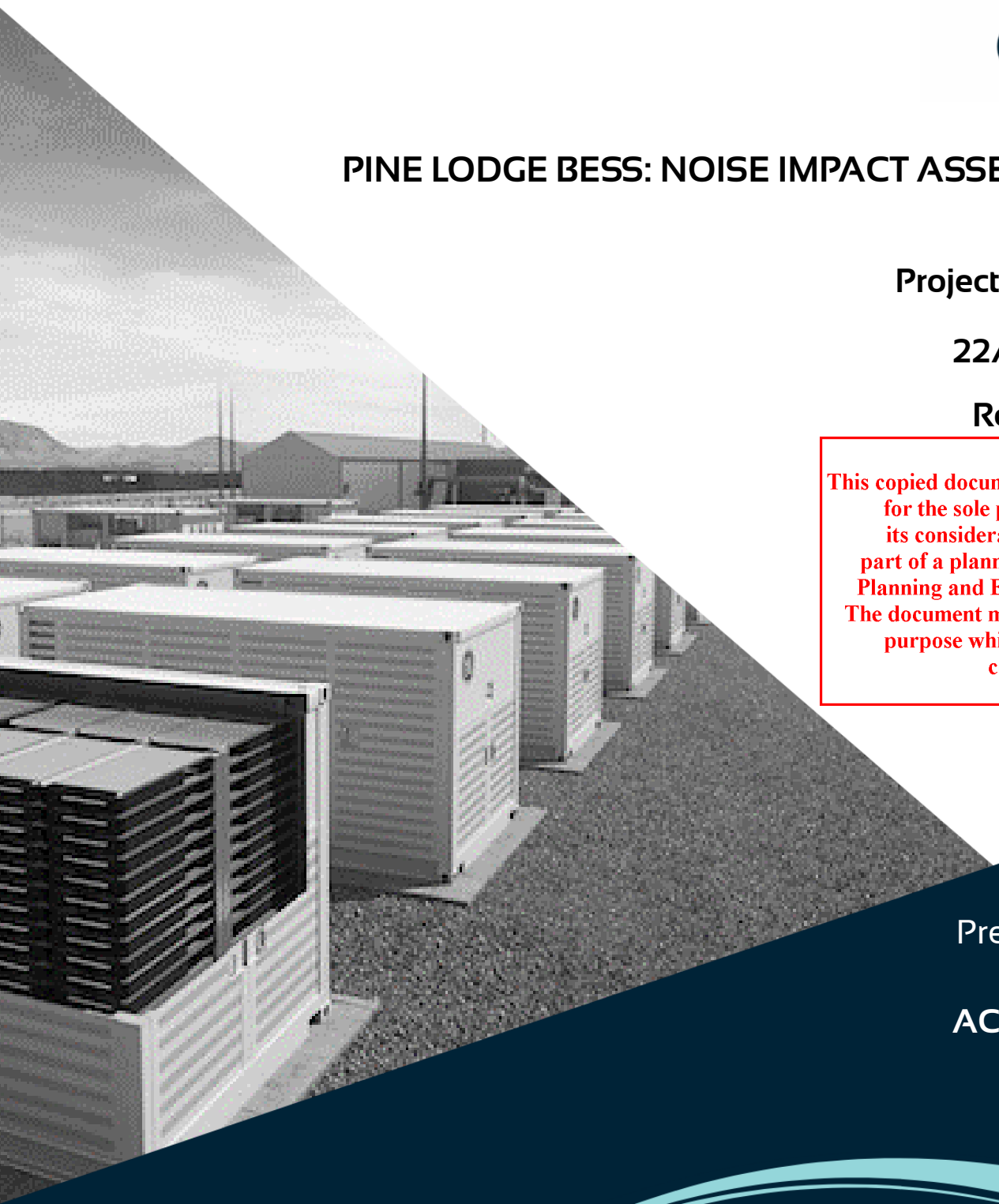

PINE LODGE BESS: NOISE IMPACT ASSESSMENT

Project ID: 14038

22/07/2024

Release: R8

Prepared For:

ACLE Pty Ltd

Assured Environmental

DOCUMENT CONTROL PAGE

Project Title: PINE LODGE BESS: NOISE IMPACT ASSESSMENT

Project Reference ID: 14038

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Table 1: History of Revisions

Revision	Date	Issued to	Changes
R0	14/10/2021	D. Wilkinson	Initial Release
R1	19/11/2021	D. Wilkinson	Client Comments
R2	02/12/2021	J.Bai	Client Comments
R3	23/12/2021	J.Bai	Change in modelling scenario
R4	13/01/2022	J.Bai	Updated text
R5	01/03/2022	J.Bai	Updated Layout and equipment
R6	04/03/2022	J.Bai	Minor text update
R7	28/04/2022	J.Bai	Minor text update
R8	22/07/2024	Y.Zhan	Updated Layout and equipment

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complete and accurate. It is further assumed that normal activities were being undertaken at the site on the day of the site visit(s), unless explicitly stated otherwise.

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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.
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.
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

BESS	Battery Energy Storage System
MVPS	Medium Voltage Power Station
EPA	Environmental Protection Authority
LIDAR	Light Detection and Ranging

1 INTRODUCTION

1.1 Scope of Assessment

Assured Environmental (AE) was appointed by ACLE Pty Ltd to undertake a noise impact assessment for the proposed Battery Energy Storage System (BESS), located in Pine Lodge, VIC.

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

- Environmental Protection Act 2017 (incorporating amendments as at 1 July 2021);
- Environment Protection Regulations 2021;
- Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues (referred to as "Assessment Protocol" herein) (EPA, Publication 1826.4, May 2021); and
- Noise guideline – assessing low frequency noise (EPA Publication 1996, June 2021); and

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

1.2 This Report

This report presents the noise impact assessment in accordance with the agreed scope of work.

2 PROPOSED DEVELOPMENT SITE

2.1 Development Site

The proposed development site is located at 910 Sidebottoms Road, Pine Lodge. Specifically, the proposed BESS is to be constructed on Lot 1 on TP761710, shown in Figure 1. The area surrounding the proposed development includes agricultural purposes with associated rural dwellings.

2.2 Nearby Sensitive Receptors

There are six single existing dwellings located in the vicinity of the proposed BESS. Table 2 and Figure 1 provide a summary of selected sensitive receptors to the proposed development and approximate distance to the infrastructure footprint.

