MARSHALL DAY Acoustics

WINTON BESS
ENVIRONMENTAL NOISE ASSESSMENT

Rp 001 R02 20241089 | 23 October 2025

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SUMMARY

Avenis Energy (Avenis) propose to develop a 120 MW/480 MWh grid-scale battery energy storage system (BESS) at 6 Bowers Lane, Winton, approximately 10 km east of Benalla, Victoria, referred to as Winton BESS (Project).

The Project is located adjacent to Hume Freeway and close to several other existing and proposed developments, primarily comprising electrical utility and solar energy infrastructure.

NGH Consulting (NGH) is assisting Avenis with the preparation of planning application for the Project. NGH has engaged Marshall Day Acoustics (Australia) Pty Ltd (MDA) to assess potential noise impacts from the Project, to inform an evaluation of feasibility and support the planning permit application.

We have undertaken a predictive environmental noise assessment to address the requirements of the EP Act and other relevant Victorian noise policy, including applicable noise limits and Project design targets.[1] The assessment adopts a candidate configuration of noise generating equipment and noise controls that has been developed in consultation with Avenis.

Avenis has considered the general environmental duty (GED) and implemented reasonably practicable noise control measures into the candidate Project design. These include equipment selection, proprietary battery and inverter at-source noise mitigation (noise control kits) and conceptual noise barriers.

Project noise limits and design targets have been derived considering existing noise conditions in the area based on a noise survey conducted in May 2025. Consideration has also been given to the other utility and infrastructure developments in the area with regard to direct measurement.

Predicted noise levels from the candidate Project design are indicated to comply with the relevant Project design targets and noise limits.

As the Project is further developed, and Avenis undertakes detailed design, tender and procurement, equipment selections the noise mitigation measures may be refined. This must be done in conjunction with additional acoustic review and with consideration of the GED made under the EP Act. If the Project design development offers reasonably practical measures that provide a material reduction in the risk of harm due to noise, the GED requires such measured to be implemented.

[1] Victoria State Government, *Environment Protection Act 2017*, Act Number 51/2017 (EP Act)

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1.0 INTRODUCTION

Avenis Energy (Avenis) propose to develop a 120 MW/480 MWh grid-scale battery energy storage system (BESS) at 6 Bowers Lane, Winton, approximately 10 km east of Benalla, Victoria, referred to as Winton BESS (Project).

The Project is located adjacent to Hume Freeway and close to several other existing and proposed developments, primarily comprising electrical utility and solar energy infrastructure. The Project comprises a lithium-ion BESS, incorporating battery units with associated inverters and transformers and a range of ancillary operational infrastructure including an onsite substation.

NGH Consulting (NGH) is assisting Avenis with the preparation of planning application for the Project. NGH has engaged Marshall Day Acoustics (Australia) Pty Ltd (MDA) to assess potential noise impacts from the Project, to inform an evaluation of feasibility and support the planning permit application.

The assessment summarised in this report is based on a candidate Project design, equipment selections and conceptual noise control measures that have been developed in consultation with Avenis. It contains details of the candidate Project, associated noise data, and an evaluation of predicted noise levels against relevant Project design goals and applicable environmental noise limits.

Where changes from any aspect of the assessment detailed in this report occur, the changes should be reviewed and verified for continued compliance of the Project.

A glossary of acoustic terminology used throughout this report is provided in Appendix A.

2.0 PROJECT OVERVIEW

2.1 Project location and description

The Project is bordered by a rail corridor and the Hume Freeway to the northwest and southeast respectively.

Rural properties surround the Project site, with the majority of the land to the north, east and south comprising existing and proposed utility infrastructure, developed by third parties.

The primary land use within and surrounding the Project site is agriculture. Under the Benalla Rural City Planning Scheme, the Project site is predominantly zoned Farming Zone (FZ), with the southeast section located within a Transport 2 Zone (TRZ2).

A land zoning map is provided in Appendix B.

At this early stage of development, a candidate Project design has been developed by Avenis to establish site feasibility. The candidate Project design was provided to MDA on 17 February 2025.

The key noise generating equipment in the candidate Project design are summarised in Table 1.

Table 1: Equipment description

Equipment	Quantity
Battery units	140
Inverters	42
4.6 MVA medium voltage (MV) transformer	42
150 MVA high voltage (HV) transformer	1

The candidate Project design is shown in Figure 1.

Figure 1: Candidate site layout (aerial imagery: Metromap

2.2 Noise sensitive areas

NGH has provided MDA with information regarding noise sensitive areas (receivers) identified within 4 km of the Project. All the noise sensitive areas are rural residential properties.

For the purposes of this noise assessment, a 1.5 km study area from the Project site boundary has been adopted. The residential properties within this study area are summarised in Table 2. Compliance at these receivers will imply compliance at receivers at greater distances.

Table 2: Residential properties within 1.5 km study area

Property ID	Address	Approx. distance to Project boundary, m	Note
R1	*6 Bowers Rd*	*Within boundary*	*To be demolished. Not included in assessment.*
R2	21 Bowers Rd	180	-
R3	576 Winton-Glenrowan Rd	420	-
R4	116 Lee Rd	600	-
R6	84 Glenwest Ln	1,200	-

Based on the information in Table 2, there are 4 relevant properties that are adopted as receivers for the purposes of the noise assessment. These are R2, R3, R4 and R6.

The locations of the receivers in relation to the Project are shown in Figure 2. The receivers are also shown in the land zoning map in Appendix B. All are located within land categorised as Farming Zone (FZ).

Further information regarding the definition of receivers is provided in Section 3.4 and Appendix C.

2.3 Other projects

There are several other existing and planned electrical infrastructure projects in the vicinity of the Project, including terminal stations, solar facilities and BESS facilities.

It is understood that the following projects are fully constructed and operating:

- Winton Solar Farm (WSF)
- Glenrowan West Solar Farm (GWSF)
- Glenrowan Solar Farm (GSF)
- Glenrowan Terminal Station (GTS).

In addition, there are 2 linked facilities that are under construction and partially operating. These are:

- Mokoan Solar Farm and Mokoan 2 Solar Farm (collectively referred to as MSF).

Finally, there are additional facilities that are known to be under development but are not currently constructed or operating. These include:

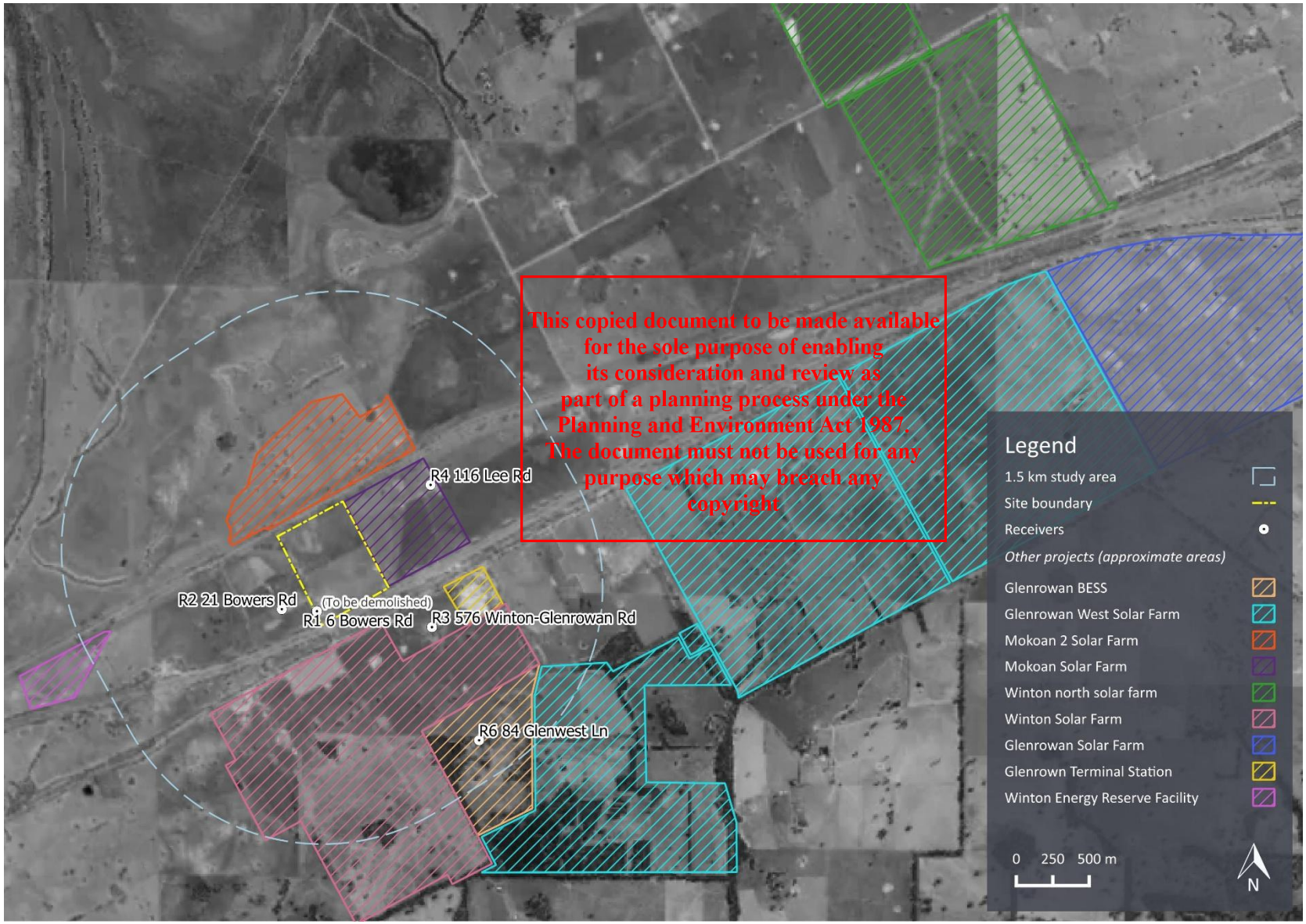
- Winton North Solar Farm (WNSF)
- Winton Energy Reserve Facility (WERF)
- Glenrowan BESS (GBESS).

It should be noted that several of the existing solar farm facilities are sufficiently recent that they are not reflected in available public aerial imagery.

The location of the above sites in relation to the Project is shown in Figure 3.

Figure 2: Project site and receivers (aerial imagery: Metromap)

Figure 3: Other projects (aerial imagery: Metromap)



3.0 LEGISLATION AND GUIDELINES

In Victoria, environmental noise is regulated by several different requirements, including various legislation, local laws, and Victoria's planning system.

The environmental noise assessment requirements for commercial, industrial and trade (CIT) premises are defined by several Victorian government documents, comprising:

- *Environment Protection Act 2017 (EP Act)*
- *Environment Protection Regulations 2021 (EP Regulations)*
- EPA Publication 1826.4 *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues* dated May 2021 (Noise Protocol)

The requirements and guidance of these documents is summarised below. Additional details and extracts from these documents are provided in Appendix C.

3.1 Environment Protection Act 2017

The EP Act provides the overarching legislated protection of the environment in Victoria and establishes mandatory requirements for the control of environmental noise. The following key obligations apply under the EP Act:

- A person who is engaging in an activity that may give rise to risks of harm to human health or the environment has a general environmental duty (GED) to minimise the risk of harm, so far as reasonably practicable.
- A person must not, from a place or premises that are not residential premises, emit unreasonable noise or permit unreasonable noise to be emitted.

The risk of harm under the EP Act includes both health and amenity related noise impacts. The EP Act defines environmental noise as unreasonable if it is:

- prescribed to be unreasonable from an assessment against mandatory noise limits (see Sections 3.2, Section 3.4 and Section 5.3), or
- assessed to be unreasonable according to the following factors defined in the EP Act:
  - noise volume, intensity or duration
  - noise character
  - the time, place and other circumstances in which the noise is emitted
  - how often the noise is emitted
  - any prescribed factors relating to the noise (frequency spectrum being a prescribed factor).

3.2 Environment Protection Regulations 2021

The EP Regulations give effect to the EP Act by establishing prescriptive requirements for a range of environmental considerations including noise.

The noise requirements are defined according to the type of noise generating activity under consideration. The EP Regulations also define the types of noise sensitive areas where these requirements apply and the hours of different assessment time periods (i.e. day, evening and night).

The EP Regulations specify that the prediction, measurement, analysis and assessment of operational industry noise within a noise sensitive area must be conducted in accordance with the Noise Protocol (see Section 3.4).

Noise from industry is prescribed by the EP Regulations to be unreasonable for the purposes of the EP Act if it exceeds the noise limit determined in accordance with the Noise Protocol.

3.3 Environment Reference Standard

The ERS was introduced under the EP Act and sets out environmental and human health outcomes that are sought to be achieved and maintained in Victoria. The outcomes are described by the ERS in terms of a collection of environmental values, indicators and objectives.

The environmental values of the ambient sound environment defined by the ERS relate to conditions that are conducive to domestic activities (conversation, recreation and sleep), learning, and appreciation and enjoyment of tranquillity in natural areas. The environmental values in most settings are defined using quantitative indicators and the objectives for these indicators are defined according to the land use and planning zone.

For natural areas, the indicator is qualitative and is based on an appraisal of sound quality that is conducive to human tranquillity and enjoyment of natural soundscapes.

Indicators and objectives for the ambient sound in different settings are defined to provide a basis for assessing actual and potential risks to the environment. They also provide a benchmark for comparing the state of the environment, or potential changes to the environment, to desired outcomes. However, the ERS is not a compliance standard. The primary function of the ERS is to provide an environmental assessment reporting benchmark which can be used as a reference point for decision makers to consider whether a proposal or activity is consistent with the environmental values identified in the ERS.

Direct regulation such as noise limits (refer Section 3.4), where applicable, takes precedence over the ERS.

3.4 EPA Publication 1826.4 (Noise Protocol)

The Noise Protocol defines a procedure for setting noise limits that apply to the operation of industry premises and entertainment venues in Victoria. Compliance with the noise limits is mandatory.

The Noise Protocol defines noise limits that are used to assess whether a noise is prescribed to be unreasonable in accordance with the EP Regulations and the EP Act. Noise from the Project and all other CIT premises, when measured within a '*noise sensitive a*rea' must be below the limits.

The noise limits apply at a noise sensitive area, which is defined by the EP Regulations as being '*within 10 metres of the outside of the external walls'* of buildings including dwellings, hotels, and schools. In rural areas, noise sensitive areas also include land within the boundary of campgrounds, caravan parks and certain types of tourist establishments. In this report, noise sensitive areas are referred to as receivers.

The procedures for setting noise limits are defined separately for urban and rural areas. However, in both cases, the noise limits are defined by considering the land zoning in the area and the noise environment of the receiver (in the absence of the noise source being assessed), and apply separately for day, evening and night periods.

The noise limits derived for the Project are provided Section 5.3.

3.5 Related Victorian guidelines

To support the application the legislation and guidance summarised in the preceding sections, a range of Victorian publications provide additional advice on matters of interpretation and technical procedures. These publications include:

- EPA Publication 1992 *Guide to the Environment Reference Standard,* dated June 2021
- EPA Publication 1996 *Noise guideline – assessing low frequency noise,* dated June 2021
- EPA Publication 1997 *Technical guide: Measuring and analysing industry noise and music noise*, dated June 2021.

The EPA also provides online guidelines relating to noise, including:

- commerce, industry and trade noise guidelines[2]
- noise advice for businesses[3]
- unreasonable noise guidelines[4].

Broader relevant industry guidance is also provided in:

- EPA Publication 1695.*1 Assessing and controlling risk for business*, dated 1 March 2019
- EPA Publication 1856 *Reasonably practicable*, dated September 2020.

These guidelines are non-statutory documents which provide detailed advice for a broad range of technical considerations. Relevant aspects of these guidelines are referenced where appropriate in this assessment.

3.6 Town planning

The Project is located within Benalla Rural City Council boundary. Relevant clauses from the Planning Scheme are discussed in the following sections.

