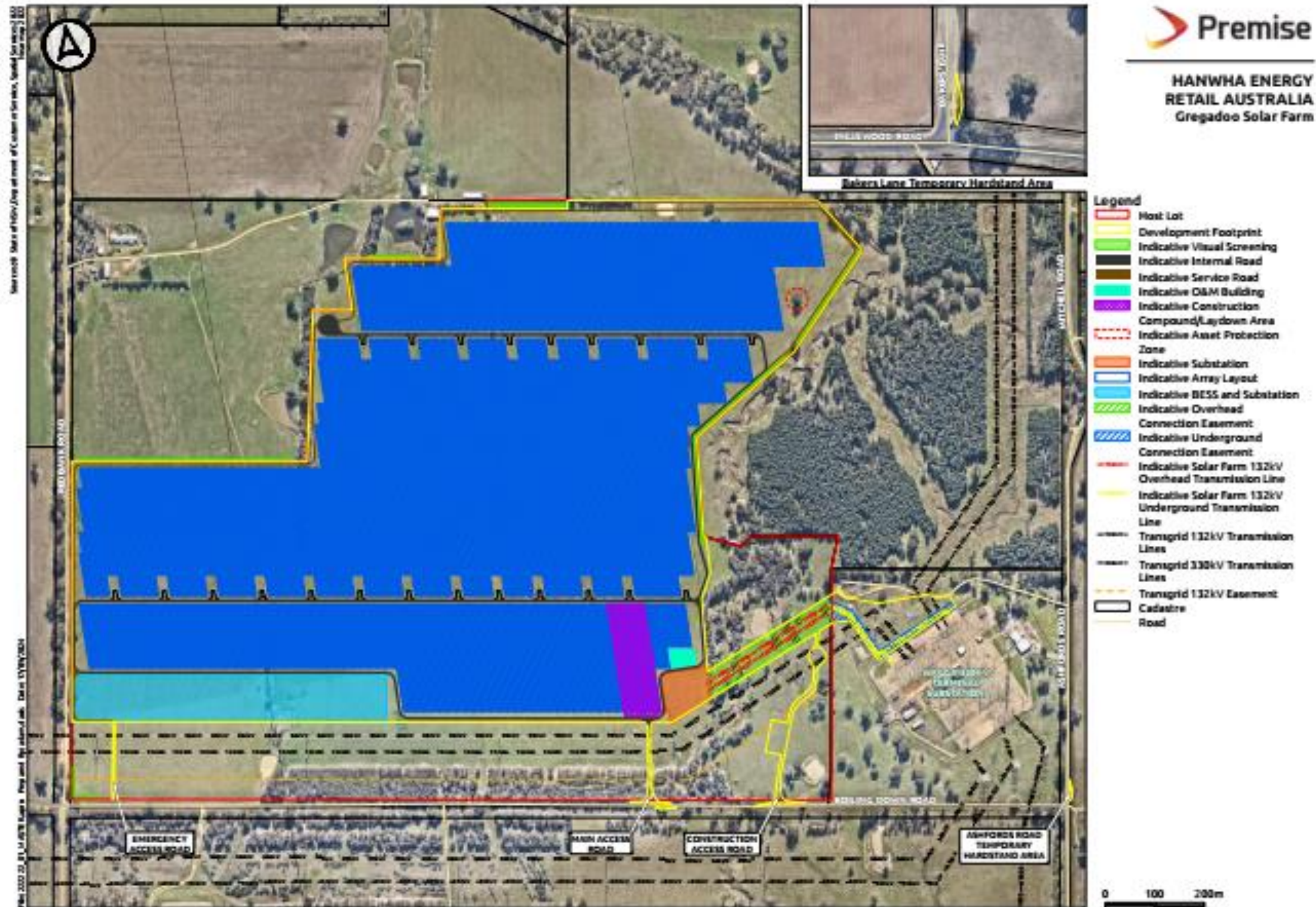


Figure 2: Terrain as obtained from NSW Clip and Ship (m AHD)



3 EXISTING ACOUSTIC ENVIRONMENT

3.1 Methodology

Noise measurements were undertaken in accordance with the requirements of Australian Standard AS 1055-2018 '*Acoustics – Description and measurement of environmental noise*' and the NPfI (EPA, 2017). The instrument was situated in a free-field position and a sampling time of 15-minutes was adopted for the monitoring. The microphone was positioned at a height of 1.5 metres above ground level and fitted with a windshield throughout the measurements.

3.2 Monitoring Locations

Baseline noise monitoring was conducted from 24 January to 6 February 2022 at two locations in Gregadoo, NSW. Figure 4 presents the noise monitoring locations.

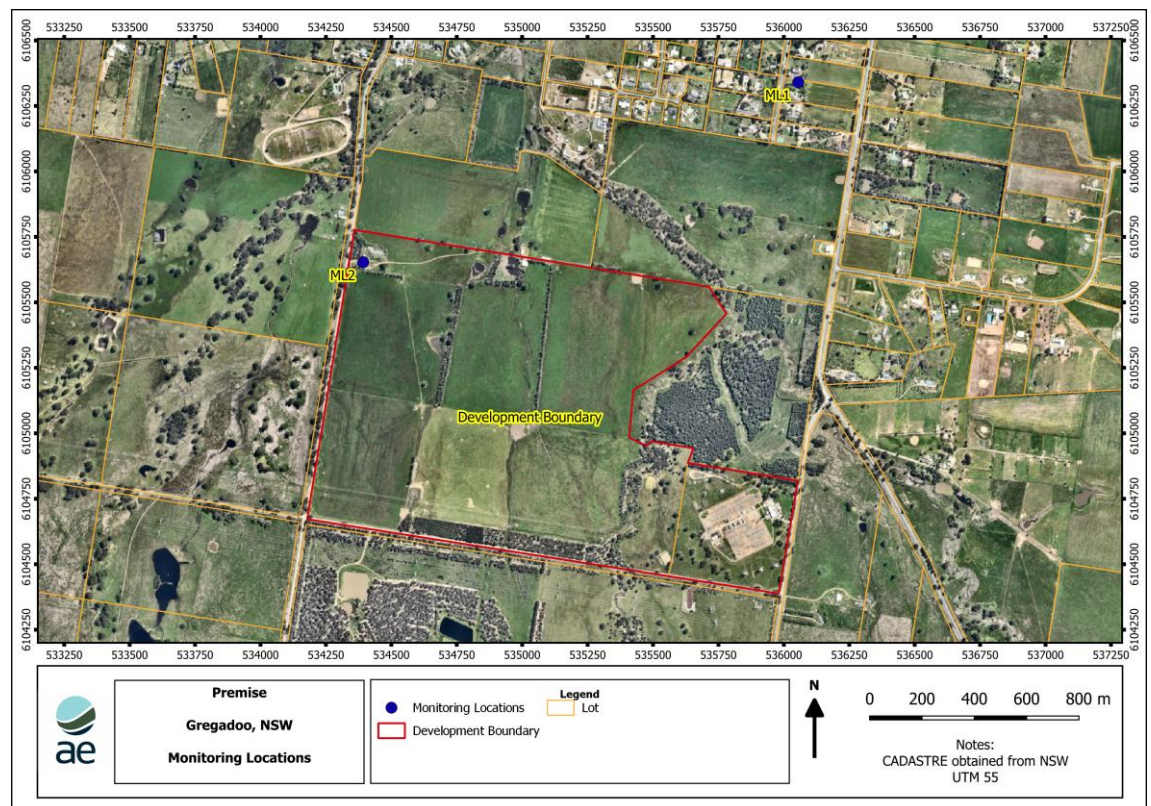


Figure 4: Noise Measurement Location

3.3 Weather Affected Bias

A weather station was co-located with the noise monitoring instrument at ML2 for the duration of the monitoring period. Wind and rainfall data indicates approximately 14 hours of noise data were potentially affected by winds above 5 m/s or rainfall. To avoid weather-related bias, noise measurements associated with wind or rain-affected periods have not been considered.

3.4 Equipment

The serial numbers and calibration information for the sound monitoring instrument used are presented in Appendix B.

3.5 Summary of Noise Measurement Data

A summary of the noise monitoring data by period are presented in Table 3. The time history of noise measurements is presented in Appendix B. A review of the 1/3 octave spectrum for each period identified an increase between 1.0 kHz and 5.0 kHz, which is mostly associated with frog and bird noise. This interpretation of the data was confirmed by onsite observations, which identified that bird noise was prevalent nearby. As monitoring was undertaken in a rural environment during summer, frog noise during the night-time period is also likely. The noise monitoring data has been adjusted to remove the influence of both frog and bird noise.

Table 3: Overall Noise Measurement Data

Period	L _{max}	L ₁	L ₁₀	L ₉₀	L _{eq}	RBL
ML1						
Day	90	56	47	36	47	33
Evening	86	55	46	33	48	29
Night	75	44	38	31	38	29
ML2						
Day	97	57	50	37	52	32
Evening	94	52	45	33	52	28
Night	93	42	38	30	39	26

The monitoring data shows that the Rating Background Level (RBL) for both locations is below the minimum level accepted by the NPfI. This is discussed further in Section 5.

3.6 Previous Noise Monitoring Data

Previous baseline noise monitoring was undertaken by NGH Environmental from 14 February to 28 February 2018 at two locations, 9 Blackbutt Road and 17 Butterbush Road. A summary of the noise monitoring taken from the NGH Environmental report *Environmental Impact Statement Gregadoo Solar Farm* is given in Figure 5.

Table 6-20 Rating background noise level measured and derived for the development site.

Location	Time of day	RBL L _{AF90} dB(A)
Blackbutt Rd	Day	33.5
	Evening	33.8
	Night	30.8
Butterbush Rd	Day	35.6
	Evening	34.7
	Night	30.8
Project RBL	Day	34.7
	Evening	34.3
	Night	30.8

Figure 5: NGH Environmental Background Noise Monitoring Results.

The derived intrusiveness criteria based on the average of the RBL values for each monitoring location is outlined in Figure 6.



Table 6-17 NSW Noise Policy for Industry intrusiveness goals.

Time of day	RBL dB(A) L_{A90}	Intrusive noise = RBL + allowance	NML dB(A) L_{A90} (15min)
Day	34.7	= RBL + 5	40
Evening	34.3	= RBL + 5	39
Night	30.8	= RBL + 5	36

Figure 6: NGH Environmental Derived Intrusiveness Criteria

A comparison of the resulting RBLs from the previous monitoring and that undertaken by AE in 2023 indicates the evening and night RBLs at the Blackbutt monitoring locations is lower for the background monitoring conducted in 2023.

Given monitoring in 2018 was also undertaken in February, frogs, insects and birds were most likely active. As there is no indication in the NGH Environmental report whether 1/3 octave review has been conducted to remove the influence of bird, insect or frog noises, it is assumed the higher evening and night-time RBL observed in the 2018 is a result of this.