Table 2: Nearby Sensitive Receptors

Receptor	Use	Land Zoning	Coordinate System EPSG:32755		Distance to infrastructure (m)	Height (m)
			Easting	Northing		
R01	Existing Dwelling	Farming Zone (FZ1)	5976622	370266	540	1.5
R02	Existing Dwelling	Farming Zone (FZ1)	5977235	372384	740	1.5
R03	Existing Dwelling	Farming Zone (FZ1)	5978210	371222	1400	1.5
R04	Existing Dwelling	Farming Zone (FZ1)	5976409	372124	1120	1.5
R05	Existing Dwelling	Farming Zone (FZ1)	5978075	370388	460	1.5
R06	Existing Dwelling	Farming Zone (FZ1)	5976767	371384	1000	1.5

2.3 Topography

Figure 2 illustrates the local topography, as obtained from the LIDAR imaging. It can be seen the topography is flat.

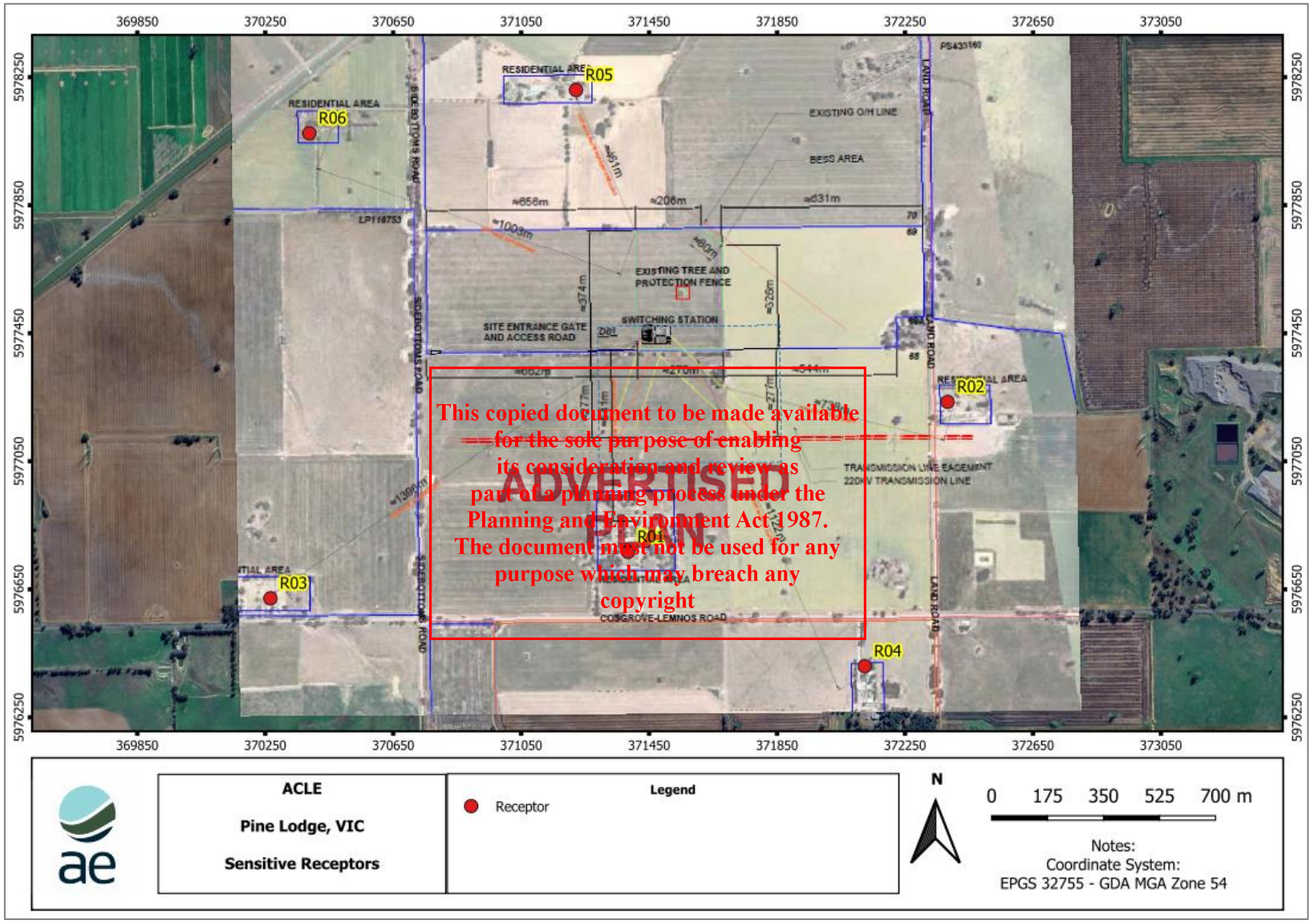


Figure 1: Site Location and Surrounding Receptors

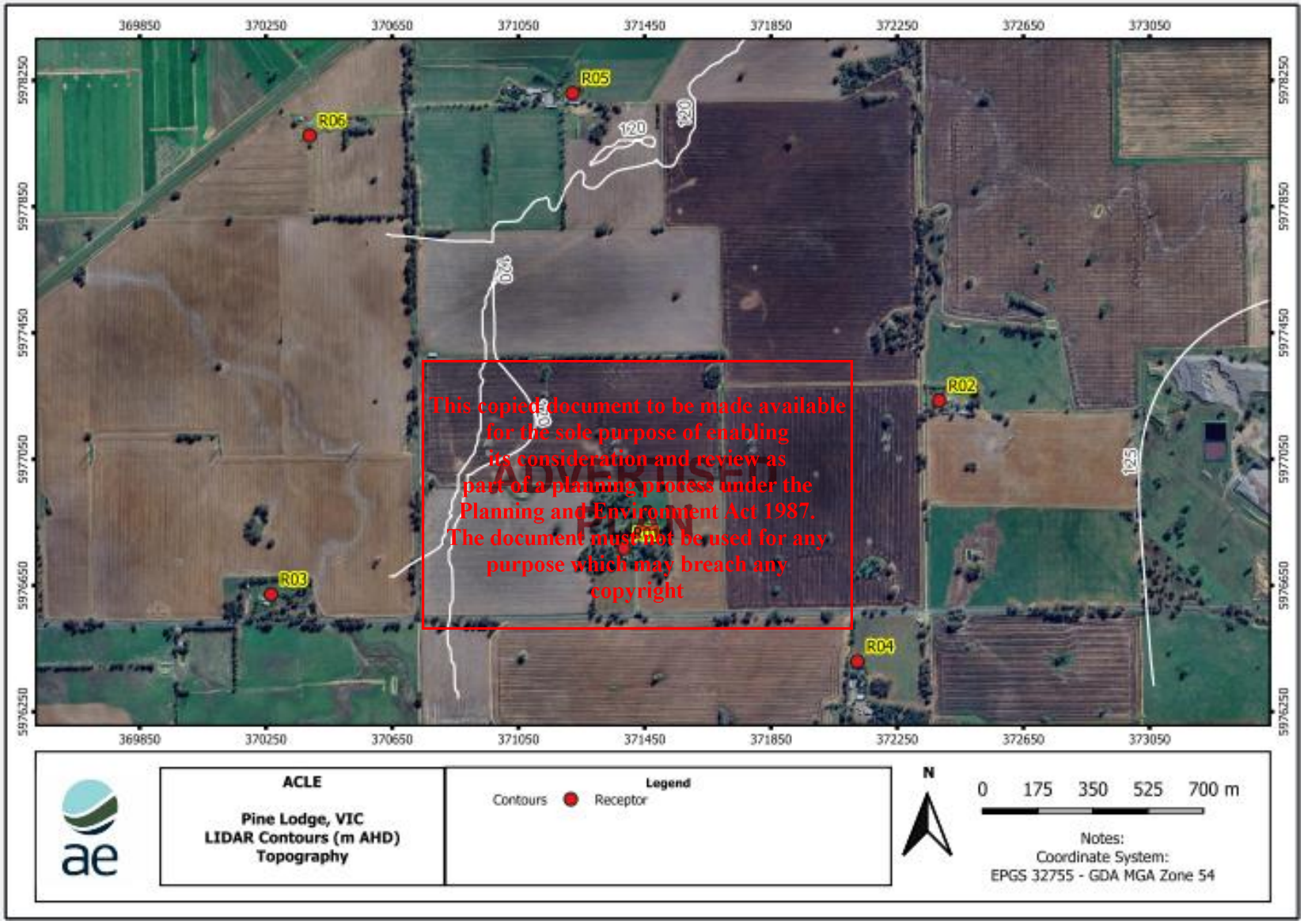


Figure 2: Site Topography (5m Intervals AHD)

3 CRITERIA

3.1 Overview

The Environment Protection Act 2017 includes amendment as of 1 July 2021. The new legislation focuses on preventing pollution impacts rather than managing those impacts after they have occurred.

In relation to noise, the revision means the previous guidance (SEPP N1 and N2) are obsolete, with the new guidance (*Noise Limit and Assessment Protocol for the Control of Noise from Commercial, Industrial and Trade Premises and Entertainment Venues* (Publication 1826.4, Environment Protection Authority, May 2021) designed to set noise levels to protect sensitive areas.

Under the new regulations, ACLE have a responsibility to understand, and minimise the risks they pose to the environment, referred to as General Environmental Duty (GED). Where risks are identified, the company has obligations to comply with noise limits.

For most companies, the implementation of best-practice noise management measures, compliance with occupational noise and air quality levels and industry standard legislation (where applicable) will ensure that risks are managed.

3.2 Greater Shepparton Planning Scheme

The Subject Site will operate within the Greater Shepparton government area, which states the following regarding noise abatement:

13.05-1S Noise abatement

Objective

To assist the control of noise effects on sensitive land uses.