3.6.1 Clause 13.05

Clause 13.05 *'Noise'* includes general requirements to '*minimise the impact on human health from noise exposure'*.[5] It lists '*building siting and design (including orientation and internal layout), urban design and land use separation techniques*' as noise mitigation measures but does not prescribe specific requirements.

Broadly, the intent of the clause aligns with the legislated GED described in Section 3.1.

The policy documents summarised in Section 3.1 through Section 3.4 are stated to be considered *'as relevant'* to the clause.

[2] See EPA commerce, industry and trade noise guidelines through this weblink

[3] See EPA noise advice for business through this weblink

[4] See EPA unreasonable noise guidelines through this weblink

[5] https://planning-schemes.app.planning.vic.gov.au/Benalla/ordinance

Additional documents listed in the clause relate to noise from rail infrastructure and are not relevant to this assessment.

Overall, the clause does not impose any mandatory or specific requirements additional to those outlined by state legislation.

3.6.2 Clause 19.01-2S *Renewable Energy*

This clause provides generalised commentary regarding siting and design of renewable energy facilities, including consideration of effects of a proposal on the local community and environment.

No specific requirements regarding noise or BESS facilities are provided.

3.6.3 Clause 53.13 *Renewable Energy Facility (other than wind energy facility)*

The purpose of this clause is to facilitate the establishment and expansion of renewable energy facilities, with '*minimal impact on the amenity of the area*'.

No specific criteria or requirements are provided, however an amenity impact assessment for noise is noted to be required as part of an application.

4.0 EXISTING NOISE ENVIRONMENT

MDA conducted a survey at the Project site to gain an understanding of the existing noise conditions.

MDA attended site on Tuesday 13 May 2025 to carry out attended measurements and deploy a noise logger to continuously measure noise levels for 8 days.

4.1 Noise logging

Noise logging was conducted at R2 21 Bowers Road using a 01dB Fusion sound level meter (S/N 15392). The location of the noise logging is shown in Figure 4.

The noise logger was calibration checked before and after the survey and no significant drifts were observed. The microphones were mounted on tripods at approximately 1.5m above local ground level. An image of the noise logger in-situ is provided in Appendix D.

The noise logger was on site for 8 days. A weather station was deployed alongside the noise logger to continuously record wind speed, rain intensity and temperature throughout the survey. Review of the weather data indicated appropriate conditions for noise measurements in accordance with the Noise Protocol with hourly mean wind speeds lower than 5 m/s and no rain recorded.[6]

During deployment, the Hume Freeway was the dominant noise source, with no other significant environmental noise sources. No sound from other currently operational CIT premises (refer Section 2.3) was audible at the time of deployment.

The arithmetic average of the hourly measured background noise levels ($L_{A90,1hr}$) recorded for each day, evening and night period was calculated in accordance with the Noise Protocol, and are shown in Table 3.

Due to being located a similar distance from the Hume Freeway, the background noise level data for R2 has also been referenced for R3.

[6] EPA Publication 1826.4 *Noise limit and assessment protocol for the control of noise from commercial, industry and trade premises and entertainment venues*

Table 3: Average hourly measured background noise levels, R2, dB $L_{A90,1hr}$

Day	Date	Day	Eve	Night
Tues	13 May 2025	-[a]	51	49
Wed	14 May 2025	45	51	49
Thu	15 May 2025	45	51	49
Fri	16 May 2025	46	49	42
Sat	17 May 2025	47	41	32
Sun	18 May 2025	-[b]	50	40
Mon	19 May 2025	46	49	47
Tues	20 May 2025	45	49	48
Wed	21 May 2025	45	48	45
Minimum		45	41	32

a The average for the day period on Tuesday 13 May was not calculated due to insufficient data.

b Day period is not calculated on Sundays, as the evening period is defined as 0700-2200 hrs.

Charts showing the hourly measured noise levels at each location, and the hourly measured equivalent noise levels ($L_{Aeq,1hr}$) are provided in Appendix E.

4.2 Attended observations

Various attended measurements and observations were carried out at the locations shown in Figure 4. Meteorological conditions during the attended survey were still, with no rain, and ambient temperatures in the order of 4-12 °C.

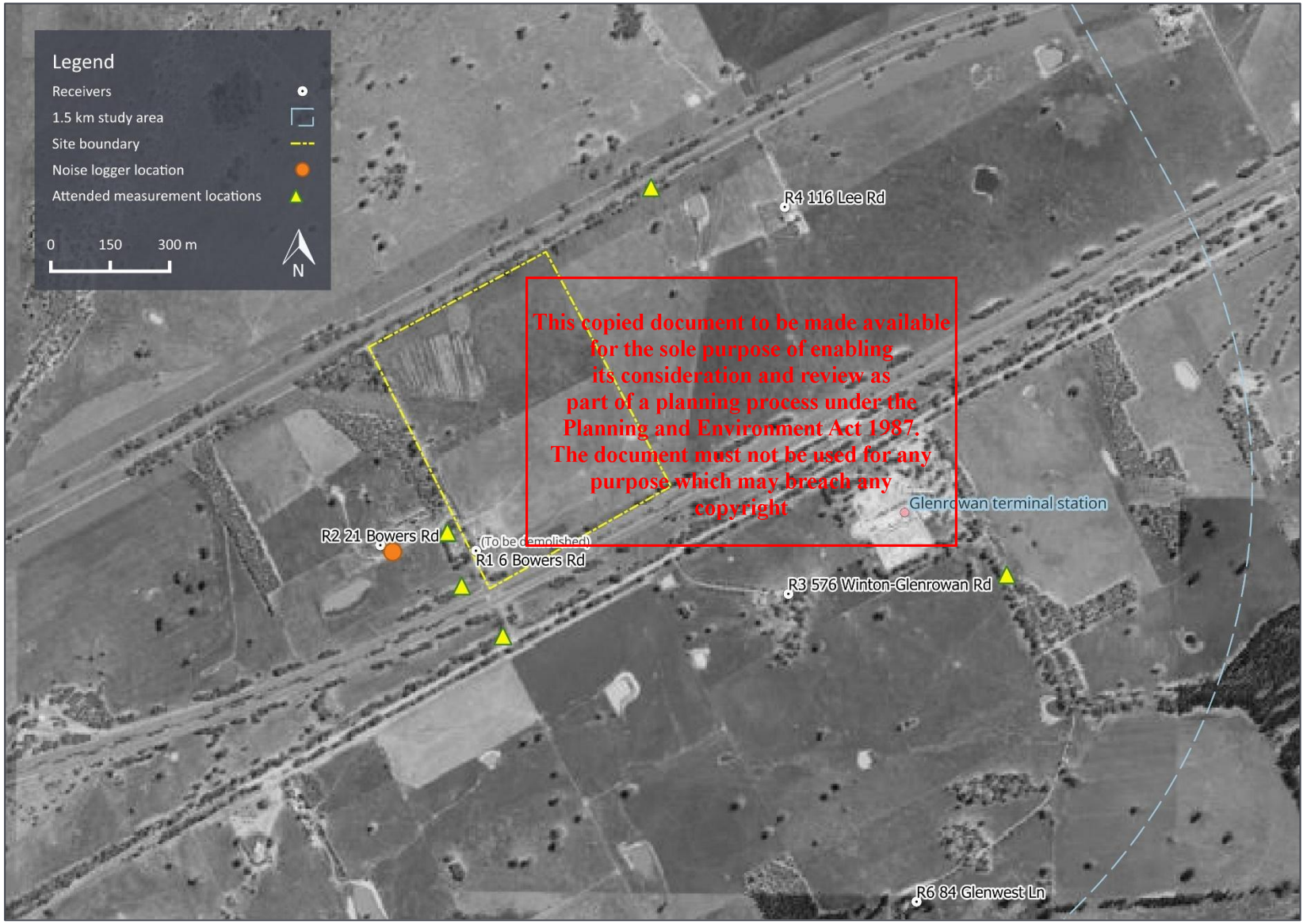
Noise from all operational CIT premises was inaudible at R2. The noise environment was dominated by road traffic noise. Given the nature of Hume Highway, traffic flow, and consequently, traffic noise, was generally constant during the day and evening periods. At night noise from the highway remained dominant but with lower traffic flow intensity.