The 2018 monitoring data is also now five years old, and the noise environment has likely changed in this time. As such, the previous monitoring undertaken in 2018 has not been considered further in determining the criteria for this assessment.



4 CONSTRUCTION NOISE ASSESSMENT

4.1 Duration of Construction Works

The construction of the Gregadoo Solar Farm is expected to take approximately 14 months, with a number of different activities undertaken in conjunction with each other over that time.

Construction would be restricted to what the EPA term '*recommended construction hours*' (as described in Table 4 below), which are between 7 am and 6 pm Monday to Friday and 8 am to 1 pm Saturday, with no works on Sundays or Public Holidays.

The assessment has therefore considered the potential for adverse amenity impacts associated with construction during recommended standard hours only.

4.2 Interim Construction Noise Guideline

Guidance on the assessment and management of construction noise in NSW is provided in the Interim Construction Noise Guideline 2009 (ICNG) published by the NSW EPA.

The main objectives of the Guideline are to:

- Promote a clear understanding of ways to identify and minimise noise from construction works;
- Focus on applying all 'feasible' and 'reasonable' work practices to minimise construction noise impacts;
- Encourage construction to be undertaken only during the recommended standard hours, unless approval is given for works that cannot be undertaken during these hours;
- Streamline the assessment and approval stages and reduce time spent dealing with complaints at the project implementation stage;
- Provide flexibility in selecting site-specific feasible and reasonable work practices in order to minimise noise impacts; and
- Provide guidelines for assessing noise generated during the construction phase of developments.

In achieving these objectives, the guideline provides a framework for the qualitative and quantitative assessment of potential construction noise impacts noting that, for major projects, a quantitative assessment is the preferred approach.

Table 4 presents construction noise criteria outlined in the guideline. Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. For this assessment, noise levels have been predicted at the residential property.



Table 4: NSW EPA Construction Noise Criteria – Residential Receivers

Time of Day	Management Level (Free-field)	How to Apply
Recommended standard hours: Monday to Friday, 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq}(15\text{ min})$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

Where nearby sensitive receptors are predicted to be noise affected, the proponent of the project is required to apply reasonable and feasible noise mitigation measures, noting that a noise mitigation measure is feasible if it is capable of being put into practice and is practical to build given the project constraints.

Selecting reasonable mitigation measures from those that are feasible involves making a judgement to determine whether the overall noise benefit outweighs the overall social, economic, and environmental effects.

For construction in standard operating hours, the assessment criteria have been determined based on the measured RBL (refer to Section 3). That is, for the purposes of the assessment the minimum level has been adopted in accordance with the NPfI. As such, the RBL is 35 dB(A) for daytime periods (standard operating hours) thereby resulting in a noise affected management level of 45 dB(A) and a highly noise affected management level of 75 dB(A).



4.3 Construction Noise Sources

It is noted that construction works are expected to progress across the site such that plant and equipment would only be in a single area for a short period of time. Given this, the potential for adverse impacts at any one receptor is expected to only occur for a short period of time.

Table 5 below presents a summary of the plant and equipment likely to be required to complete the on-site construction works. The sound power levels presented have been sourced from published noise emission datasets and the library of source noise levels maintained by Assured Environmental.

Table 5: Construction Noise Sources

Construction Phase	Plant Item	Number Required	Sound Power Level, dB(A)	Acoustical Usage Factor, % c)
Site preparation and construction of ancillary infrastructure a) including internal access tracks from Boiling down Road to the overhead transmission line between Gregadoo Solar farm Substation and TransGrid Substation	Truck & Dog b)	3	115	40
	Compactor	3	108	20
	Bulldozer	2	112	40
	Water Cart	1	103	40
	Vibratory Roller	3	108	20
Installation of solar PV modules & inverter assemblies and grid connection	Piling Rig d)	1	112 - 124	20
	Franna Crane	2	107	16
	Trencher	1	97	40
	Loader	2	107	40
	Generator	1	73	50
	Trucks	3	108	20

a) Construction plant used intermittently as required. Continuous use not expected.

b) Truck movements associated with deliveries assumed to move through site at 10 km per hour as a moving point source.

c) The 'Acoustical Usage Factor' represents the percentage of time that a particular item of equipment is assumed to be running at full power while working on site.

d) The piling sound power level used in the model is 107 dB(A) and includes a correction for tonality.

4.4 Assessment of Impacts

For the purposes of predicting impacts associated with noise emissions from the development site on nearby sensitive receptors, calculations of the noise impacts from construction activities have been undertaken using first principal calculations based on the distance separation of the receptor and the development site (Figure 1).

Construction activities across the site will vary in location and duration; mobile plant will move around the development site throughout the construction phase.

Table 6 below presents predicted most affected receptor noise levels taking into consideration the following assumptions:



- All equipment and plant are located in the same area – at the closest point to the Project Area boundary to the receptors. This is considered to be a hypothetical worst-case scenario and unlikely to occur; and
- The number of construction equipment and plant at this stage of development are estimates.
- Propagation is assumed to occur over hard ground and no screening objects between the source and the receiver

Table 4 outlines the derived construction noise criteria for residential receptors. The results presented in Table 6 show the following:

- The closest sensitive receptors exceed the noise affect criteria of 45 dB(A) during the first stage of construction; however none meet or exceed the highly noise affected criteria during this stage of construction.
- All receptors exceed the noise affected criteria of 45 dB(A) during the second stage of construction; and
- R1 exceeds the highly noise affected criteria of 75 dB(A) during the second stage of construction.

It is recommended that reasonable and feasible mitigation measures such as those presented in Section 4.5 are implemented to reduce the noise impact at all receptors.

Table 6: Construction Noise Results

ID	Distance from Site	Standard Hours Criteria		Site preparation and construction ancillary infrastructure	Installation of solar PV modules & inverter assemblies and grid connection
		Noise Affected	Highly Noise Affected		
R1	72	45	75	73	80
R2	597	45	75	55	62
R3	597	45	75	55	62
R4	624	45	75	54	61
R5	624	45	75	54	61
R6	628	45	75	54	61
R7	636	45	75	54	61
R8	620	45	75	54	61
R9	672	45	75	54	61
R10	920	45	75	51	58
R11	860	45	75	52	59
R12	680	45	75	54	61
R13	735	45	75	53	60
R14	590	45	75	55	62
R15	576	45	75	55	62
R16	510	45	75	56	63
R17	181	45	75	65	72



ID	Distance from Site	Standard Hours Criteria		Site preparation and construction ancillary infrastructure	Installation of solar PV modules & inverter assemblies and grid connection
		Noise Affected	Highly Noise Affected		
R18	910	45	75	51	58
R19	1256	45	75	48	55
R20	1107	45	75	49	56
R21	550	45	75	56	62
R22	662	45	75	54	61
R23	740	45	75	53	60
R24	736	45	75	53	60
R25	744	45	75	53	60
R26	834	45	75	52	59
R27	730	45	75	53	60
R28	720	45	75	53	60
R29	805	45	75	52	59
R30	866	45	75	52	59
R31	936	45	75	51	58
R32	990	45	75	50	57
R33	1050	45	75	50	57
R34	722	45	75	53	60
R35	811	45	75	52	59
R36	855	45	75	52	59
R37	932	45	75	51	58
R38	870	45	75	52	58
R39	900	45	75	51	58
R40	917	45	75	51	58
R41	885	45	75	51	58
R42	775	45	75	53	59
R43	723	45	75	53	60
R44	962	45	75	51	58
R45	870	45	75	52	58
R46	796	45	75	52	59
R47	746	45	75	53	60
R48	936	45	75	51	58
R49	1125	45	75	49	56
R50	862	45	75	52	59
R51	800	45	75	52	59
R52	610	45	75	55	62
R53	490	45	75	57	63



4.5 Mitigation of Construction Noise Levels

Potential controls available to the construction contractor to minimise potential impacts for construction works could include:

- Limiting the type and scale of concurrent activities undertaken close to sensitive receptors where possible;
- Using broad band reversing alarms on all mobile plant and equipment;
- Examine different types of machines that perform the same function and compare the noise level data to select the least noisy machine;
- Operating plant in a quiet and efficient manner;
- Reduce throttle setting and turn off equipment when not being used; and
- Regularly inspect and maintain equipment to ensure it is in good working order including checking the condition of mufflers.
- Conduct community consultation and discuss the timing of works and potential respite periods.

It is noted that noise level estimates were calculated using worst case scenario with no ground absorption and minimum distances between plant equipment and Sensitive Receptors. In practice, construction activities will take place at variable distances, as such the construction assessment is conservative and actual construction noise levels would be lower than those predicted.

The highest predicted noise level is at R1, located to the west of the development site and exceeds the highly affected noise criteria of 75 dB(A). As such, it is recommended that a temporary noise barrier is installed to minimise noise impacts experienced at this receptor. This barrier should be installed as needed to mitigate noise as the construction moves closer to the nearest sensitive receptors. Alternatively, the affected resident could be engaged through consultation to identify alternate means of reducing their noise exposure, such as timing works during particular hours of the day, introducing respite periods, or offering alternate accommodation during the period where works will occur in proximity to the residence.

It is recommended that during any work generating high noise levels that have impulsive, intermittent, low frequency, or tonal characteristics, consult with sensitive receptors regularly. Analysis of the individual noise sources has identified that the highest contributor to noise at R1 are the piling rigs. During works, following best practice mitigation detailed above and staff training regarding excessive noise from machinery use is recommended.



4.6 Previous Construction Noise Results

The results of the previous construction noise assessment performed by NGH Environmental is outlined in Figure 7 and Figure 8 below for each assessed scenario.

Table 6-24 Predicted noise levels at selected receiver, road and compound construction.

Receiver	Distance (m) from project boundary	Road and compound works calculated noise level dB(A)	Daytime NML dB(A) (RBL + 5dBA)
1	540	54	46 dBA
2	640	53	46 dBA
7	660	53	46 dBA
15	660	53	46 dBA
17	650	53	46 dBA
18	1260	48	46 dBA

Figure 7: NGH Environmental Construction Noise Results

Table 6-25 Predicted noise levels at selected receiver, panel framing and cabling.

Receiver	Distance (m) from project boundary	Panel framing and cabling calculated noise level dB(A)	Daytime NML dB(A) RBL +5 dB(A)
1	540	54	46 dBA
2	640	54	46 dBA
7	660	54	46 dBA
15	660	54	46 dBA
17	650	54	46 dBA
18	1260	48	46 dBA

Figure 8: NGH Environmental Construction Noise Results

It is noted that results of NGH Environmental construction assessment are lower than those performed by AE. Comparison of the NGH Environmental construction noise results and AE construction noise results identified the following key differences:

- NGH distance is measured from the receptor to the development footprint rather than the site boundary. AE has measured from the receptor to the development site boundary, as it is unknown how plant will move around site at this stage of development. As such this is a conservative assumption.
- The number of noise sources has not been reported in the NGH report, thus it's assumed that one of each noise source has been modelled. In Table 5, AE has modelled multiple noise sources, contributing to an overall higher noise level at receivers.
- Differences in sound power level exist between reports as can be seen when comparing Table 5 and Figure 9.