Strategy

Ensure that development is not prejudiced, and community amenity and human health is not adversely impacted by noise emissions, using a range of building design, urban design and land use separation techniques as appropriate to the land use functions and character of the area.

Policy guidelines

Consider as relevant:

- The noise requirements in accordance with the Environment Protection Regulations under the Environment Protection Act 2017.

Policy documents

Consider as relevant:

- Environment Protection Regulations under the Environment Protection Act 2017

- Noise Limit and Assessment Protocol for the Control of Noise from Commercial, Industrial and Trade Premises and Entertainment Venues (Publication 1826.2, Environment Protection Authority, March 2021)

3.3 Assessment Protocol

Part 1 of The Noise Limit and Assessment Protocol for the Control of Noise from Commercial, Industrial and Trade Premises and Entertainment Venues - Rural Method (EPA Publication 1826.4 dated May 2021) outlines the methodology for setting the noise limits for a commercial, industrial and trade premises in both urban and rural areas of Victoria.

The Assessment Protocol further outlines the steps that must be followed to undertake an assessment (measurement or prediction) of the effective noise level (i.e. predicted noise level) within a noise sensitive area (i.e. receptors). A comparison between the effective noise level and the relevant noise limit or the relevant alternative assessment criterion will determine whether the noise that is emitted from the commercial, industrial or trade premises is determined to be unreasonable under Regulation 118 of the Regulations.

Clause 23 of 1826.4 states "where the noise being assessed will meet the noise limit based on either the base noise limits or distance-adjusted levels and there is no other contributing noise source from a commercial, industrial or trade premises, an assessment of background level is not mandatory".

3.3.1 Land Use Zone

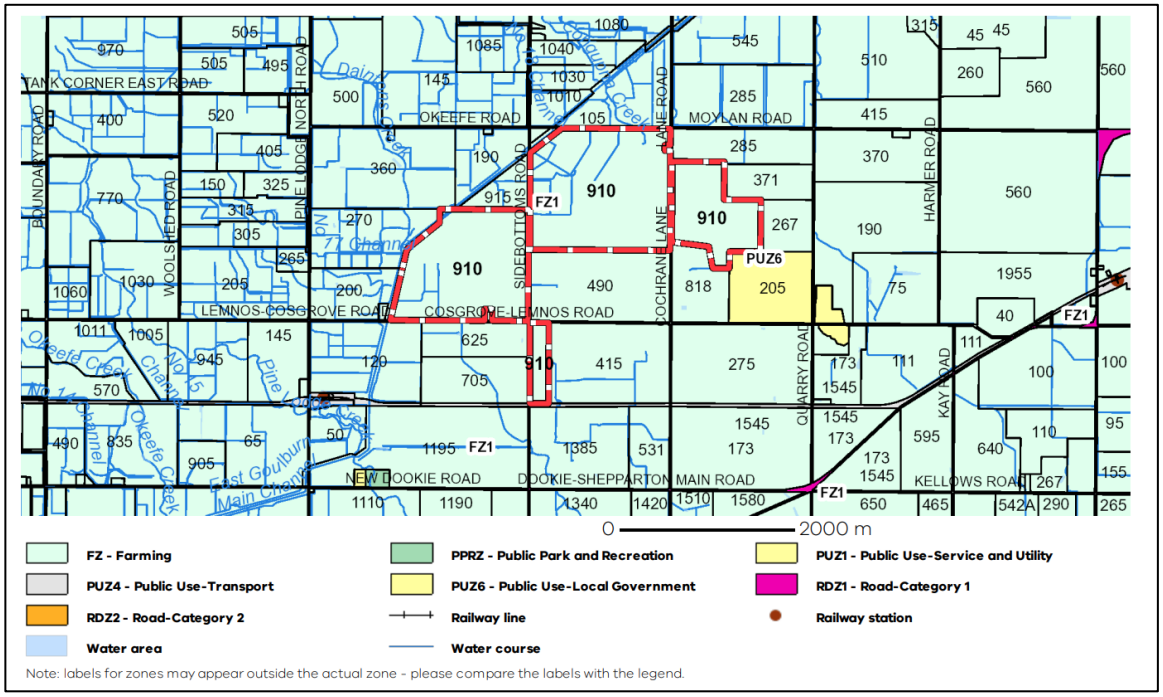
The Subject Site and surrounding areas are currently zoned as Farming Zone 1 (FZ1), as shown in Figure 3.