Receiver R4 is located adjacent to the recently constructed MSF. The site is characterised by arrays of solar panels, with distributed inverter stations throughout the site that were observed to generate continuous noise during the survey. The closest inverter to R4 is located approximately 185 m from the dwelling. To assess potential noise from MSF at R4, noise was measured along Lee Road. It was observed that noise from the MSF inverter stations was clearly audible within approximately 50 m. At larger distances, similar to those between R4 and the closest MSF inverter stations, noise from the inverters was barely audible above the noise from road traffic.

For R3, alternative measurement locations along Glenwest Lane were used to assess whether noise from GTS was likely to be a significant factor at R3. The measurements were taken such that the distance to GTS was similar to R3, but the distance to the road, which may provide masking noise, was greater. Noise from GTS was inaudible during the measurements.

On this basis noise from operational CIT premises is not indicated to be a contributing factor to cumulative noise at the receivers.

Figure 4: Noise survey measurement locations (aerial imagery: Metromap)



5.0 ASSESSMENT METHOD

5.1 Overview

As discussed in the previous section, the overarching noise requirements for the Project are defined by the EP Act.

The cornerstone of the EP Act is the GED, which requires that the risk of harm due to noise be minimised so far as reasonably practicable. Residual noise impacts are then assessed as to whether they could constitute unreasonable noise under the EP Act. Natural areas that are not directly covered by direct legislation (Noise Procol) are also given consideration.

Unreasonable noise is addressed by considering the requirements of the EP Regulations and the Noise Protocol.

The overarching approach to the assessment of noise for the Project is described in Table 4.

Table 4: Assessment method

Step	General method
Consider hazards and assess risk	Preliminary noise modelling was used to identify specific hazards which could contribute to the risk of harm. Equipment noise data was provided by Avenis or derived by MDA from previous projects.
Reduce risk so far as reasonably practicable	In consultation with the Project team, controls were investigated which could reduce the risk of harm, and it was determined whether they were reasonably practicable. Noise control measures were informed by iterative noise modelling to determine whether they afforded a material reduction in noise level.
Assess residual noise impacts	Measures that were deemed reasonably practicable and feasible for consideration at this stage were incorporated into the assessment. Noise levels were predicted with measures in place to determine residual noise impacts and inform the residual risk of harm due to noise.
Check controls	GED obligations are ongoing over the life of the Project. Ways to effectively monitor and maintain compliance with the GED have been recommended.

5.2 Consideration of natural areas (ERS)

The ERS describes a natural area as *'Unique combinations of landscape, biodiversity and geodiversity. These natural areas typically provide undisturbed species habitat and enable people to see and interact with native vegetation and wildlife.'*

Natural areas in the vicinity of the Project include bushland and wetland reserves. These are shown in Appendix C3

Only one natural area, the Winton Wetlands Natural Features Reserve, lies within 1.5 km of the Project site and this represents only a small fraction of the overall Reserve.

It is anticipated that noise from the Project will be audible at times within some parts of the Winton Wetlands Natural Features Reserve. However these parts of the Reserve will already be subject to noise from the Hume Freeway which runs adjacent to the site. Furthermore, as seen in Section 2.3, significant other utility projects are in development throughout the area

In the context of these other noise sources, noise from the Project site is not anticipated to significantly alter the character of existing noise within the Reserve.

5.3 Operational noise limits

Noise limits have been derived in accordance with the rural area method of the Noise Protocol. The limits are expressed in terms of the effective noise level (ENL) which is defined as the 30-minute worst-case equivalent (L_{Aeq}) noise level, adjusted to account for noise character if required.

As defined in the EP Regulations, the limits apply externally, up to 10m from the exterior walls of a dwelling, but within the property boundary.

The environmental noise limits derived for the relevant receivers within the study area, based on the land zoning and the measured background noise levels, are summarised in Table 5**.**

Detailed derivations of the noise limits are summarised in Appendix C5.

Table 5: Summary of environmental noise limits, dB ENL

Period	R2 21 BowersRd / R3 576 Winton-Glenrowan Rd	R4 116 Lee Rd / R6 84 Glenwest Ln
Day	53	45
Evening	46	39
Night	37	34

5.4 Project targets to allow for cumulative noise

The noise limits in Section 5.3 apply to noise from all CIT premises.

In evaluating noise levels from other existing CIT premises MDA has placed reliance on information collected during the noise survey described in Section 4.0.

During the survey, road traffic noise was observed to be dominant at the assessment receivers. Additionally, the attended noise survey summarised in Section 4.2 indicated that noise from operational CIT premises was not audible at the receivers and therefore not indicated to be a contributing factor to cumulative noise at the receivers

Nonetheless a conservative -3 dB adjustment to the noise limits has been adopted to allow for potential cumulative noise beyond what was directly observed at site by MDA. Quantitatively, this adjustment would enable 50% of the noise at a receiver location to be generated by other sites. This also allows for noise from other CIT premises that are currently in development. Given the existing noise environment and distances to the other projects in development (refer Section 2.3) this is expected to be an appropriate allowance.

The project targets are provided in Table 6.

Table 6: Project design targets, dB ENL

	R2 21 BowersRd / R3 576 Winton-Glenrowan Rd	R4 116 Lee Rd / R6 84 Glenwest Ln
Noise limit (Day/Evening/Night)	53/46/37	45/39/34
Allowance for cumulative noise	-3	-3
Project design targets (Day/Evening/Night)	**50/43/34**	**42/36/31**

5.5 Noise prediction method

Operational noise levels associated with the Project are predicted using:

- noise emission data for the battery units, inverters, and transformers.
- a 3D digital model of the Project and the surrounding environment, using proprietary noise modelling software SoundPLANnoise v9.1.
- implementation of the environmental sound propagation method specified in ISO 9613-2.[7]

The implementation of ISO 9613-2 within proprietary noise modelling software enables multiple sound transmission paths, including reflected and screened paths, to be accounted for in the calculated noise levels. ISO 9613-2 was designed to assume conditions that favour the propagation of noise from meteorological effects, described as a slight wind (1 to 5 m/s) blowing from source to receiver, or a well-developed moderate ground-based temperature inversion.

A digital terrain map with a cell size of 10 m has been sourced from the public national portal, Elevation Information System (ELVIS) to develop the topographical model used within the context of the noise model. [8]

All equipment items are modelled as omnidirectional point sources of noise with associated octave and third-octave band sound power level noise emissions. Further details regarding equipment noise levels are provided in Section 6.2.

Further information and details of the noise model inputs and noise modelling method are presented in Appendix F.

[7] International Standard ISO 9613-2: 2024 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: Engineering method for the prediction of sound pressure levels outdoors.*

[8] https://elevation.fsdf.org.au/

6.0 ASSESSMENT OF PREDICTED NOISE

Detailed information regarding the noise model inputs and method is provided in Appendix F.

There are several relevant contextual points relating to assumptions and inputs that contribute to the outcomes of this planning stage assessment, including:

- the inclusion of noise controls in the assessment (discussed in Section 6.1).
- the selection of representative noise emission data for equipment (discussed in Section 6.2).
- the selection of equipment operational duty (discussed in Section 6.2).
- application of character adjustments (discussed in Section 6.3).
- cumulative noise from existing electrical infrastructure (discussed in Section 6.4).

The final equipment selections would be nominated after a tender process to procure the supply of batteries, inverters and transformers. The final selection would be based on a range of design requirements including achieving compliance with the noise limits at surrounding receivers.

Accordingly, to assess the potential noise impacts at this stage of the Project, it is necessary to consider a candidate configuration of noise generating equipment and noise controls, using equipment noise emission data that is representative of the size and type of equipment being considered.

As with any infrastructure Project, specific aspects of the design, including equipment selections, may change during detailed design, tender and procurement as further, detailed information is established. All obligations under the EP Act, including the GED, and not generating unreasonable noise including by complying with noise limits, will continue to be evaluated during subsequent stages of development.