Table 6-23 Construction equipment sound power levels.

Scenario 1		Scenario 2	
Road work / compound construction equipment	Sound power level (dB)	Panel framing and cabling equipment	Sound power level (dB)
Water Cart	107	Delivery Truck	108
Front End Loader	113	Fixed Crane	113
Light vehicles (e.g. 4WD)	103	Pile drilling rig	111
Grader	110	Backhoe	111
Vibratory Roller	109	Power Generator	103
Delivery Truck	108	Concrete Truck	109

Figure 9: NGH Environmental Construction Equipment Sound Power Levels

Overall, AE's assessment of construction noise impacts is considered more conservative and include additional construction required for internal access roads not previously considered.

5 OPERATIONAL NOISE ASSESSMENT

5.1 Operational Assessment Criteria

The acoustic assessment has been completed in accordance with the procedure identified in the NPfI. The NPfI recognises that scientific literature has identified that both the increase in noise level above background levels (that is, intrusiveness of a source), as well as the absolute level of noise are important factors in how a community will respond to noise from industrial sources.

In response to this, the NPfI establishes two separate noise criteria to meet environmental noise objectives: one to account for intrusive noise and the other to protect the amenity of particular land uses. These two criteria are then used to determine project triggers levels against which the proposed development will be assessed. The project noise trigger level is a level that, if exceeded, would indicate a potential noise impact on the community, and so 'trigger' a management response.

The derivation of the two sets of criteria are presented below. For residential dwellings, the noise criteria are assessed at the most-affected point (i.e., highest noise level) on or within the property boundary. Where the property boundary is more than 30 metres from the house, then the criteria apply at the most-affected point within 30 m of the house.

5.1.1 Intrusiveness Noise Criteria

The project intrusiveness noise level is intended to protect against significant changes in noise levels as a result of industrial development. To achieve this, the NPfI describes intrusive noise as noise that exceeds background noise levels (as defined by the Rating Background Level or RBL) by more than 5 dB.

Table 7 presents the derivation of the intrusiveness criteria based on the noise monitoring undertaken at the development site. The noise monitoring identified that during all period, the RBL is below the minimum level accepted by the NPfI at both monitoring locations. Therefore, this minimum level has been applied.

Table 7: Derived Intrusiveness Noise Criteria

Type of Receiver	Intrusiveness $L_{Aeq,15\text{-minute}}$ Criteria		
	Day	Evening	Night
Measured Data at ML1 ^{a)}	$33 + 5 = 38$	$29 + 5 = 34$	$29 + 5 = 34$
Measured Data at ML2 ^{a)}	$32 + 5 = 37$	$28 + 5 = 33$	$26 + 5 = 31$
Measured Data Blackbutt Road (2018) ^{c)}	$33.5 + 5 = 39$	$33.8 + 5 = 39$	$30.8 + 5 = 36$
Measured Data Butterbush Road (2018) ^{c)}	$35.6 + 5 = 41$	$34.7 + 5 = 40$	$30.8 + 5 = 36$
Minimum Level ^{b)}	40	35	35

^{a)} Measured background noise level established by the NPfI 2017 + 5 dB.
^{b)} Receptor noise criteria applied at a location 30 m from the dwelling façade.
^{c)} Refer to Section 3.6 for discussion

5.1.2 Amenity Criteria

The project amenity noise level seeks to protect against cumulative noise impacts from industry and maintain amenity for particular land uses. Review of the surrounding area has identified that there are other industrial noise sources in the area, and that future industrial

development in the area is likely. As such, 5 dB has been subtracted from the project amenity noise levels to the indicative noise amenity area total industrial noise levels as presented in Table 8.

Table 8: NPfl Amenity Noise Levels

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended (dB(A))		L _{Aeq} Noise Level
			Total Noise	Industrial	
Residence	Rural	Day	50		45
		Evening	45		40
		Night	40		35

5.1.3 Project Noise Trigger Levels

The Project Noise Trigger Level (i.e., the noise criteria considered by the assessment) is the lower value of the project intrusiveness noise level and the project amenity level, after the conversion to L_{Aeq, 15 min} dB(A) equivalent level. Table 9 presents the standardised intrusiveness noise level and the project amenity level as derived by adding 3 dB(A) to each period of the day.

Table 9: Determining Project Trigger Level

Type of Receiver	Time of Day	Standardised L _{Aeq, 15 min} Noise Level (dB)		
		Intrusiveness Noise Level	Amenity Noise Level	Project Noise Trigger Levels
Residence	Day	40	45 + 3 = 48	40
	Evening	35	40 + 3 = 43	35
	Night	35	35 + 3 = 38	35

5.1.4 Sleep Disturbance

NSW EPA have identified a screening assessment for sleep disturbance based on the night-time noise levels at a residential location. Where noise levels at a residential location exceed:

- L_{Aeq, 15 min} 40 dB(A) or the prevailing RBL plus 5 dB, whichever is greater; and/or
- L_{AFmax} 52 dB(A) or the prevailing RBL plus 15 dB whichever is the greater, a detailed maximum noise level event assessment should be undertaken.

As discussed in Section 5.5 the predicted noise levels at residential locations do not exceed 40 dB(A) L_{Aeq, 15 min}, therefore a detailed sleep disturbance assessment is not required. Further, given the noise sources associated with the operation of a solar farm are all continuous (inverters) or semi-continuous (tracking motors) during daylight hours, short-term instantaneous noise events are unlikely. As such, consideration of compliance against the L_{AFmax} sleep disturbance criteria is unwarranted.



5.2 Noise Modelling Methodology

For the purposes of predicting impacts associated with noise emissions from the development site on nearby sensitive receptors, noise modelling of the sources was completed using the proprietary software CadnaA (2024 MR2 build 203.5403) developed by DataKustik. CadnaA incorporates the influence of meteorology, terrain, ground type and air absorption in addition to source characteristics to predict noise impacts at receptor locations. All predictions have been undertaken in accordance with CONCAWE.

The model is utilised to assess the potential noise emissions from the development site under a range of operating scenarios and meteorological conditions. The noise modelling also allows investigation of possible noise management solutions, in the event that non-compliance with the assessment criterion is predicted.

The NPfI presents guidelines for the consideration of meteorological effects on noise propagation, specifically, temperature inversions and/or gradient winds. NPfI provides two options for assessing meteorological effects as detailed in Table 10.

Table 10: Standard and Noise Enhancing Meteorological Conditions

Meteorological Conditions	Meteorological Parameters
Standard conditions	Day/Evening/Night: stability categories A-D with wind speed up to 0.5 m/s at 10 m AGL ^b .
Noise enhancing conditions	Day/Evening: stability categories A-D with light winds (up to 3 m/s at 10 m AGL). Night: stability categories A-D with light winds (up to 3 m/s at 10 m AGL). And/or stability category F with light winds (up to 2 m/s at 10 m AGL).
<i>a) Pasquill-Gifford Atmospheric Stability Class</i>	
<i>b) AGL: Above ground level</i>	

The following conditions have been modelled:

- Day Periods – Stability class D at 3 m/s;
- Evening Periods – Stability class D at 3 m/s; and
- Night period - Stability class F at 2 m/s.

5.3 Model Configuration

Table 11 summarises the model configuration used for the modelling.

Table 11: Model Configuration

Parameter	Approach
Standards	CONCAWE
Time Periods	Day (07:00 – 18:00 hours) Evening (18:00 – 22:00 hours) Night (22:00 – 07:00 hours)
Digital Terrain	Lidar at 1 m resolution. Triangulation calculation applied.
Ground Absorption	Default absorption for soft surface. Aerial mapping used to include hard ground.



5.4 Noise Sources

Table 12 provides a summary of the noise sources adopted for this assessment and the operational details of each source. Where annoying noise characteristics have been identified the adjustment has been included in the L_{Aeq} column.

The solar tracker to be used for the development is still undecided between NEXTracker and ATI. As such, the solar tracker with the highest sound power level of these options has been used for the assessment in order to assess the worst case.

When considering the sound power levels, the following is noted:

- The sound power level for the inverters was obtained from the manufacturer's datasheet for SMA SCS3950UP-XT,
- Internal Transformers within SMA inverters noise generation was captured within the SMA SCS3950UP-XT noise data.
- Worst Case noise generation was used in selection of sound power levels associated with SMA SCS3950UP-XT
- The sound power level for the solar trackers were taken from "Array Technologies Inc. Noise Emission Review".
- Sound power levels for the BESS unit was taken from manufacturers datasheet "0.5P – 0.67P Solbank Noise Level Testing sheet" – CSI Energy Storage Technologies Co, Ltd.
- Transformer (auxiliary transformers and large-scale connection asset) sound power level calculated from Standard 60076/IEC-2001.

Solar farm inverters modelled as conservative point sources in line with previous iterations of assessment. ^(a)

1/3 Octave spectral data for transformers were taken from the Australian Acoustical Society. ^(b)

- Equipment locations are in line with CAD drawings provided by Premise through email communication dated 27.03.2024.
- Tonality corrections were applied in line with methodology outlined within the NPfl assessing tonality at the receptor.

a) Gregadoo Mod 3 – Noise Impact Assessment RI: Prepared by Assured Environmental, February 2023 - #REF 14754

b) Paper Number 23, Proceedings of ACOUSTICS 2011: Low-frequency and Tonal Characteristics of Transformer Noise: Prepared by Michael Gange November 2011



Table 12: Sound Power Levels

Activity	Noise Source	Qty	Height (m)	Usage Period (%)			Sound Power Level (dB(A))		Noise Characteristics (as per the NPfI)
				Day	Evening	Night	L _{Aeq}	L _{Amax}	
Solar Farm	Solar Tracker	1466	1.4	100	0	0	78	-	-
Solar Farm	Light Vehicle	-	1.5	1/h	1/hr	1/h	88	-	-
Solar Farm	Inverter ^(a)	22	2.8	100	100	100	90		+5 dB adjustment for tonality
MVPS (Medium Voltage Power Station) Model (SCS3950UP-XT with Silencer Kit) SMA Solar Technology	MVPS Inverter Top Side	78	2.90	100	100	100	60	-	-
	MVPS Inverter Front Side	78	2.90	100	100	100	80	-	-
	MVPS Inverter Back Side	78	2.90	100	100	100	74	-	-
	MVPS Inverter AC inlet Side	78	2.90	100	100	100	72	-	-
	MVPS Inverter AC outlet Side	78	2.90	100	100	100	76	-	-
BEES (Battery Energy Storage System) (Model 0.5-0.67P_SolBank) CSI Energy Storage Technologies	BEES Front side	228	2.90	100	100	100	80	-	-
	BEES Back side	228	2.90	100	100	100	67.2	-	-
	BEES Left side	228	2.90	100	100	100	67	-	-
	BEES Right side	228	2.90	100	100	100	68	-	-
250 MVA Transformer	250 MVA Transformer	1	2.50	100	100	100	99.6	-	-
Auxiliary Transformers	33kV/0.415kV Auxiliary Transformer	12	1.50	100	100	100	76	-	-

a) Inverter SWL as described in previous iteration of Gregadoo solar farm noise impact assessment - "GREGADOO MOD 3 – NOISE IMPACT ASSESMENT #REF 14754 R1"



5.5 Predicted Operational Noise Levels

Table 13 below presents predicted receptor noise levels for the Gregadoo Solar Farm during the operational phase of the proposed development site. Review of the predicted noise levels confirms that compliance with the intrusive noise criteria established in accordance with the NPfI can be achieved for all receptors for all periods under worst-case meteorological conditions.