The rural method states that background monitoring can be circumvented if there is no contributing industry. View of the arial photography identified some industrial activity located 1.1 km southeast of the Subject Site boundary. A desktop study of the site identified that these activities will not impact background levels due to the distance, which is 500 m between the boundary and the nearest receptor.

As both the emitting and receiving zones are classified as farming, the noise criteria for the surrounding receptors are selected from B-1 of the Assessment Protocol, which is summarised in Table 3.

Table 3: Table B.1: Zone levels (dB(A)) for Rural Area Method for Commercial, Industrial and Trade Premises

Generating Zone ↓ / Receiving Zone →	Farming Zone FZ Green Wedge GW General Residential Zone GRZ Neighbour Residential Zone NRZ Residential Growth Zone RGZ, Rural Activity Zone RAZ, Township Zone TZ. Urban Growth Zone before an incorporated precinct structure plan UGZ Group B CDZ, SUZ & UGZ (*)
Farming FZ (*) Green Wedge GWZ, Green Wedge A GWAZ Public Use 2 & 5 PUZ2, PUZ5 Rural Activity RAZ Rural Conservation RCZ Rural Living RLZ Urban Growth Zone before an incorporated precinct structure plan (UGZ) Group B CDZ, SUZ & UGZ (*)	Day 46 Evening 41 Night 36



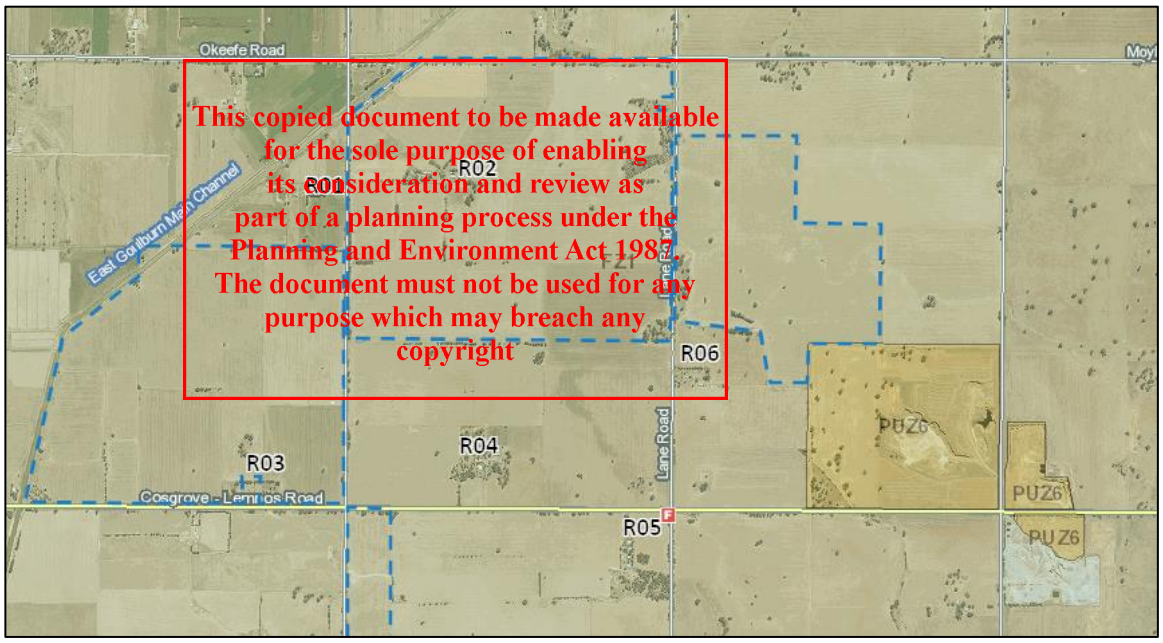


Figure 3: Sensitive Receptors and Surrounding Land Use

3.3.2 Determining Assessment Criteria

Using clause 19 of the Assessment Protocol, the following adjustments are made between the zone where the noise generator is located and the location of the noise receiver in the noise sensitive area:

- if the noise generator and receiver are covered by the same contiguous zone, the distance adjustment is 0 dB;
- if the noise generator and receiver are not located in land use zones with the same zone code subtract 1 dB for every 100 metres of receiver distance.

As the zone between the generator and the receiver is the same (FZ1), no correction is applied.

3.4 Noise Limits in rural areas for Utilities

This development is classified as a Utility development, it has its own set of criteria. Clause 31, of the noise protocol describes the following.

> *(31) If the utility is located in a Farming Zone, Rural Activity Zone or Green Wedge Zone and the distance adjustment is 0 dB, and unless a background level assessment is conducted in accordance with clauses 21 to 23, then:*
>
> *a. The distance-adjusted level for each period is –*
>
> *i. Day: 45 dB(A)*
>
> *ii. Evening: 39 dB(A)*
>
> *iii. Night: 34 dB(A).*
>
> *b. The noise limit is the distance-adjusted level defined in clause 31, unless a background level assessment is conducted in accordance with clauses 21 to 23*

As the utility is in a Farming Zone and Rural Activity Zone the distance adjustment is 0 dB. The distance-adjusted level for each period is –

Clause 31:

i. Day: 45 dB(A)
ii. Evening: 39 dB(A)
iii. Night: 34 dB(A)

3.4.1 Project Trigger Levels

The project trigger level (i.e., the noise criteria considered by the assessment) is shown in Table 4. The project trigger levels take into consideration additional corrections required for distance-based adjustment and specified land zones.