6.1 Noise controls

The GED requires that the risk of harm be reduced so far as reasonably practicable. We have considered the available risk controls for noise and discussed these with the Project team.

The key available noise controls for a Project of this type are discussed in the following sections.

The adopted controls for the Project at this stage are intended to be reviewed and refined as the design progresses. Any changes to the controls will require further acoustic review.

6.1.1 Selection of low noise equipment

For a BESS, the most effective noise control is typically the selection of equipment with the lowest possible noise levels.

This decision has been considered by the Project team in the early stages of development.

At this stage the equipment selections have not yet been finalised as this will require further detailed design development work.

A candidate equipment selection has been nominated for the purposes of this assessment with the intent to review and implement quieter equipment wherever practicable as the design of the Project progresses. The candidate equipment has been confirmed as being representative and feasible for use for the Project, by the Proponent.

It is noted that the noise modelling adopts a concept of all equipment operating concurrently at maximum cooling system operation under normal conditions at all times. This is unlikely to be the case in practice, particularly at night when ambient temperatures are lower and cooling system requirements are reduced. On this basis night-time noise predictions are expected to be conservative.

6.1.2 Equipment layout and orientation

The noise from some items such as batteries is typically directional.

With the site, the equipment has been located as far as practicable from the nearest noise sensitive receivers.

At this stage, insufficient information is available for the candidate equipment to robustly quantify the effect of equipment directivity, on this basis batteries are modelled as omni-directional noise sources. Such an approach is expected to be conservative a preferential rotation of batteries will result in lower noise levels at receivers than predicted by this noise model.

Equipment layout and directivity factors should be reviewed during detailed design and incorporated into the site design wherever practicable.

6.1.3 At-source mitigation

Some BESS equipment such as inverters and batteries can be procured with at-source mitigation that is fitted to each unit.

The candidate inverters and batteries for the Project have been selected to include proprietary at-source mitigation which are available from the manufacturer, by way of OEM at-source noise control kits.

It should be noted that as the Project development progresses the need for noise control kits or sound covers may change as further detailed information is developed, or other noise controls, is adopted into the Project and corresponding noise model.

6.1.4 Noise barriers

In some cases, noise barriers can provide useful noise mitigation, however their effectiveness depends on multiple factors including site layout and terrain.

For the Project, preliminary noise barriers have been incorporated into the design as shown in Appendix F2.

The main noise barriers are 4.5 m tall, with a 6.0 m tall barrier around the HV transformer. All barriers should be constructed without holes or gaps, including at the bottom of the barrier. Multiple construction materials are allowable, providing a minimum surface mass of 15 kg/m² is achieved.

Acoustically absorptive material, rated at least NRC 0.9, is required to the entirety of the 'inside' faces of the barriers.

Similar to at-source mitigation, the requirement for barriers may change as the Project develops.

6.2 Equipment sound levels

At this stage of the Project equipment selections have not been conclusively determined and final selections will be established during detailed design and tender. Candidate equipment selections detailed in this report have been used for the purpose of noise assessment and have been reviewed by the Proponent and approved as being representative.

Where available, the Proponent has provided detailed third octave band noise data from the corresponding manufacturer. Where this data is not available MDA has established approximations or assumptions based on comparable data or existing acoustic literature.

Due to commercial sensitivities the specific inverter and battery unit manufacturer and model is not detailed in this report. The noise levels for equipment with noise control kits have been adopted with reference to laboratory test data for actual equipment configurations.

Sound power levels for individual equipment items, as used in the noise model, are detailed in Table 7. Data is provided as un-weighted (linear) octave band sound power level spectra and A-weighted overall sound power level.

The noise modelling includes all equipment operating concurrently, without allowance for reduced cooling system operation at any time. This is expected to be a conservative approach, particularly at night when ambient temperatures are lower and cooling system requirements are reduced.

Table 7: Sound power levels for Project equipment items, dB L_W re 10^{-12} W

Item	Octave band centre frequency, Hz							
	63	125	250	500	1k	2k	4k	A
Inverter (4600 kVA with proprietary noise control kit)	88	85	82	75	70	77	85	88
Battery unit (4 MWH with proprietary noise control kit)	85	85	81	78	73	66	60	79
HV transformer	86	96	92	88	78	70	66	88
MV transformer	61	72	68	63	53	46	41	64

Descriptions of the source of various noise data are presented in Table 8.

Table 8: Noise data descriptions

Item	Description
Inverter (4600 kVA with proprietary noise control kit)	Manufacturer third octave band sound power levels measured in accordance with ISO 9614-2:2016 .[9] Noise data associated with 100% apparent power with the proprietary noise control kit has been adopted. A +2dB uncertainty factor has been included per the manufacturer's datasheet.
Battery unit (4 MWH with proprietary noise control kit)	Manufacturer third octave band sound power levels measured in accordance with ISO 3744:2010[10]. Noise associated with the maximum fan speed operation of the unit cooling system as reported under normal operation with the proprietary noise control kit. The datasheet provides sound power level information calculated from sound pressure level measurements at different distances. The higher derived sound power level, derived from the closer set of measurements, and which is approximately 2 dB higher than the other reported level, was adopted for the noise modelling.
MV transformer	Avenis has provided a datasheet that presents overall A-weighted sound power levels. A formal test standard is not quoted; however the datasheet provides evidence of a procedure in line with that provided in ISO 3744:2010. Spectral octave band data was then estimated by averaging and normalising the spectral levels of several similar transformers as well as the Bies & Hansen corrections from Table 11.27, (Location 1a for outdoor transformer noise).[11]
HV transformers	Avenis has advised that the transformers would have a capacity of up to 150 MVA. No test data is currently available. In line with common practice, we have estimated the overall sound power levels for the given power ratings utilising the method described in AS 60076-10:2023. The 'reduced maximum' sound power level indicated in the standard has been adopted. Spectral data for each transformer was then estimated by averaging and normalising the spectral levels of several similar transformers as well as the Bies & Hansen corrections from Table 11.27, (Location 1a for outdoor transformer noise).[12]

[9] ISO 9614-2:2016 *Acoustics – Determination of sound power levels of noise sources using sound intensity – Part 2: Measurement by scanning*

[10] ISO 3744:2010 *Acoustics – Determination of sound power levels and sound energy levels of noise sources using sound pressure – Engineering methods for an essentially free field over a reflecting plane*

[11] *Bies, D. H. & Hansen, C. H. (2009). Engineering noise control: theory and practice (Fourth edition.). p. 601*

[12] *Bies, D. H. & Hansen, C. H. (2009). Engineering noise control: theory and practice (Fourth edition.). p. 601*

6.3 Tonality

Noise associated with the operation of BESS infrastructure has the potential to have tonal characteristics.

In accordance with the Noise Protocol, where tonality is present and audible within a noise sensitive area, an adjustment of either +2 dB or +5 dB is applied to the predicted or measured noise level. The adjusted level is then assessed against the limit.

Section 3.4 of the Noise Protocol provides a mechanism by which the characteristics of a noise source, such as tonality, may attract the application of a modifying factor adjustment if deemed to meet the prescribed criteria. The Noise Protocol states that:

> *The following adjustments apply –*
>
> *a. when the tonal character of the noise is just detectable then Atone = +2 dB;*
>
> *b. when the tonal character of the noise is prominent then Atone = +5 dB.*

As evidenced by the observations during the site survey (Section 4.0), a significant amount of masking noise occurs within the study area due to the presence of the Hume Freeway. Consideration of this fact, and review of the distances between the Project and the assessment receivers and the frequency spectrum of the candidate equipment selections indicate that a +2 dB adjustment is an appropriately balanced approach at this stage.

6.3.1 Other noise characteristics

Noise from Project equipment items is generated either by fan-based cooling systems or underlying electrical function. Equipment will therefore give rise to steady-state, continuous noise levels over a typical 30-minute assessment period. While noise levels may change throughout a typical 24 hr period, changes would be gradual and not associated with acoustic definitions of intermittency, especially when considered in context of the existing noise environment. Impulsive or instantaneous noises (bangs, clicks, clatters, or thumps) are not a characteristic of BESS operation.