Table 13: Predicted Receptor Noise Levels

Receptor	Predicted Noise Levels (dB(A))				Criteria (D / E / N)	Comply (Y/N)
	Day 15min)	(L _{Aeq} , Evening 15min)	(L _{Aeq} , Night 15min)	(L _{Aeq} ,		
R1	31	29	29		(40 / 35 / 35)	(Y / Y / Y)
R2	32	30	30		(40 / 35 / 35)	(Y / Y / Y)
R3	32	30	30		(40 / 35 / 35)	(Y / Y / Y)
R4	32	30	30		(40 / 35 / 35)	(Y / Y / Y)
R5	32	31	31		(40 / 35 / 35)	(Y / Y / Y)
R6	32	31	31		(40 / 35 / 35)	(Y / Y / Y)
R7	32	30	30		(40 / 35 / 35)	(Y / Y / Y)
R8	32	30	30		(40 / 35 / 35)	(Y / Y / Y)
R9	30	28	28		(40 / 35 / 35)	(Y / Y / Y)
R10	27	25	25		(40 / 35 / 35)	(Y / Y / Y)
R11	28	26	26		(40 / 35 / 35)	(Y / Y / Y)
R12	27	26	26		(40 / 35 / 35)	(Y / Y / Y)
R13	28	27	27		(40 / 35 / 35)	(Y / Y / Y)
R14	31	30	30		(40 / 35 / 35)	(Y / Y / Y)
R15	32	30	30		(40 / 35 / 35)	(Y / Y / Y)
R16	31	30	30		(40 / 35 / 35)	(Y / Y / Y)
R17	26	24	24		(40 / 35 / 35)	(Y / Y / Y)
R18	21	20	20		(40 / 35 / 35)	(Y / Y / Y)
R19	23	22	22		(40 / 35 / 35)	(Y / Y / Y)
R20	21	21	21		(40 / 35 / 35)	(Y / Y / Y)
R54	34	32	32		(40 / 35 / 35)	(Y / Y / Y)
R21	27	26	26		(40 / 35 / 35)	(Y / Y / Y)
R22	29	27	27		(40 / 35 / 35)	(Y / Y / Y)
R23	28	27	27		(40 / 35 / 35)	(Y / Y / Y)
R24	29	27	27		(40 / 35 / 35)	(Y / Y / Y)
R25	29	27	27		(40 / 35 / 35)	(Y / Y / Y)
R26	28	27	27		(40 / 35 / 35)	(Y / Y / Y)
R27	30	29	29		(40 / 35 / 35)	(Y / Y / Y)
R28	31	30	30		(40 / 35 / 35)	(Y / Y / Y)
R29	27	26	26		(40 / 35 / 35)	(Y / Y / Y)
R30	26	24	24		(40 / 35 / 35)	(Y / Y / Y)



Receptor	Predicted Noise Levels (dB(A))			Criteria (D / E / N)	Comply (Y/N)
	Day 15min)	(L _{Aeq} , Evening 15min)	(L _{Aeq} , Night 15min)		
R31	25	24	24	(40 / 35 / 35)	(Y / Y / Y)
R32	27	26	26	(40 / 35 / 35)	(Y / Y / Y)
R33	26	24	24	(40 / 35 / 35)	(Y / Y / Y)
R34	30	29	29	(40 / 35 / 35)	(Y / Y / Y)
R35	27	25	25	(40 / 35 / 35)	(Y / Y / Y)
R36	26	24	24	(40 / 35 / 35)	(Y / Y / Y)
R37	25	23	23	(40 / 35 / 35)	(Y / Y / Y)
R38	29	28	28	(40 / 35 / 35)	(Y / Y / Y)
R39	29	27	27	(40 / 35 / 35)	(Y / Y / Y)
R40	26	25	25	(40 / 35 / 35)	(Y / Y / Y)
R41	26	24	24	(40 / 35 / 35)	(Y / Y / Y)
R42	30	29	29	(40 / 35 / 35)	(Y / Y / Y)
R43	31	29	29	(40 / 35 / 35)	(Y / Y / Y)
R44	23	21	21	(40 / 35 / 35)	(Y / Y / Y)
R45	26	24	24	(40 / 35 / 35)	(Y / Y / Y)
R46	27	26	26	(40 / 35 / 35)	(Y / Y / Y)
R47	28	26	26	(40 / 35 / 35)	(Y / Y / Y)
R48	21	19	19	(40 / 35 / 35)	(Y / Y / Y)
R49	11	9	9	(40 / 35 / 35)	(Y / Y / Y)
R50	22	20	20	(40 / 35 / 35)	(Y / Y / Y)
R51	25	24	24	(40 / 35 / 35)	(Y / Y / Y)
R52	28	27	27	(40 / 35 / 35)	(Y / Y / Y)
R53	28	27	27	(40 / 35 / 35)	(Y / Y / Y)

The calculated noise levels show full compliance during all evaluation periods. On this basis, it is not considered necessary to implement any mitigation as full compliance is achieved at all receptors.

The findings of this assessment rely on the equipment sound power levels presented in Table 12.

Alternative equipment selections may be considered where the sound power levels are the same or lower than those used in this assessment.

Detailed noise contours can be found in Appendix C.



6 ROAD TRAFFIC NOISE ASSESSMENT

6.1 Introduction

Noise impacts associated with vehicle movements during the operational phase of the development site are expected to be negligible as no staff will be permanently based on-site. Visitation will be limited to periodic maintenance and infrequent plant and equipment replacements. During construction and any future decommissioning of the farm however, traffic movements will be more significant.

Construction is expected to be completed over a 12-month period with peak construction period expected to take 6 months. This assessment will consider the peak construction volumes in assessment. It's anticipated that during peak construction there will be 174 light vehicle movements and 120 heavy vehicle movements during peak construction, as outlined in the Traffic Impact Assessment undertaken by Amber Organisation.

During peak construction period the hourly traffic generation for the Solar Farm and BESS will be a total of 87 Light Vehicle movements and 6 Heavy Vehicle movements (A total of 93 vehicle movements).

The client has confirmed that heavy vehicle movements will be scheduled throughout the day, resulting in a steady distribution of construction traffic to/from the site and minimising simultaneous heavy vehicle movements and queuing. Platooning and short stacking will be avoided by allowing 10 minutes between heavy vehicles entering and leaving the site to avoid queuing on the road at the site access point and along site access roads. As such there will be no more than 6 heavy vehicles associated with site activities travelling along the access route during any given hour.

Peak vehicle volumes are expected to be affecting the site for a relatively short period while equipment is delivered to the BESS and Solar Farm. As such road traffic noise generated from the Subject Site will be lower than the predicted values for the majority of the construction period.

It is expected that all light vehicles accessing the site would from the north via Mitchell Road, Ashford Road and Boiling Downs Road. The Heavy vehicles and heavy vehicles require escort similarly will travel down Mitchel Road, Ashfords road and Boiling Down Road.

The traffic impact assessment provides existing and future traffic volumes for Mitchell Road and Ashford roads only, as such these are the only roads than can be evaluated for the road traffic assessment.

All movements are expected to occur during standard construction hours (7 am to 6 pm Monday to Friday and 8 am to 1 pm Saturday) allowing 1 hour from 6 am to 7 am to arrive at site. A summary of road traffic data presented in Table 14.



Table 14: Road Traffic Data

Road Segment	Vehicle Type	Vehicle Speed ^{a)}	Number of Movements ^(b)	
			Day (Peak 1-hour)	Night (Peak 1-hour)
Ashfords Road (Existing Traffic)	Light	85 km/hr	10	16
	Heavy		7	3
Ashfords Road (Future Traffic)	Light	85 km/hr	105	97
	Heavy		10	6
(Mitchell Road)	Light	85 km/hr	64	29
	Heavy		28	13
(Mitchell Road) (Future Traffic)	Light	85 km/hr	166	139
	Heavy		34	19

a) Assumed conservative speed based on Amber Traffic impact assessment table 1.^c
b) Vehicle volumes correspond to tables 4,5,6 in Amber Traffic impact assessment

6.2 Assessment Criteria

The ICNG does not provide criteria for the assessment of construction road traffic during the project. Given this, reference is made to the noise criteria provided in the NSW Road Noise Policy (RNP). Based on the type of roadway, Table 15 below presents the applicable road traffic noise criteria for existing residences affected by traffic on existing roadways generated by land use developments.

Table 15: Applicable Road Traffic Noise Criteria

Road Category	Type of Project & Land Use	Assessment Criteria
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	Day: $L_{Aeq,1 \text{ hour}}$ 55 dB(A) (external) Night: $L_{Aeq,1 \text{ hour}}$ 50 dB(A) (external)
Freeway/ arterial/ sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	Day: $L_{Aeq,1 \text{ hour}}$ 60 dB(A) (external) Night: $L_{Aeq,1 \text{ hour}}$ 55 dB(A) (external)

6.3 Noise Modelling Methodology

For the purposes of predicting impacts associated with road traffic noise emissions was completed using the proprietary software CadnaA (2024 MR2 build 203.5403) developed by DataKustik. The model incorporates the influence of terrain, ground type and air absorption in addition to source characteristics to predict noise impacts at receptor locations. All predictions have been undertaken in accordance with Calculation of Road Traffic Noise (CRTN) methodology developed by the UK Department of Transport. In accordance with the

^c Gregadoo Solar Farm and BESS, Traffic Impact Assessment; Amber; 25 June 2024



requirements of the RNP, the predictive noise modelling incorporated the following assumptions:

- L_{Aeq} values were calculated from the L_{A10} values predicted by the CRTN methodology using the approximation $L_{Aeq,1 \text{ hour}} = L_{A10,1 \text{ hour}} - 3$.
- Noise source heights were set at 0.5 m above road level for cars, 1.5 m for heavy vehicle engines and 3.6 m for heavily vehicle exhausts.
- Noise from heavy vehicle exhausts is 8 dB lower than the steady continuous engine noise; and
- Corrections established for Australian conditions applied through a negative correction to the CRTN predictions of -1.7 dB for façade-corrected levels (Samuels and Saunders, 1982).