Table 4: Project Trigger Levels

Time of Day	Standardised $L_{Aeq,\ 15\ min}$ Noise Level (dB)		
	Specified Zone Limits	Distance Adjustment	Project Trigger Level
Day	45	45 + 0 = 45	45
Evening	39	39 + 0 = 39	39
Night	34	34 + 0 = 34	34

3.5 Low Frequency Noise

The Noise Guideline – Assessing Low Frequency Noise relates to noise from commercial, industrial and trade premises should be assessed by comparing its frequency spectrum to the relevant threshold levels. Specifically, Z-frequency weighted (unweighted or linear) measurements in one-third octave bands from 10 Hz to 160 Hz are compared with low frequency threshold levels.

The threshold levels are not set limits. Rather, they are levels that indicate a potential risk of problematic low frequency noise. The disturbance from low frequency noise depends on the:

- noise level
- characteristics that can increase annoyance with the noise, for example, tonality, frequency modulation.
- baseline noise levels in the absence of the noise of concern.

Table 5 provides indoor and outdoor noise threshold levels to be used for indoor measurements.

Table 5: Indoor and Outdoor Low Frequency Noise Threshold Levels

1/3 Octave Low Frequency Noise Threshold Levels													
1/3 Octave (Hz)	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
Indoor L_{eq} (dB)	92	87	83	74	64	56	49	43	42	40	38	36	34
Outdoor L_{eq} (dB)	92	89	86	77	69	61	54	50	50	48	48	46	44

Noise level calculations in the low frequency range can be problematic and of limited accuracy. The use of noise calculations should be restricted to indicative estimations only. Due to this, calculations should only be used as a screening tool to assess the risk of low frequency noise from the proposed development and/or extension of existing commercial, industrial and trade premises.

3.6 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 whichever is the greater, a detailed maximum noise level event assessment should be undertaken.

As discussed in Section 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 the BESS are all continuous. As such, consideration of compliance against the L_{AFmax} sleep disturbance criteria is unwarranted.

4 PREDICTIVE NOISE MODELLING

4.1 Overview

It is understood that the equipment and associated noise level data used as the basis for this assessment will be comparable with the final selections for the proposed facility. The primary recommendation will be that a suitably qualified acoustic consultant is engaged during detailed design to ensure that compliance with relevant criteria is achieved at nearby noise sensitive receptors. Should equipment with lower sound power level information than adopted, then the nominated noise control strategies may be amended with approval by a suitably qualified acoustic consultant.

The following summaries the assumptions, techniques, and data used to represent the BESS in the noise model.

4.2 Noise Modelling Methodology

For the purposes of predicting impacts associated with noise emissions from the Subject 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, topography, 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 Subject 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.

Consideration of meteorological effects on noise propagation, specifically, temperature inversions and/or gradient winds, has also been incorporated. Table 6

4.3 Meteorology

Noise levels were predicted using the CONCAWE propagation methodology, which incorporates the influence of meteorological conditions on the propagation of noise through the atmosphere. The modelled meteorological parameters shown in Table 6 were selected to predict the worst-case noise levels at all receptors during all seasons and all time periods.

Table 6: Model Parameters

Parameter	Day (Noise-Enhancing)	Evening (Noise-Enhancing)	Night (Noise-Enhancing)
Temperature	20°C	10°C	10°C
Relative Humidity	75%	75%	75%
Wind Speed (m/s)	3.0	3.0	2.0
Stability Class	D	D	F
Wind Direction:	Worst Case	Worst Case	Worst Case

4.4 Model Configuration

Table 7 summarises the model configuration used for the modelling.

Table 7: 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 Topography	LiDAR data at 5 m intervals
Ground Absorption	Based on aerial mapping. Subject Site ground absorption set to 0.1, surrounding rural areas ground absorption set to 1.0.
Meteorology	Day and Evening: Stability class D at 3 m/s Night: Stability class F at 2 m/s Worst case wind direction (source to receptor)

4.5 Noise Sources and Assumptions

Table 8 presents a summary of the source noise levels considered in the assessment. The sound power levels for the plant and equipment presented in the table below are as provided by the manufacturer or taken from information held in AE's library.

All noise sources associated with BESS are considered continuous in nature and are associated with fixed plant items operating in the charging and distribution process. Where annoying noise characteristics have been identified the adjustment has been included in the L_{Aeq} column. The sound power levels have been taken from the following sources.

For modelling, the following assumptions were made:

- Inverter detailed from manufacturers data sheet. Apparent power rated percentage was provided to AE by ACLE through email communication.
- All MVPS (internal inverters, transformers) and liquid cooling BESS were modelled using the "box method", this methodology allows for individual sound power levels assigned to each façade of the inverters and BESS units. Individual façade power levels were provided

by manufacturers datasheets. This model considers the front, back, AC inlet side, AC outlet side and roof for each unit.

- Batteries will be in containers, which will be enclosed; therefore, each enclosure will provide shielding.
- All sources operate continuously within any 15-minute period and therefore no duration or impulsive or intermittent adjustment is required.

- As per the attached plans In Appendix A, a large portion of the site is comprised of a switching station. A switching station is a substation that does not contain power transformers but only have power poles, wires and circuit breaker to permit a circuit to be disconnected or change the electric connection between the circuit, and therefore does not produce any noise during the operation.
- Review of the 1/3 octave frequency confirmed that a +5 dB adjustments was applied to the Inverters.
- Current model assumes no tonality correction required for BESS – at this stage 1/3 octave spectral data is not available for the BESS, tonality assessment/adjustment to be conducted at a later stage when updated noise data is received.
- BESS equipment oriented such that loudest façade (i.e., Front façade) is directed towards the East (towards R02).
- MVPS (Medium Voltage Power Station) equipment oriented such that loudest façade (i.e., ac outlet) is directed West (towards R03/R06).
- 1/3 Octave spectral data for transformers were taken from the Australian Acoustical Society[(a)].
- Transformer (large-scale connection asset) SWL and MVPS internal transformer SWL calculated from Standard 60076/IEC-2001.
- Tonality corrections applied in line with methodology outlined in 1826.4 (Noise limit and assessment protocol for the control of noised from commercial, industrial and trade premises and entertainment venues: ANNEX C: Objective tonal method) (EPA VIC, 2021).
- Harmonic filter noise and spectral data provided by ACLE to AE through email communication dated 15/07/2024.