As such neither intermittency nor impulsiveness are considered applicable.

6.4 Cumulative noise consideration

The noise survey (refer Section 4.0) indicated that noise from other CIT premises was not audible at the subject receivers, with the noise environment dominated by traffic noise from Hume Highway.

On this basis noise from operational CIT premises is not indicated to be a contributing factor to cumulative noise at the receivers.

Notwithstanding this the Project targets have been developed accounting for a -3 dB margin to allow for potential contributions from other future CIT developments in the area.

Where the Project adopts the requirements of the GED and demonstrates compliance with the Project targets it is expected that cumulative noise factors will be appropriately managed.

6.5 Predicted noise levels

6.5.1 Without noise barriers

Predicted noise levels for the Project have been calculated considering the method detailed in Section 5.5, and the candidate equipment sound levels summarised in Section 6.2.

Noise control measures including low noise equipment, equipment layout and orientation and at-source mitigation have been included as summarised in Section 6.1.1 through Section 6.1.3.

The noise barriers described in Section 6.4 are not included.

Table 11 provides a summary of the predicted noise levels and a comparison with the night period noise limits, being the most stringent currently applicable.

The predictions consider the maximum operating capacity of all equipment. No timed operational contextualisation (such as day and night cooling system operation) has been incorporated into the noise modelling.

Where the predicted noise levels are below the night period target, they would also be below the higher evening and day targets.

Table 9: Predicted noise levels for the Project, dB

Receiver no.	Project noise level, L_{Aeq}	A_{tone}	Assessable noise level, ENL	Project target (Night), ENL	Below target?
R2	33	+2	35	34	No
R3	30	+2	32	34	Yes
R4	28	+2	30	31	Yes
R6	20	+2	22	31	Yes

The project targets presented in Table 9 are derived to allow for cumulative noise from other Projects as detailed in Section 5.4.

The same predicted noise levels are compared directly to the mandatory noise limits in Table 12. The noise limits are not adjusted to allow for any cumulative noise, in order to demonstrate the difference between the predicted noise level and the noise limit.

Table 10: Predicted noise levels for the Project, dB

Receiver no.	Project noise level, L_{Aeq}	A_{tone}	Assessable noise level, ENL	Noise limit (Night), ENL	Below limit?
R2	33	+2	35	37	Yes (-2 dB)
R3	30	+2	32	37	Yes (-5 dB)
R4	28	+2	30	34	Yes (-4 dB)
R6	20	+2	22	34	Yes (-12 dB)

6.5.2 With noise barriers

Predicted noise levels for the Project have been calculated considering the method detailed in Section 5.5, the noise control factors set out in Section 6.1 including noise barriers, and the candidate equipment sound levels summarised in Section 6.2.

Table 11 provides a summary of the predicted noise levels and a comparison with the night period noise limits, being the most stringent currently applicable.

The predictions consider maximum operating capacity of all equipment. No timed operational contextualisation (such as day and night cooling system operation) has been incorporated into the noise modelling.

Where the predicted noise levels are below the night period target, they would also be below the higher evening and day targets.

Table 11: Predicted noise levels for the Project, dB

Receiver no.	Project noise level, L_{Aeq}	A_{tone}	Assessable noise level, ENL	Project target (Night), ENL	Below target?
R2	32	+2	34	34	Yes
R3	28	+2	30	34	Yes
R4	29	+2	31	31	Yes
R6	20	+2	22	31	Yes

The project targets presented in Table 11 are derived to allow for cumulative noise from other Projects as detailed in Section 5.4.

The same predicted noise levels are compared directly to the mandatory noise limits in Table 12. The noise limits are not adjusted to allow for any cumulative noise, in order to demonstrate the difference between the predicted noise level and the noise limit.

Table 12: Predicted noise levels for the Project, dB

Receiver no.	Project noise level, L_{Aeq}	A_{tone}	Assessable noise level, ENL	Noise limit (Night), ENL	Below limit?
R2	32	+2	34	37	Yes (-3 dB)
R3	28	+2	30	37	Yes (-7 dB)
R4	29	+2	31	34	Yes (-3 dB)
R6	20	+2	22	34	Yes (-12 dB)

7.0 CONCLUSION

The noise assessment conducted for the Project indicates that predicted noise levels for the candidate equipment and noise controls are below the Project targets, and Noise Protocol noise limits for day, evening and night periods.

This outcome is based on conservative assumptions including:

- Omni-directional noise emission from batteries (preferential rotation of equipment would result in lower noise levels at receivers but cannot be demonstrated with currently available information).
- Adopting the same maximum cooling system operation throughout the day, evening and night assessment periods(in practice, lower ambient temperatures during the night will result in reduced cooling system operation and lower noise levels).

The candidate Project layout incorporates reasonably practicable noise control measures in accordance with the GED. These include equipment selection, at-source mitigation and noise barriers.

An updated noise assessment is required during detailed design, once final equipment selections have been determined, to inform the ultimate set of noise controls that may be required for the Project to address the GED and to demonstrate compliance with the noise limits.