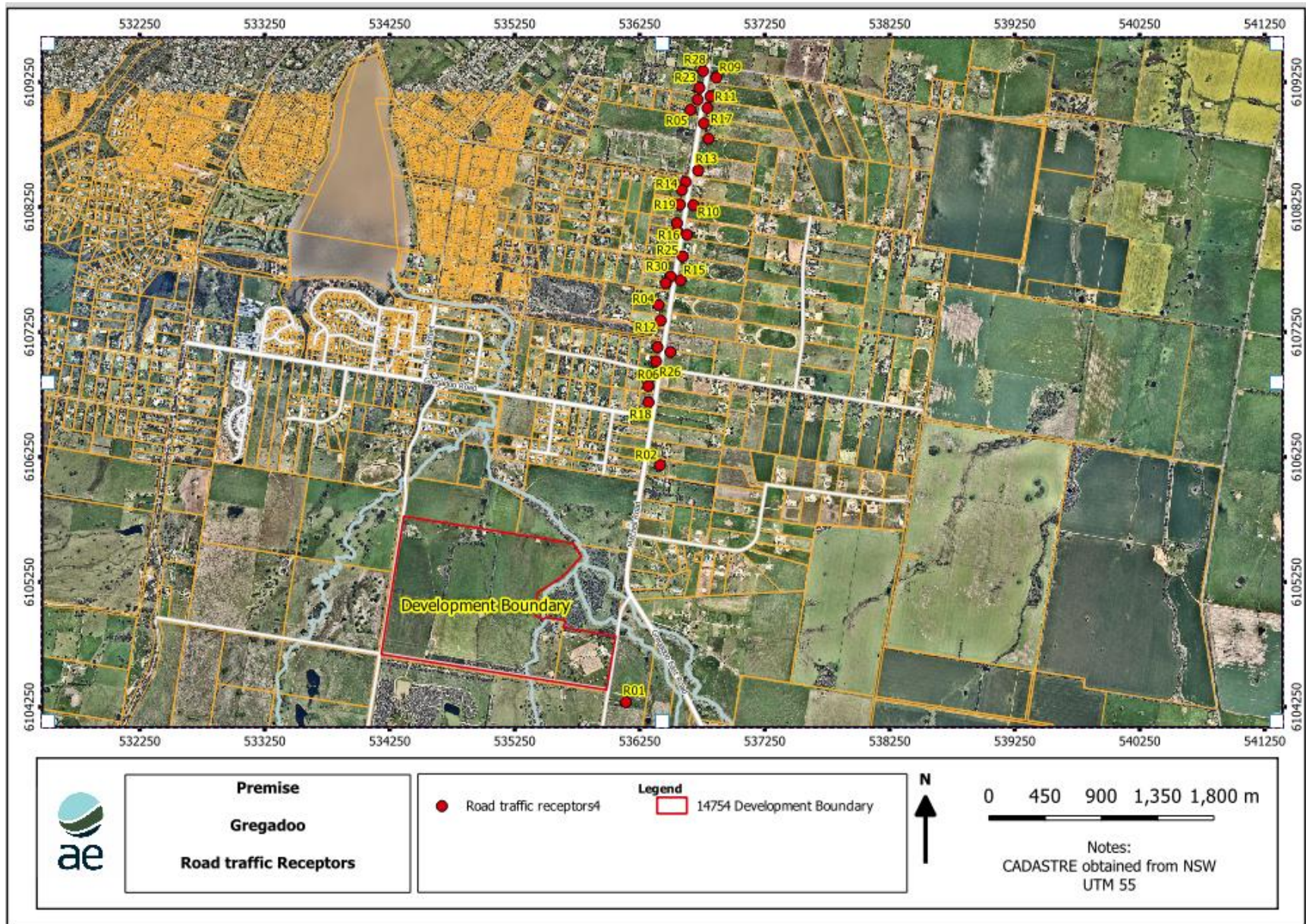


Figure 10: Road Traffic Receptors

Table 16: Predicted $L_{Aeq,1\text{-hour}}$ Noise Levels - Road Traffic Noise

Sensitive Receptor	Setback from Roadway	Period	Parameter	Criteria (dB(A))	Existing Traffic Noise Level (dB(A))	Predicted Noise (dB(A))	Future Level	Relative Difference Between and Road Noise (dB(A))	Future Existing Traffic Levels	Comply (Y/N)
R01 - Ashfords Road	150 m	Day	$L_{Aeq,1\text{ hour}}$	55	46.5	49.1		2.6		Y
		Night	$L_{Aeq,1\text{ hour}}$	50	43.1	47.5		4.4		Y
R02 - Mitchell Road	125 m	Day	$L_{Aeq,1\text{ hour}}$	55	54.2	55.8		1.6		Y
		Night	$L_{Aeq,1\text{ hour}}$	50	51.6	53.6		2.0		Y
R03 - Mitchell Road	90 m	Day	$L_{Aeq,1\text{ hour}}$	55	56.1	57.7		1.6		Y
		Night	$L_{Aeq,1\text{ hour}}$	50	53.5	55.4		1.9		Y
R04 - Mitchell Road	96 m	Day	$L_{Aeq,1\text{ hour}}$	55	55.7	57.3		1.6		Y
		Night	$L_{Aeq,1\text{ hour}}$	50	53.1	55.0		1.9		Y
R05 - Mitchell Road	89 m	Day	$L_{Aeq,1\text{ hour}}$	55	55.8	57.3		1.5		Y
		Night	$L_{Aeq,1\text{ hour}}$	50	53.1	55.0		1.9		Y
R06 - Mitchell Road	76 m	Day	$L_{Aeq,1\text{ hour}}$	55	57.5	59.0		1.5		Y
		Night	$L_{Aeq,1\text{ hour}}$	50	54.8	56.7		1.9		Y
R07 - Mitchell Road	62 m	Day	$L_{Aeq,1\text{ hour}}$	55	59.1	60.8		1.7		Y
		Night	$L_{Aeq,1\text{ hour}}$	50	56.5	58.5		2.0		Y
R08 - Mitchell Road	65 m	Day	$L_{Aeq,1\text{ hour}}$	55	58.1	59.6		1.5		Y
		Night	$L_{Aeq,1\text{ hour}}$	50	55.4	57.3		1.9		Y
R09 - Mitchell Road	76 m	Day	$L_{Aeq,1\text{ hour}}$	55	56.3	57.9		1.6		Y
		Night	$L_{Aeq,1\text{ hour}}$	50	53.7	55.6		1.9		Y
R10 - Mitchell Road	55 m	Day	$L_{Aeq,1\text{ hour}}$	55	59.6	61.3		1.7		Y
		Night	$L_{Aeq,1\text{ hour}}$	50	57.0	59.0		2.0		Y
	52 m	Day	$L_{Aeq,1\text{ hour}}$	55	59.6	61.2		1.6		Y



Sensitive Receptor	Setback from Roadway	Period	Parameter	Criteria (dB(A))	Existing Traffic Noise Level (dB(A))	Predicted Noise (dB(A))	Future Level	Relative Difference Between and Road Noise (dB(A))	Future Existing Traffic Levels	Comply (Y/N)
R11 – Mitchell Road		Night	L _{Aeq,1 hour}	50	56.9	58.9		2.0		Y
R12 – Mitchell Road	58 m	Day	L _{Aeq,1 hour}	55	59.3	60.7		1.4		Y
		Night	L _{Aeq,1 hour}	50	56.6	58.5		1.9		Y
R13 – Mitchell Road	52 m	Day	L _{Aeq,1 hour}	55	60.4	62.1		1.7		Y
		Night	L _{Aeq,1 hour}	50	57.8	59.8		2.0		Y
R14 – Mitchell Road	59 m	Day	L _{Aeq,1 hour}	55	59.4	60.9		1.5		Y
		Night	L _{Aeq,1 hour}	50	56.7	58.6		1.9		Y
R15 – Mitchell Road	47 m	Day	L _{Aeq,1 hour}	55	60.3	61.9		1.6		Y
		Night	L _{Aeq,1 hour}	50	57.6	59.6		2.0		Y
R16 – Mitchell Road	54 m	Day	L _{Aeq,1 hour}	55	59.8	61.3		1.5		Y
		Night	L _{Aeq,1 hour}	50	57.1	59.0		1.9		Y
R17 – Mitchell Road	43 m	Day	L _{Aeq,1 hour}	55	61.0	62.7		1.7		Y
		Night	L _{Aeq,1 hour}	50	58.4	60.4		2.0		Y
R18 – Mitchell Road	49 m	Day	L _{Aeq,1 hour}	55	60.0	61.6		1.6		Y
		Night	L _{Aeq,1 hour}	50	57.4	59.3		1.9		Y
R19 – Mitchell Road	52 m	Day	L _{Aeq,1 hour}	55	59.7	61.2		1.5		Y
		Night	L _{Aeq,1 hour}	50	57.1	58.9		1.8		Y
R20 – Mitchell Road	51 m	Day	L _{Aeq,1 hour}	55	60.2	61.7		1.5		Y
		Night	L _{Aeq,1 hour}	50	57.5	59.4		1.9		Y
R21 – Mitchell Road	39 m	Day	L _{Aeq,1 hour}	55	61.4	63.1		1.7		Y
		Night	L _{Aeq,1 hour}	50	58.8	60.8		2.0		Y
	44 m	Day	L _{Aeq,1 hour}	55	60.5	62.0		1.5		Y



Sensitive Receptor	Setback Roadway	from	Period	Parameter	Criteria (dB(A))	Existing Traffic Noise Level (dB(A))	Predicted Noise (dB(A))	Future Level	Relative Difference Between and Road Noise (dB(A))	Future Existing Traffic Levels	Comply (Y/N)
R22 – Mitchell Road			Night	L _{Aeq,1 hour}	50	57.9	59.8		1.9		Y
R23 – Mitchell Road	45 m		Day	L _{Aeq,1 hour}	55	60.1	61.6		1.5		Y
			Night	L _{Aeq,1 hour}	50	57.4	59.3		1.9		Y
R24 – Mitchell Road	34 m		Day	L _{Aeq,1 hour}	55	62.7	64.4		1.7		Y
			Night	L _{Aeq,1 hour}	50	60.1	62.1		2.0		Y
R25 – Mitchell Road	33 m		Day	L _{Aeq,1 hour}	55	62.8	64.4		1.6		Y
			Night	L _{Aeq,1 hour}	50	60.1	62.1		2.0		Y
R26 – Mitchell Road	41 m		Day	L _{Aeq,1 hour}	55	61.3	62.8		1.5		Y
			Night	L _{Aeq,1 hour}	50	58.7	60.5		1.8		Y
R27 – Mitchell Road	39 m		Day	L _{Aeq,1 hour}	55	61.6	63.1		1.5		Y
			Night	L _{Aeq,1 hour}	50	58.9	60.8		1.9		Y
R28 – Mitchell Road	41 m		Day	L _{Aeq,1 hour}	55	60.6	62.2		1.6		Y
			Night	L _{Aeq,1 hour}	50	57.9	59.9		2.0		Y
R29 – Mitchell Road	36 m		Day	L _{Aeq,1 hour}	55	62.5	64.0		1.5		Y
			Night	L _{Aeq,1 hour}	50	59.8	61.7		1.9		Y
R30 – Mitchell Road	35 m		Day	L _{Aeq,1 hour}	55	62.3	63.8		1.5		Y
			Night	L _{Aeq,1 hour}	50	59.7	61.5		1.8		Y



6.4 Road Traffic Assessment Conclusion

Computational modelling of existing traffic volumes (as described by Amber Traffic Impact Assessment^d) demonstrated that the existing road traffic noise is already above the road traffic noise assessment criteria for the associated residential premises. The Road Noise Policy (RNP) makes an allowance “for existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in total traffic noise levels should be limited to 2dB above that of the corresponding “no build option””.