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

Table 8: Noise Sources

Equipment	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}	
MVPS (Medium Voltage Power Station) [a] Inverter Container with Sound Proofing	MVPS Inverter (Top façade)	88	2.90	100	100	100	60[a]	n/a	+5 dB
	MVPS Inverter (Front façade)	88	2.90	100	100	100	76[a]	n/a	+5 dB
	MVPS Inverter (Back façade)	88	2.90	100	100	100	72[a]	n/a	+5 dB
	MVPS Inverter (AC inlet Side)	88	2.90	100	100	100	69[a]	n/a	+5 dB
	MVPS Inverter (AC outlet Side)	88	2.90	100	100	100	72[a]	n/a	+5 dB
MVPS Internal Transformer (4 MVA)	MVPS internal transformer (Top façade)	88	2.90	100	100	100	76[d]	n/a	+5 dB
	MVPS Transformer (Side façades)	88	2.90	100	100	100	76[d]	n/a	+5 dB
BESS (Battery Energy Storage System) [b][c] BESS	BESS Air Intake side (north)	352	2.90	100	100	100	80[c]	n/a	None[c]
	BESS Back side (south)	352	2.90	100	100	100	67[c]	n/a	None[c]
	BESS Air Outtake side	352	2.90	100	100	100	67[c]	n/a	None[c]
	BESS Chiller side	352	2.90	100	100	100	68[c]	n/a	None[c]
	BESS Top side		2.90	100	100	100	76	n/a	None[c]
Kiosk Substation	1.5 MVA Auxiliary substation	4	2.50	100	100	100	69	n/a	+5 dB
Harmonic Filter	34.5 kV/ 25 MVA Harmonic filter (3-phase)	2	2	100	100	100	76	n/a	None
120 MVA Transformer	120 MVA Transformer	2	2.00	100	100	100	95[d]	n/a	+5 dB

a) Datasheet provides Sound pressure level at 0.2 m at each of the different facades. Model was calibrated so each façade produced a sound pressure level at 0.2 m as described in manufacturers datasheet.

b) Data sheet provides sound pressure levels at 1m from each of the different facades. Model was calibrated such that each façade produced a sound pressure level at 1m as described in manufacturers datasheet.

c) Assumes no tonality correction required for BESS – at this stage 1/3 octave spectral data is not available, tonality assessment/adjustment to be conducted at a later stage when updated noise data is received.

d) Sound power calculation for transformers guided by Standard 60076-10/IEC-2001.

5 PREDICTED NOISE LEVEL

The site in its current arrangement does not require additional acoustic barriers to achieve compliance. It is noted however no tonality correction has been applied to BESS equipment in absence of 1/3 octave spectral data. Further adjustment to the model may be required at a later stage when updated manufacturer noise data is available.

Table 9 below presents predicted receptor noise levels during the operational phase of the proposed BESS with inverter soundproofing and containerized BESS.

Review of the predicted noise levels confirms that compliance with the distance adjusted noise criteria established in accordance with the assessment protocol can be achieved for all receptors for both day, evening, and night periods under worst-case meteorological conditions.

Review of the predicted 1/3 octave frequency spectra at receptor R05, indicates that there is no risk of problematic low frequency noise, as described in the Low Frequency Noise guidelines.

Table 9: Predicted Receptor Noise Levels (dB(A))

Receptor	Predicted Operational Noise Levels, LAeq,			Distance Adjusted (Day/Evening/Night)	Comply (Y/N)
	Day	Eve	Night		
R01	31	31	31	45/39/34	Y | Y | Y
R02	30	30	30	45/39/34	Y | Y | Y
R03	21	21	21	45/39/34	Y | Y | Y
R04	24	24	24	45/39/34	Y | Y | Y
R05	34	34	34	45/39/34	Y | Y | Y
R06	23	23	23	45/39/34	Y | Y | Y

6 CONCLUSION

ACLE propose to develop a BESS in Pine Lodge, VIC. The noise impact assessment has considered the potential for adverse impacts resulting from operational noise emissions on nearby residential uses.

The results of the assessment demonstrate; with the inverters soundproofed and the containerized BESS equipment the impact to surrounding receptors is considered low, when compared to distance adjusted limits described in the Noise Protocol.

Overall, the risk of residual adverse impacts as a result of the proposed BESS is considered to be low with noise emissions complying with the applicable criteria. Hence, from an acoustic perspective, the proposed Subject Site is considered acceptable for the proposed use.