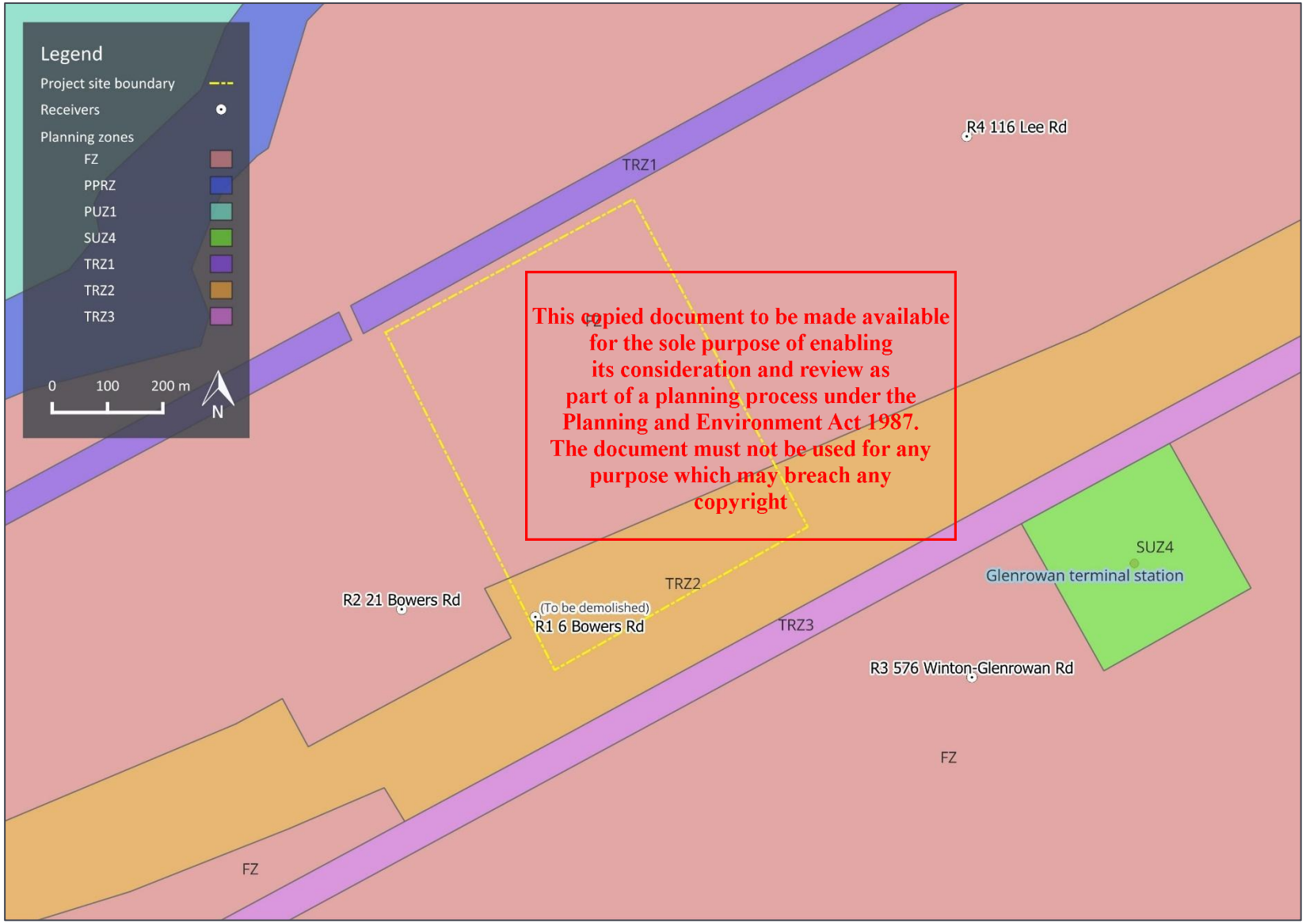
APPENDIX A GLOSSARY OF TERMINOLOGY

Term	Definition
A-weighting	A set of frequency-dependent sound level adjustments that are used to better represent how humans hear sounds. Humans are less sensitive to low and very high frequency sounds. Sound levels using an "A" frequency weighting are expressed as dB L_A.
Background sound	The sound that is continuously present in a room or outdoor location. Often expressed as the A-weighted sound level exceeded for 90% of a given time period i.e. L_{A90}.
dB	Decibel. The unit of sound level.
Frequency	Sound occurs over a range of frequencies, extending from the very low (e.g. thunder) to the very high (e.g. mosquito buzz). Measured in units of Hz. Humans typically hear sounds between 20 Hz and 20 kHz. High frequency acuity naturally reduces with age most adults can hear up to 15 kHz.
Hz	The unit of frequency, hertz (Hz), named after Gustav Hertz (1887-1975). One hertz is one pressure cycle of sound per second. One thousand hertz – 1000 cycles per second – is a kilohertz (kHz).
L_{Aeq}	The equivalent continuous A-weighted sound level. Commonly referred to as the average sound level and is measured in dB.
L_w	Sound power level. The calculated level of total sound power radiated by a sound source. Usually A-weighted i.e. L_{WA}.
Octave band	The interval between one frequency and its double. Sound is divided into octave bands for analysis. The typical octave band centre frequencies are 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, and 4 kHz.
Third octave band	One-third of an octave band. Used for more detailed analysis of sound frequency.
ENL	The effective noise level from commercial, industrial or trade premises determined in accordance EPA Publication 1826.4 Noise limit and assessment protocol for the control of noise from commercial, industry and trade premises and entertainment venues. This is the L_{Aeq} noise level over a 30-minute period, adjusted for the character of the noise. Adjustments are made for tonality, intermittency and impulsiveness.

The basic quantities used within this document to describe noise adopt the conventions outlined in ISO 1996-1:2016 *Acoustics - Description measurement and assessment of environmental noise – Basic quantities and assessment procedures*.

Accordingly, all frequency weighted sound pressure levels are expressed as decibels (dB) in this report. For example, sound pressure levels measured using an "A" frequency weighting are expressed as dB L_A. Alternative ways of expressing A-weighted decibels such as dBA or dB(A) are therefore not used within this report, unless included in a direct quote of external documentation.

APPENDIX B ZONING MAP



APPENDIX C NOISE LEGISLATION AND GUIDELINES

C1 Environment Protection Act 2017

The following key concepts and definitions are reproduced from the *Environment Protection Act 2017* (EP Act).

General environmental duty (Section 25(1)):

> *A person who is engaging in an activity that may give rise to risks of harm to human health or the environment from pollution or waste must minimise those risks, so far as reasonably practicable.*

Harm (EP Act Section 4(1)):

> *In this Act, harm, in relation to human health or the environment, means an adverse effect on human health or the environment (of whatever degree or duration) and includes—*
> *(a) an adverse effect on the amenity of a place or premises that unreasonably interferes with or is likely to unreasonably interfere with enjoyment of the place or premises; or*
> *(b) a change to the condition of the environment so as to make it offensive to the senses of human beings; or*
> *(c) anything prescribed to be harm for the purposes of this Act or the regulations*

Minimising harm (EP Act Section 6(1)):

> *A duty imposed on a person under this Act to minimise, so far as reasonably practicable, risks of harm to human health and the environment requires the person—*
> *(a) to eliminate risks of harm to human health and the environment so far as reasonably practicable; and*
> *(b) if it is not reasonably practicable to eliminate risks of harm to human health and the environment, to reduce those risks so far as reasonably practicable.*

Prohibition of unreasonable noise (EP Act Section 166):

> *A person must not, from a place or premises that are not residential premises—*
> *(a) emit an unreasonable noise; or*
> *(b) permit an unreasonable noise to be emitted*

Unreasonable noise definition (EP Act Section 3):

> ***unreasonable noise** means—*
> *(a) noise that is unreasonable having regard to the following—*
> *(i) its volume, intensity or duration;*
> *(ii) its character;*
> *(iii) the time, place and other circumstances in which it is emitted;*
> *(iv) how often it is emitted;*
> *(v) any prescribed factors; and*
> *(b) noise that is prescribed to be unreasonable noise; and*
> *(c) does not include noise prescribed not to be unreasonable noise*

C2 Environmental Protection Regulations 2021

The *Environment Protection Act 2017* (EP Act) does not specify noise limit values or technical aspects of environmental noise but sets out legal requirements to comply with the described below. Clause 166 of the EP Act essentially places the onus of achieving compliance with noise limits on the commercial, industrial and trade (CIT) premises.

The *Environmental Protection Regulations 2021* (EP Regulations) are made under Section 465 of the EP Act and impose obligations in relation to environmental protection, including noise. The EP Regulations state that a person who conducts a prediction, measurement, assessment, or analysis of noise within a noise sensitive area must do so in accordance with the Noise Protocol. In particular, noise from CIT premises or entertainment venues or events is prescribed as unreasonable if it exceeds a noise limit or alternative criterion determined in accordance with the Noise Protocol.

Key matters addressed in the EP Regulations include:

- definition of CIT premises, which is essentially any premises that is not a residential premises, a road, or a railway. It is noted that noise from common building services equipment (such as shared condensing units and kitchen exhaust fans) is assessable
- definition of an indoor music entertainment venue
- definition of noise sensitive areas where the noise limits are assessed, which broadly include:
  - a residential building
  - temporary accommodation
  - hospital corrective institution
  - retirement or residential village
  - A room for learning in a childcare centre, kindergarten, or school
  - A tourist establishment, campground, or caravan park
- assessment time periods
- noise sources that must not be taken into account
- minimum noise limit values
- management of cumulative noise from multiple premises.

Part 5.3 of the EP Regulations specifically address noise. Table 13 presents a summary of the relevant Divisions and EP Regulations from this section.

Table 13: Summary of Part 5.3 - *Noise*

Section	Description
Division 1, Regulation 113	States that *a person who conducts a prediction, measurement, assessment, or analysis of noise within a noise sensitive area for the purposes of the Act or these Regulations, must conduct the prediction, measurement, assessment, or analysis in accordance with the Noise Protocol.*
Division 3	Applies to noise from CIT premises
Regulation 116	Defines the day, evening and night period as follows: • Day: 0700 to 1800 hrs, Monday – Saturday • Evening: 1800 to 2200 hrs, Monday – Saturday 0700 to 2200 hrs, Sunday, and Public Holidays • Night: 2200 to 0700 hrs the next day, Monday – Sunday.
Regulation 117	In this Division, when the level of noise emitted from CIT premises is assessed, the following sources of noise that could be expected at the proposed facility must not be taken into account: • voices • construction or demolition activity on building sites • intruder, emergency or safety alarms or sirens • equipment used in relation to an emergency • non-commercial vehicles (except for maintenance activities) • wind turbines and energy facilities • lawnmowing • livestock
Regulation 118	Defines noise as being unreasonable if it exceeds the Noise Protocol limits or the alternative assessment criteria that apply at an alternative assessment location. Defines the lowest base noise limits as follows: Major urban area: Day: 45 dB ENL Evening: 40 dB ENL Night: 35 dB ENL Rural area: Day: 45 dB ENL Evening: 37 dB ENL Night: 32 dB ENL The noise limit for CIT premises for the night period must not exceed 55 dB ENL.
Regulation 119	If multiple existing or proposed premises emit noise that contributes to the effective noise level at a noise sensitive receiver, all reasonable steps must be taken by the premises' management to ensure the combined noise level does not exceed the noise limit.
Regulation 120	This regulation essentially identifies that tonal aspects of noise must be considered when considering unreasonable noise for Section 3(1)(a)(v) of the EP Act. The Noise Protocol provides a method of assessing tonal characteristics of noise from CIT premises, with additional guidance on low frequency noise available in EPA Publication 1996 *Noise guideline – assessing low frequency noise.*

Section	Description
Regulation 121	Noise emitted from CIT premises is prescribed to be aggravated noise if it exceeds the noise limits by more than 15 dB, or the following if lower: • 75 dB ENL during the day; • 70 dB ENL during the evening; or • 65 dB ENL during the night.