Computational modelling of the future peak road traffic scenario (vehicle volumes as described in table 5 of the Amber TIA) demonstrated an increase of ≤ 2 dB(A) for all residential receptors along the access route on Mitchell Road. As such during peak construction traffic volumes all receptors will be compliant under the RNP.

^d Gregadoo Solar Farm and BESS, Traffic Impact Assessment – Table 6; Amber; 25 June 2024



7 VIBRATION ASSESSMENT

7.1 Introduction

A review of the proposal indicates there is potential for impacts as a result of vibration generated by plant and equipment during the construction phase. Given this, an assessment of the potential for vibration impacts has been undertaken. In particular, the assessment has considered the potential for impacts on both human comfort and structural damage for the nearest residence to the construction works.

7.2 Assessment Criteria

The vibration criteria presented in the Environmental Noise Management – *Assessing Vibration: A Technical Guideline* (2006) published by the NSW Department of Environment and Conservation (DEC) have been adopted for the assessment. The technical guide provides vibration criteria associated with amenity impacts (human annoyance) for the three categories of vibration:

- Continuous vibration (e.g., road traffic, continuous construction activity);
- Impulsive vibration includes less than 3 distinct vibration events in an assessment period (e.g., occasional dropping of heavy equipment); and
- Intermittent vibration includes interrupted periods of continuous vibration (e.g., drilling), repeated periods of impulsive vibration (e.g., pile driving) or continuous vibration that varies significantly in amplitude.

Table 17 and Table 18 present the criteria for continuous and impulsive vibration and intermittent vibration, respectively.

Table 17: Continuous & Impulsive Vibration Criteria for Residences – Peak Velocity

Location	Vibration Type	Preferred Limit (mm/s)	Maximum Limit (mm/s)
Residences	Continuous	0.28	0.56
Residences	Impulsive	8.6	17

Table 18: Intermittent Vibration Criteria for Residences

Location	Assessment Period	Preferred Value (m/s ^{1.75})	Maximum Value (m/s ^{1.75})
Residences	Daytime	0.20	0.40

The above criteria are suitable for assessing human annoyance in response to vibration levels. In order to assess potential damage to buildings, reference has been made to British Standard *BS 7385-2: 1993 Evaluation and measurement of vibration in buildings – Part 2: Guide to damage*



levels from ground borne vibration. Table 19 presents vibration criteria for assessing the potential for building damage.

Table 19: Transient Vibration Guide Values for Cosmetic Damage

Type of Building	Peak Particle Velocity (mm/s)	
	4 Hz to 15 Hz	15 Hz and above
Unreinforced or light framed structures – residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

7.3 Potential Vibration Sources

Table 20 identifies the vibration source levels for the equipment likely to be used for the construction of the Project.

Table 20: Vibration Source levels – Peak Particle Velocity

Equipment Item	PPV at 10 metres (mm/s)	Source
Roller	5 – 6	DEC
7 tonne compactor	5 – 7	DEC
Loaded trucks (rough surface)	5	USA DT ^{a)}
Loaded trucks (smooth surface)	1 – 2	USA DT ^{a)}
Excavator	2.5 – 4	DEC

a) Transit Noise and Vibration Impact Assessment, US Department of Transportation, May 2006.

7.4 Assessment of Potential Impacts

Based on the vibration source levels at 10 metres (presented in Table 20), peak particle velocities have been predicted at various separation distances. The NSW DEC indicates that in predicting vibration levels, it can be assumed that the vibration level is inversely proportional to distance (with the relationship varying between $d^{-0.8}$ to $d^{-1.6}$ based on field data).

The US Department of Transportation's Transit Noise and Vibration Impact Assessment (May 2006) presents the following construction vibration propagation formula assuming an inverse relationship:

$$PPV@d_2 = PPV@d_1 \times (d_1/d_2)^{1.5}$$

where: d_1 = distance 1 (reference distance for source data) (m)

d_2 = distance 2 (separation distance for predicted PPV) (m)

PPV = peak particle velocity (mm/s)



The above formula has been considered for predicted PPVs at various distances from construction equipment. Based on the above information, Table 21 presents PPV predictions for the various construction equipment.

Table 21: Predicted Peak Particle Velocity at Sensitive Receptors (mm/s)

Distance from Source (m)	Predicted Peak Particle Velocity (mm/s)				
	Roller	7 tonne compactor	Excavator	Loaded trucks (rough surfaces)	Loaded trucks (smooth surfaces)
10	6.00	7.00	4.00	5.00	1.00 – 2.00
20	2.12	2.47	1.41	1.77	0.35 – 0.71
30	1.15	1.35	0.77	0.96	0.19 – 0.38
40	0.75	0.88	0.50	0.63	0.13 – 0.25
50	0.54	0.63	0.36	0.45	0.09 – 0.18
60	0.41	0.48	0.27	0.34	0.07 – 0.14
70	0.32	0.38	0.22	0.27	0.06 – 0.11
80	0.27	0.31	0.18	0.22	0.05 – 0.09
90	0.22	0.26	0.15	0.19	0.04 – 0.07
100	0.19	0.22	0.13	0.16	0.03 – 0.06
150	0.1	0.12	0.07	0.09	0.02 – 0.03
Type	Continuous			Intermittent	
Nuisance Criteria	Residential 0.28 (preferred) / 0.56 (max)			Residential 0.20 (preferred) / 0.40 (max)	
Building Criteria	Residential				
	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz				
	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above				

The predicted vibration levels presented in Table 21 indicate compliance with the continuous maximum vibration nuisance criteria for locations at a separation distance of 50-60 metres. Compliance with the building damage criteria is predicted at 10 metres from construction for each source. Therefore, as the closest receptor (RI) is 72 m from the nearest vibration source, there will be no adverse impact.

For intermittent vibration associated with haul vehicles, it is difficult to provide an appropriate comparison with the relevant criteria (which is presented as a Vibration Dose Value (VDV) in $\text{m/s}^{1.75}$). The calculation of a VDV requires both the overall weighted RMS (root mean square) acceleration (m/s^2) typically obtained from on-site measurements and the estimated time period for vibration events.

It is noted, however, that the loaded trucks at distances of 72 m (the distance to the nearest receptor) is predicted to be within the maximum intermittent criteria of 0.2 mm/s.

7.5 Operational Vibration

The vibration from the development site will be minimal due to the separation distance and design of the surface pad.



8 CONCLUSION

Assured Environmental (AE) was appointed by Premise to undertake a noise and vibration impact assessment for the proposed Gregadoo Solar Farm co-located within the existing Wagga Wagga Substation located along Ashfords Road, Gregadoo NSW.

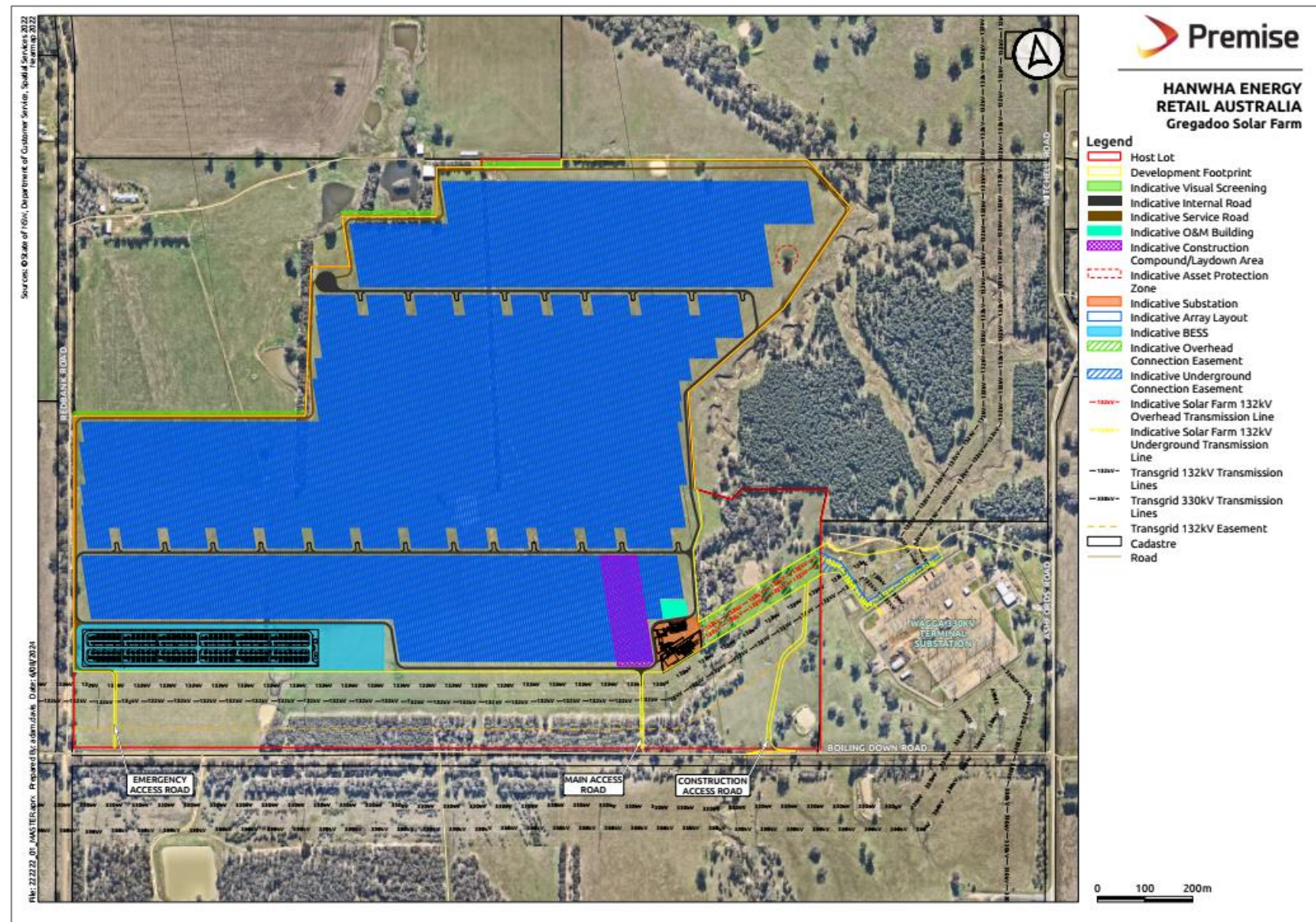
The results of the construction noise assessment determined that the closest sensitive receptor (R1) exceeds the highly noise affected criteria during the installation of solar PV modules & inverter assemblies and grid connection. As such, it is recommended that a temporary noise barrier at R01 is installed to minimise the noise at this receptor as required.