APPENDIX A: PROPOSED PLANS

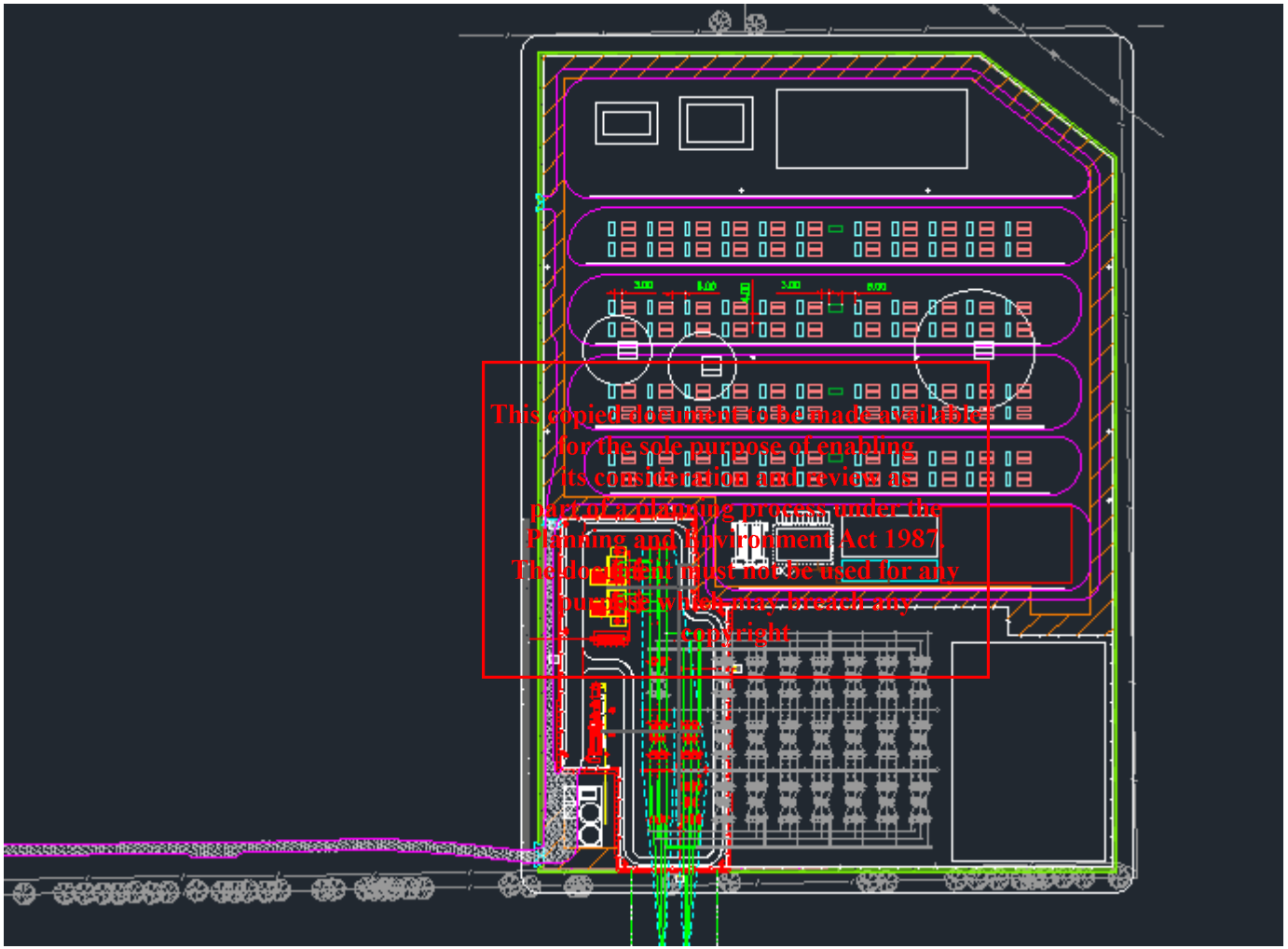


Figure 4: Equipment Layout for Subject Site (Option 2)