The road assessment was undertaken to assess worst case vehicle movements during construction. Compliance with the noise criteria for the closest sensitive receptors along Ashfords Road and Gregadoo East Road is expected to be achieved with both light and heavy vehicle peak hourly movements.

The results of the vibration assessment have determined that compliance with the nuisance and building criteria for residential uses is expected to be achieved at all sensitive receptors.

A noise model was developed to predict the operational noise from the Solar Farm at surrounding sensitive receptors in accordance with the NSW Noise Policy for Industry (EPA, 2017). The results of the predictive noise modelling have determined compliance with the derived noise criteria is expected to be achieved at all receptors. Hence, from an acoustic and vibrational perspective, the proposed development site is considered acceptable for the proposed use.

APPENDIX A: DEVELOPMENT PLANS





APPENDIX B: NOISE MONITORING DETAILS

Table 22: ML1 Site Details

Site Details: NML 1	
Coordinates:	-35.1852149 "S, 147.3957649 "E
Start / End Date	24 January 2023 at 18:40 hours to 6 February 2023 at 10:55 hours
Logger Details	Rion NL42 (serial number – SN695) Next Laboratory Calibration Due: 13 August 2023
Calibration Details	Pulsar 106 (serial number SN683) Start / End Calibration Level: 94.0 dB(A) / 94.1 dB(A) Next Laboratory Calibration Due: 10 February 2023
Measurement Details:	Fast/ A-weighting / 15-min duration / 1.2 m microphone height / Free field position
Weather Details	Onsite weather station indicated during the monitoring period 14 hours of data was affected by rainfall and wind speed.
On-site Observations:	Located at 21-31 Blackbutt Road in front garden of owner’s property. Onsite observations indicated dominant noises included wind, birds, sheep, and horses. Road traffic was light and generally quiet.

Site Photos



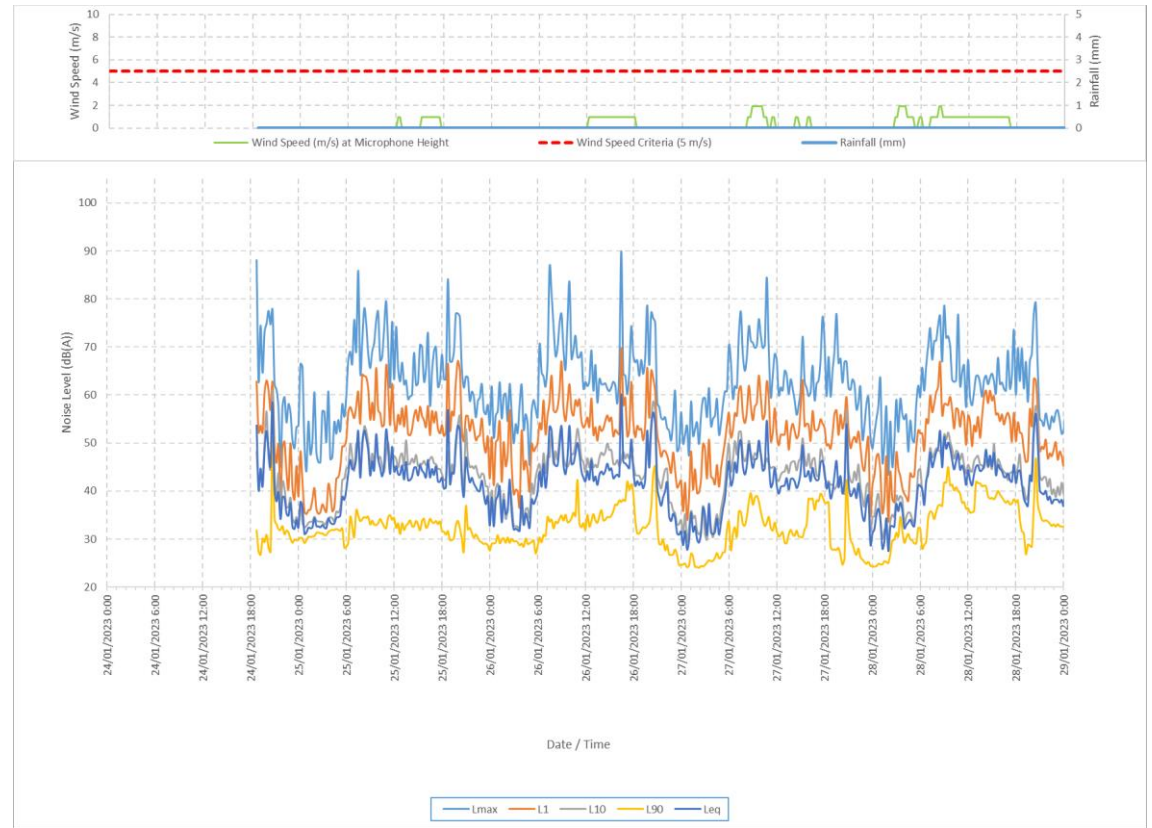


Figure 11: Time History from 24/01/2023 to 29/01/2023 at ML1

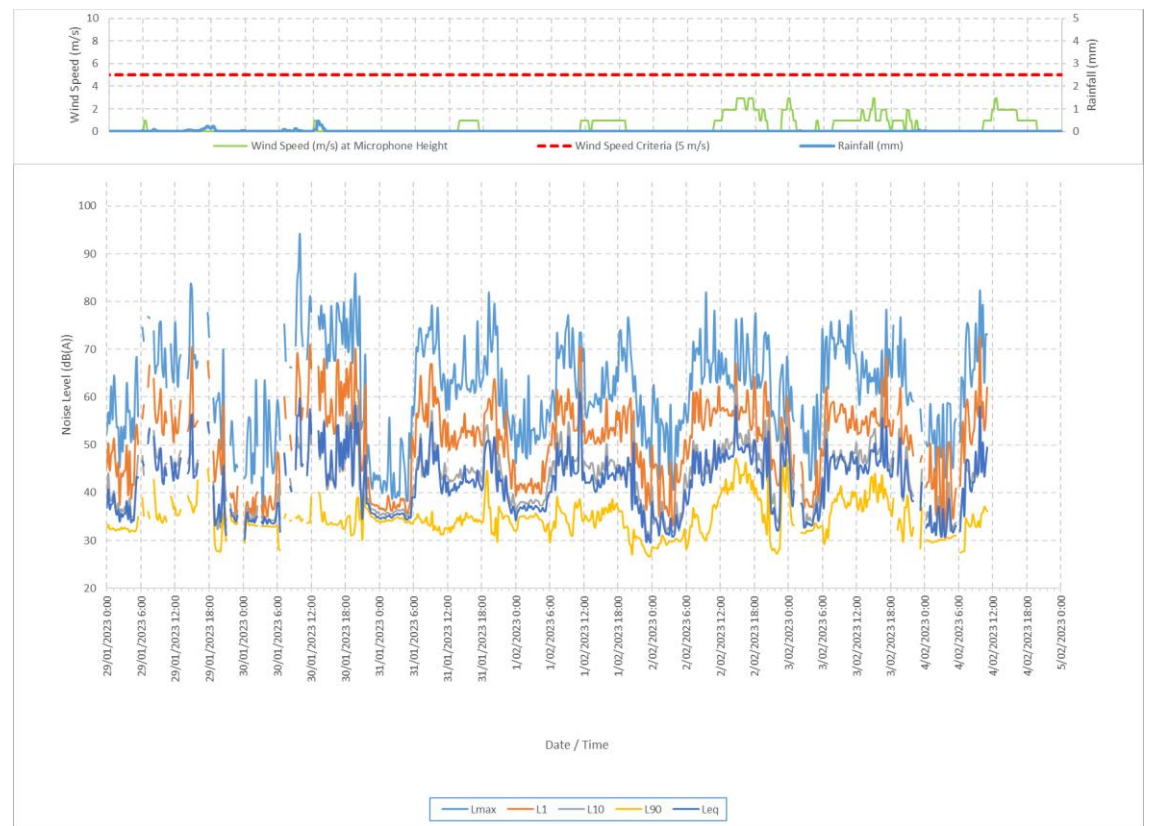


Figure 12: Time History from 29/01/2023 to 5/02/2023 at ML1



Table 23: Noise Monitoring Results ML1

Date	Period	L _{max}	L ₁	L ₁₀	L ₉₀	L _{eq}	ABL
24/01/2023	Day	-	-	-	--	-	-
	Evening	-	-	-	-	-	-
	Night	69.0	42.5	36.6	30.9	37.6	29.3
25/01/2023	Day	85.9	56.6	47.0	33.4	46.8	32.3
	Evening	84.1	56.6	46.4	31.5	48.9	29.8
	Night	70.5	48.2	39.2	29.4	39.0	28.6
26/01/2023	Day	89.9	56.3	47.3	35.2	48.7	32.8
	Evening	78.7	54.8	46.3	34.1	48.9	29.5
	Night	70.3	45.1	36.5	26.6	37.9	24.3
27/01/2023	Day	84.5	55.2	46.4	34.1	45.9	30.5
	Evening	76.9	52.8	42.8	30.8	44.8	26.3
	Night	66.2	44.6	37.1	27.9	36.6	24.6
28/01/2023	Day	78.6	56.4	46.5	38.6	46.4	35.6
	Evening	79.1	52.5	45.0	34.0	47.2	28.5
	Night	74.6	47.0	39.2	32.9	39.3	32.0
29/01/2023	Day	-	-	-	-	-	-
	Evening	-	-	-	-	-	-
	Night	-	-	-	-	-	-
30/01/2023	Day	-	-	-	-	-	-
	Evening	85.8	57.3	47.3	34.8	51.2	31.1
	Night	70.4	39.6	37.0	34.4	37.2	33.8
31/01/2023	Day	79.1	54.8	45.2	33.6	45.9	32.1
	Evening	81.8	55.2	47.3	35.5	47.4	31.3
	Night	64.5	44.4	39.2	33.9	38.3	32.0
1/02/2023	Day	77.0	54.9	47.4	35.5	48.6	32.9
	Evening	76.5	53.2	43.7	32.2	44.5	29.2
	Night	64.9	42.9	35.5	29.4	35.4	27.6
2/02/2023	Day	82.0	57.3	48.9	38.8	48.7	31.6
	Evening	77.2	53.6	45.8	34.8	47.0	28.1
	Night	-	-	-	-	-	-
3/02/2023	Day	78.4	55.8	48.1	38.8	47.5	36.4
	Evening	-	-	-	-	-	-
	Night	-	-	-	-	-	-