APPENDIX B: NOISE CONTOURS

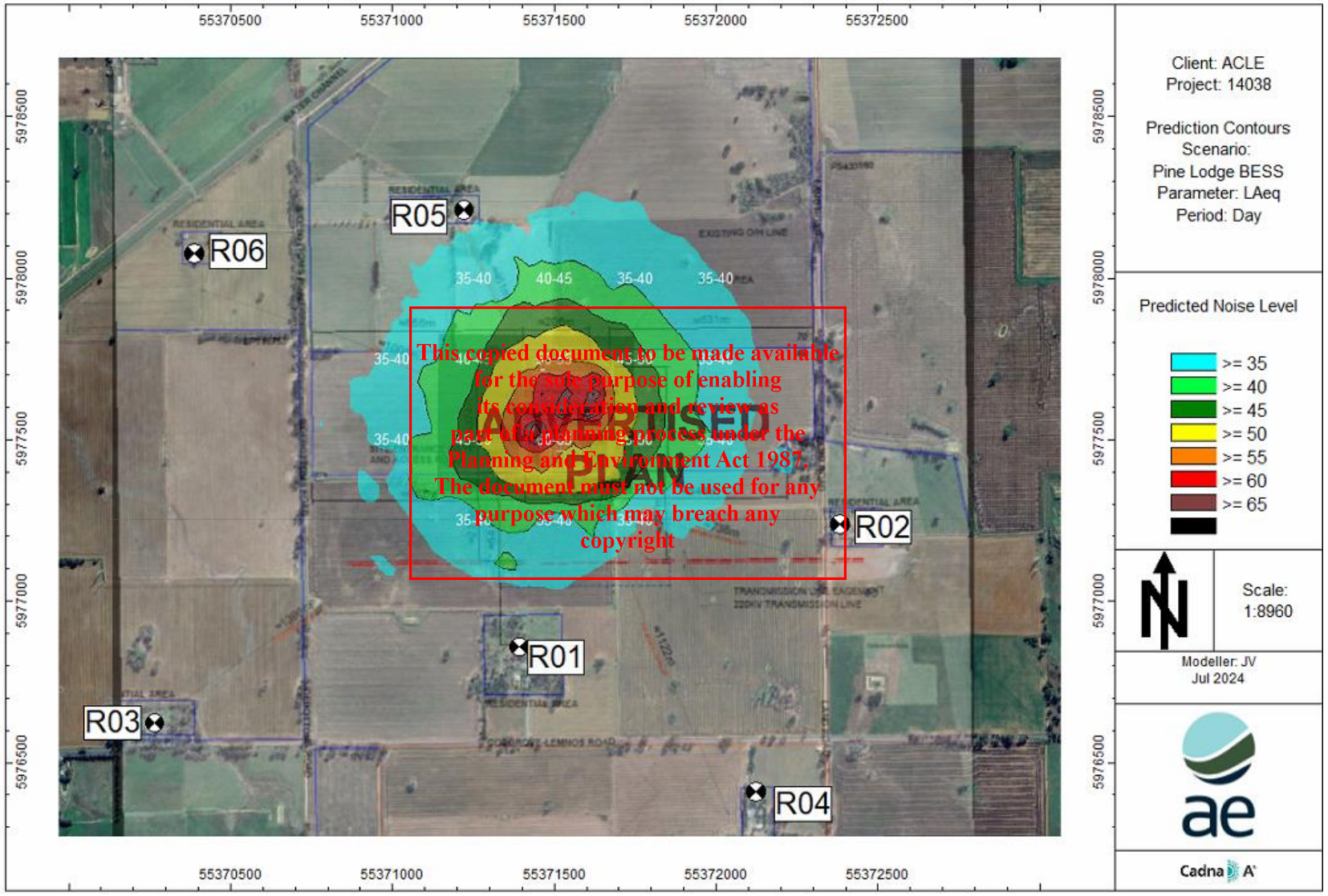


Figure 5:Predicted L_{Aeq} Operation Noise Level Contour at 1.5m– Day

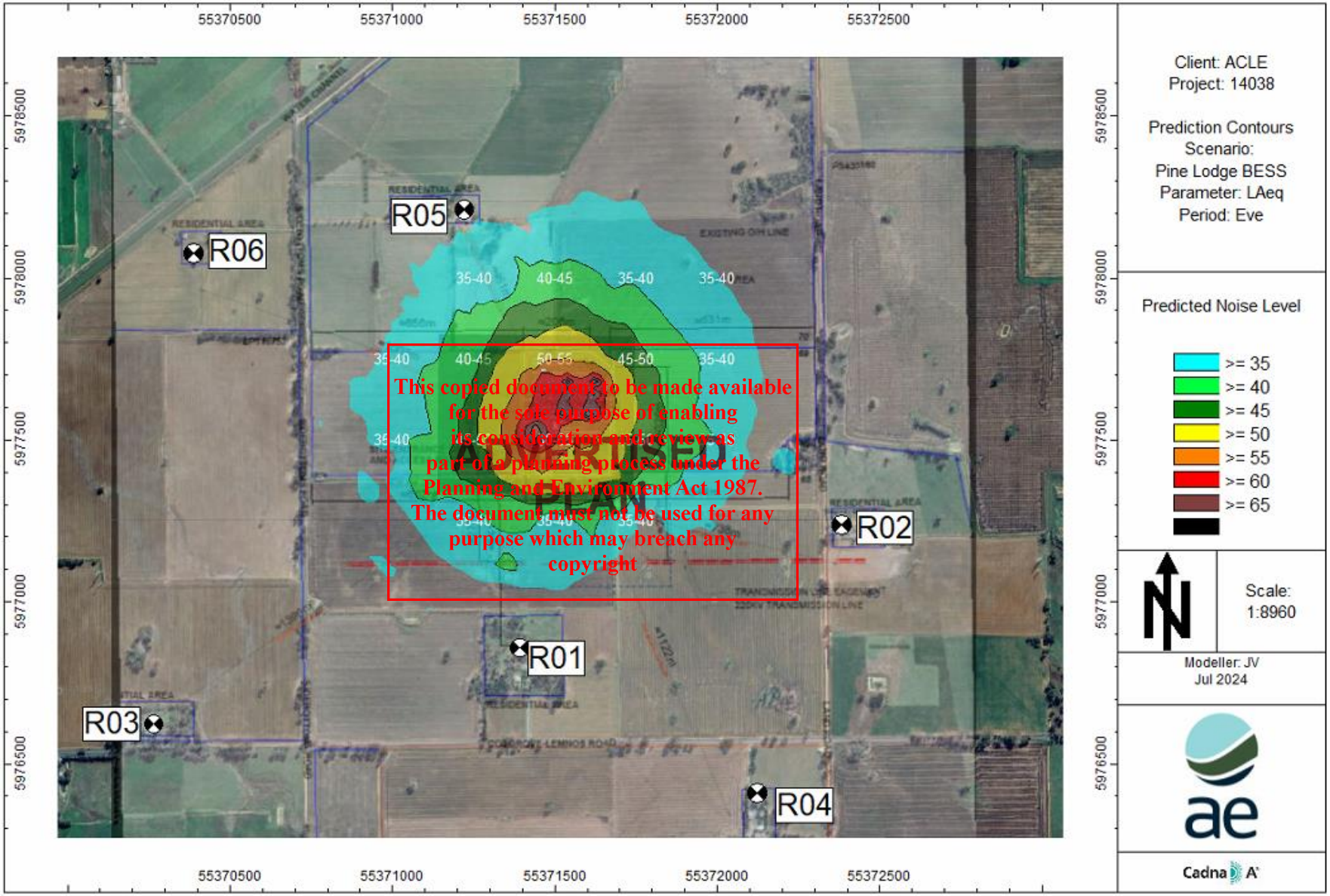


Figure 6:Predicted L_{Aeq} Operation Noise Level Contour at 1.5m– Evening

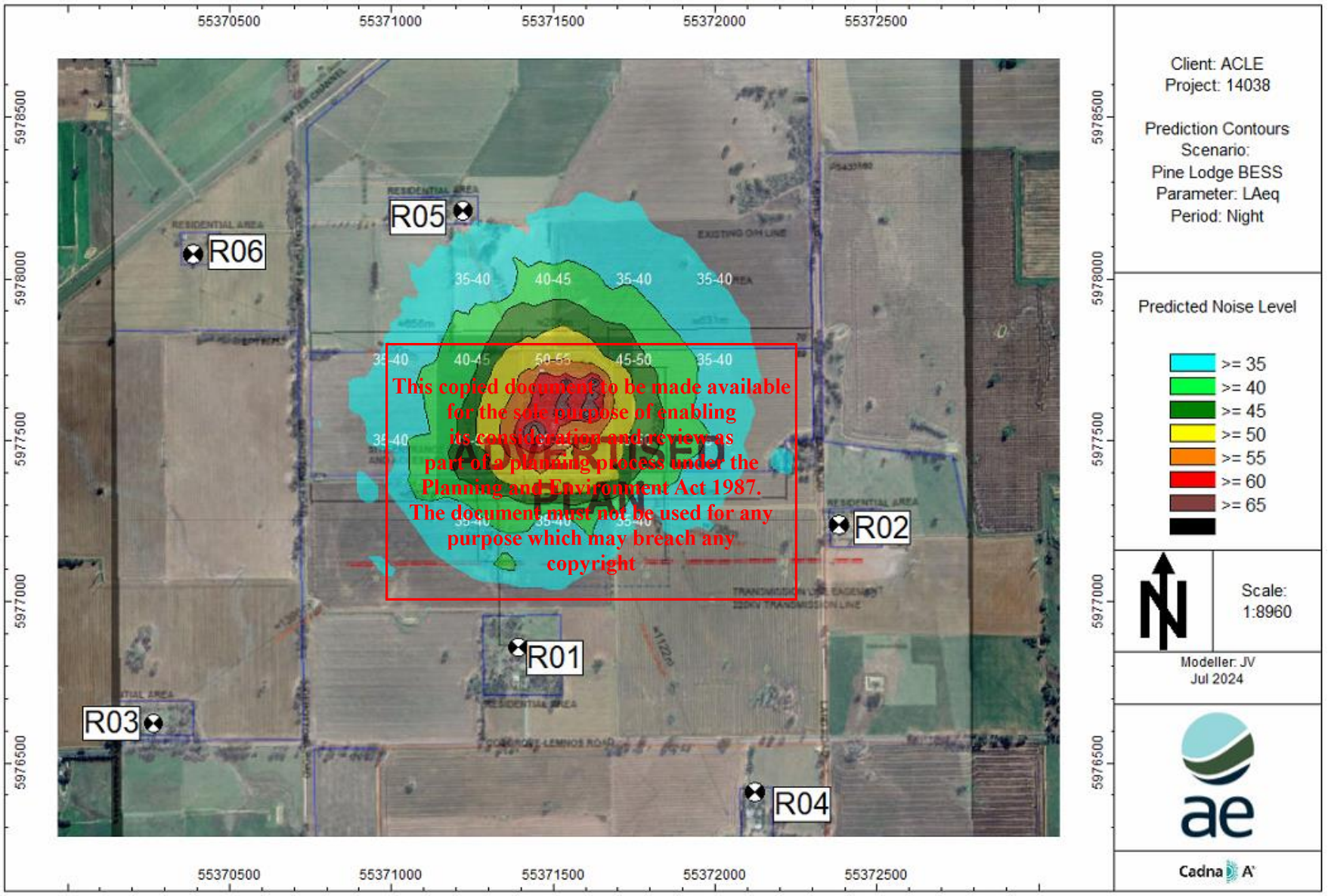


Figure 7: Predicted L_{Aeq} Operation Noise Level Contour at 1.5m– Night