Table 24: ML2 Site Details

Site Details: NML 2	
Coordinates:	-35.1914478 "S, 147.3778608 "E
Start / End Date	25 January 2023 at 08:44 hours to 6 February 2023 at 10:45 hours
Logger Details	Norsonic Nor139 (serial number – 1392800) Next Laboratory Calibration Due: 12 January 2025
Calibration Details	Pulsar 106 (serial number SN683) Start / End Calibration Level: 94.0 dB(A) / 94.1 dB(A) Next Laboratory Calibration Due: 10 February 2023
Measurement Details:	Fast/ A-weighting / 15-min duration / 1.2 m microphone height / Free field position
Weather Details	Onsite weather station indicated during the monitoring period 14 hours of data was affected by rainfall and wind speeds.
On-site Observations:	Located on front property of 123 Redbank Road on the development site. Dominate noise sources include birds, sheep and cattle. Road traffic noise was less audible at ML2 than what was observed at MLI.

Site Photos



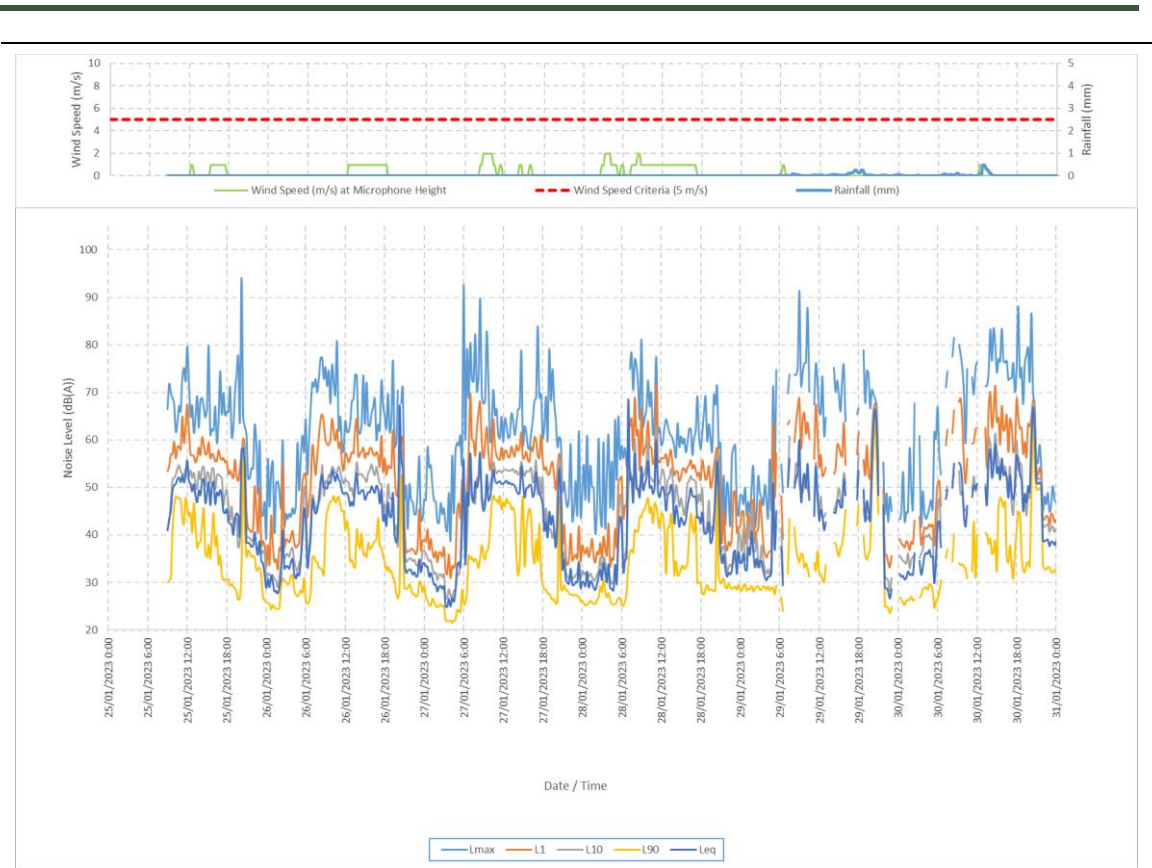


Figure 13: Time History from 25/01/2023 to 31/01/2023 at ML2

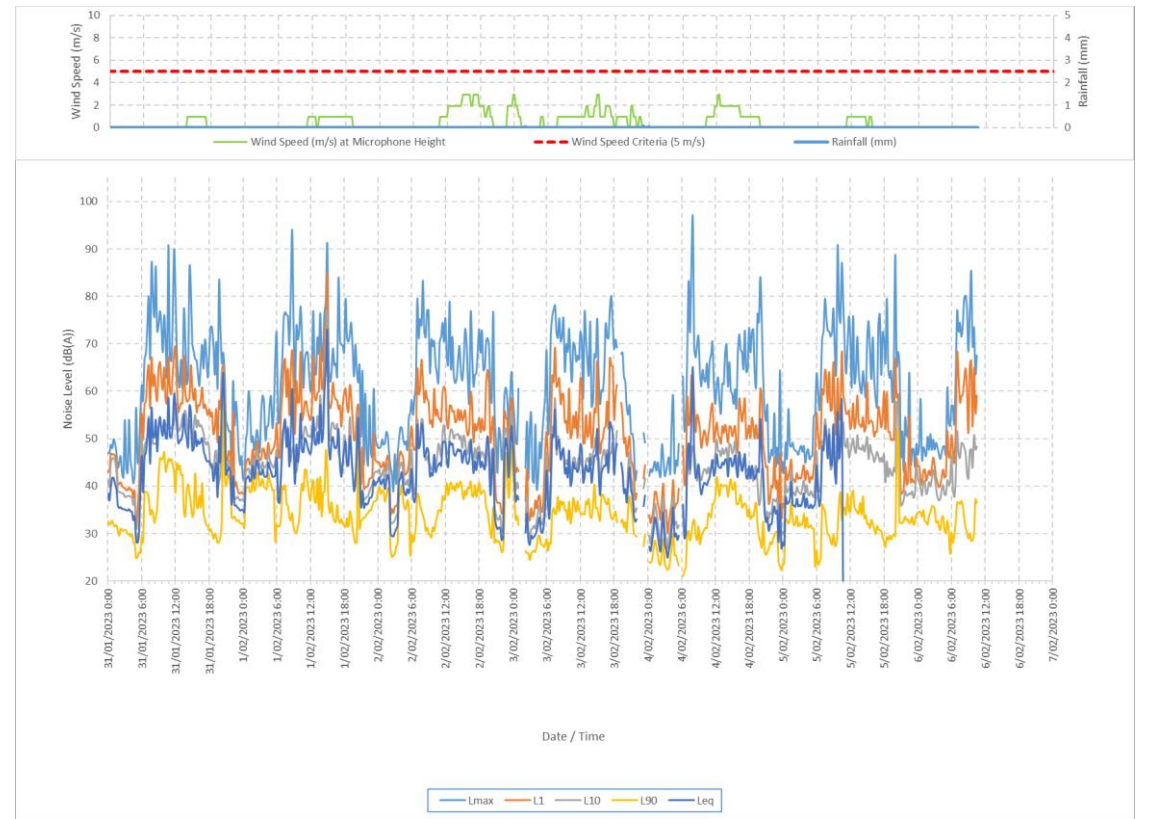


Figure 14: Time History from 31/01/2023 to 6/02/2023 at ML2



Table 25: Noise Monitoring Results ML2

Date	Period	L _{max}	L ₁	L ₁₀	L ₉₀	L _{eq}	ABL
25/01/2023	Day	-	-	-	-	-	-
	Evening	94.1	51.5	44.8	33.4	50.4	27.3
	Night	66.5	41.3	35.9	28.5	36.6	24.6
26/01/2023	Day	80.7	58.4	51.4	39.3	49.7	33.2
	Evening	76.7	50.8	44.4	32.3	55.6	28.0
	Night	92.6	39.1	33.8	25.8	41.8	22.0
27/01/2023	Day	89.8	58.7	52.1	40.5	51.1	34.0
	Evening	79.0	49.8	42.1	29.0	45.1	26.1
	Night	65.0	38.7	33.2	26.6	34.2	25.3
28/01/2023	Day	81.1	57.1	51.2	39.6	54.2	31.8
	Evening	71.3	51.1	43.9	30.6	46.1	28.0
	Night	74.7	42.7	36.8	28.6	38.7	28.1
29/01/2023	Day	-	-	-	-	-	-
	Evening	-	-	-	-	-	-
	Night	-	-	-	-	-	-
30/01/2023	Day	-	-	-	-	-	-
	Evening	88.1	60.7	53.9	43.7	57.7	33.0
	Night	68.1	43.2	40.4	30.9	39.5	27.0
31/01/2023	Day	90.8	60.6	52.3	39.2	52.6	33.5
	Evening	83.3	54.1	47.6	35.5	53.6	28.6
	Night	72.0	45.5	42.4	36.9	41.7	31.7
1/02/2023	Day	94.0	60.6	51.6	36.7	57.9	32.1
	Evening	79.5	52.5	45.1	33.0	46.8	28.8
	Night	61.7	43.5	40.5	34.2	39.5	26.2
2/02/2023	Day	83.3	56.2	48.5	36.7	47.5	30.8
	Evening	76.8	49.9	42.4	33.4	44.8	28.2
	Night	-	-	-	-	-	-
3/02/2023	Day	80.0	56.1	46.4	35.4	47.7	33.4
	Evening	-	-	-	-	-	-
	Night	-	-	-	-	-	-
4/02/2023	Day	96.6	53.0	45.4	35.2	50.1	29.7
	Evening	84.1	49.4	39.4	30.6	44.9	26.2
	Night	64.4	42.7	38.0	29.6	36.7	23.5
5/02/2023	Day	90.6	56.2	47.9	33.1	46.4	29.4
	Evening	88.8	51.3	43.6	32.5	15.6	28.5
	Night	63.9	43.8	39.8	32.5	15.6	30.1

APPENDIX C: NOISE CONTOURS