C3 Environment Reference Standard

The Environment Reference Standard (ERS) sets out environmental values for ambient sound that are sought to be achieved and maintained in Victoria and standards to support those values. The indicators and objectives within the standard provide a benchmark for comparing desired outcomes to the actual state of the environment and a basis for assessing actual and potential risks to the environmental values.

The environmental values of the ambient sound environment that are set out by the ERS are summarised in Table 14.

The ERS is not a compliance standard and the values listed within the ERS for different land uses are explicitly not noise limits nor design criteria.

Where applicable, direct regulation such as mandatory noise limits takes precedence over the ERS.

Table 14: ERS Environmental values

Environmental value	Description of environmental value
Sleep during the night	An ambient sound environment that supports sleep at night
Domestic and recreational activities	An ambient sound environment that supports recreational and domestic activities in a residential setting
Normal conversation	An ambient sound environment that allows for a normal conversation indoors without the need to raise voices
Child learning and development	An ambient sound environment that supports cognitive development and learning in children
Human tranquillity and enjoyment outdoors in natural areas	An ambient sound environment that allows for the appreciation and enjoyment of the environment for its natural condition and the restorative benefits of tranquil soundscapes in natural areas
Musical entertainment	An ambient sound environment that recognises the community's demand for a wide range of musical entertainment

Of the listed environmental values, musical entertainment is not considered to be relevant to the Project.

The ERS provides '*indicators and objectives*' which support the environmental values and which are dependent on the land zoning. For the most onerous night period, they are provided in terms of an average noise level from 2200 - 0600 hrs the next day.

Figure 5: Natural areas (aerial imagery: Metromap)

C4 EPA Publication 1826.4 (Noise Protocol)

EPA Publication 1826.4 *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues*, dated May 2021 (Noise Protocol) sets noise limits that apply to CIT premises and entertainment venues within Victoria. Compliance with the noise limits is mandatory under the EP Act.

The EP Act defines a 'commercial, industrial and trade premises as:

> *Any premises except the following –*
>
> *(a) residential premises (other than common plant under the control of an owners corporation);*
>
> *(b) a street or road, including every carriageway, footpath, reservation and traffic island on any street or road;*
>
> *(c) a railway track used by rolling stock in connection with the provision of a freight service or passenger service—*
>
> *(i) while travelling on a railway track or tramway track; or*
>
> *(ii) while entering or exiting a siding, yard, depot, or workshop;*
>
> *(d) a railway track used by rolling stock in connection with the provision of a passenger service, while in a siding, yard, depot, or workshop and is—*
>
> *(i) powering up to commence to be used in connection with the provision of a passenger service; or*
>
> *(ii) shutting down after being used in connection with the provision of a passenger service;*
>
> *(e) the premises situated at Lower Esplanade, St Kilda and known as "Luna Park" and being the whole of the land more particularly described in Certificate of Title Volume 1204 Folio 109;*

The EP Act defines an 'entertainment venue' as

> *Any premises or place where music is performed or played but does not include residential premises or a place of worship.*

Based on the above the Project is considered to be a CIT premises.

The Noise Protocol prescribes the method and measurement procedure used to determine applicable noise limits and assessment of compliance.

The EP Act requires that proposed CIT premises be designed to comply with Noise Protocol noise limits and that premises have an ongoing obligation to meet the noise limits.

A 'noise sensitive area' is defined in the EP Regulations as:

> *(a) that part of the land within the boundary of a parcel of land that is—*
>
> *(i) within 10 metres of the outside of the external walls of any of the following buildings—*
>
> *(A) a dwelling (including a residential care facility but not including a caretaker's house);*
>
> *(B) a residential building;*
>
> *(C) a noise sensitive residential use; or*
>
> *(ii) within 10 metres of the outside of the external walls of any dormitory, ward, bedroom or living room of one or more of the following buildings—*
>
> *(A) a caretaker's house;*

(B) a hospital;

(C) a hotel;

(D) a residential hotel;

(E) a motel;

(F) a specialist disability accommodation;

(G) a corrective institution;

(H) a tourist establishment;

(I) a retirement village;

(J) a residential village; or

(iii) within 10 metres of the outside of the external walls of a classroom or any room in which learning occurs in the following buildings (during their operating hours)—

(A) a childcare centre;

(B) a kindergarten;

(C) a primary school;

(D) a secondary school; or

(b) subject to paragraph (c), in the case of a rural area only, that part of the land within the boundary of—

(i) a tourist establishment; or

(ii) a campground; or

(iii) a caravan park; or

(c) despite paragraph (b), in the case of a rural area only, where an outdoor entertainment event or outdoor entertainment venue is being operated, that part of the land within the boundary of the following are not noise sensitive areas for the purposes of that event or venue—

(i) a tourist establishment;

(ii) a campground;

(iii) a caravan park;

The assessment of non-music noise from a subject site under the Noise Protocol is based on the calculation of a noise limit at a noise sensitive area, considering the background noise level and a zoning noise level derived from the land zoning types in the surrounding area.

Noise limit derivation is contingent on two separate methods:

- the rural method for NSAs outside an MUA
- the urban method for NSAs within a major urban area (MUA).

Major urban areas applicable in Victoria are set out in Table A.3 of the Noise Protocol.

Once a noise limit is established, the noise level $L_{Aeq,\ 30\ min}$ due to the CIT premises is measured or predicted. If necessary, the $L_{Aeq,\ 30\ min}$ noise level is adjusted for noise character and duration to give the effective noise level (ENL), which also applies over a 30-minute assessment period. If the ENL exceeds the noise limit, then remedial action is required.

C5 Noise limit derivation

The Noise Protocol outlines the EPA's required approach to the determination of noise limits and to the measurement, prediction and analysis of noise.

Part I Section A – Determining noise limits for commercial, industrial and trade premises

The Noise Protocol provides 2 methods for deriving the relevant noise limits, the urban area method and the rural area method.

All receivers for the Project are located outside the major urban areas as defined in the Regulations. Therefore, the rural area method for determining noise limits applies.

The noise limits are separately defined for the day, evening and night periods. The time periods are defined in the EP Regulations and summarised in Table 15.

Table 15: EP Regulations time periods

Period	Day of week	Start time, hrs	End time, hrs
Day	Monday-Saturday	0700	1800
Evening	Monday-Saturday	1800	2200
	Sunday, Public holidays	0700	2200
Night	Monday-Sunday	2200	0700

Under the rural area method, zoning levels are first determined based on the land zoning of the generating zone and the receiving zone is Farming Zone (FZ). Refer to Appendix B for a land zoning map.

The Noise Protocol then requires consideration of additional calculation steps or application of variations to determine the final noise limits.

Since the Project is defined as being a '*utility*' and is located within a Farming Zone with a distance adjustment of 0 dB, for which different noise limits apply.[13]

The noise limits for the Project are derived in Table 16 and Table 17.

[13] EPA Publication 1997 provides the following definition for 'utility': *'Utility installation' as defined in the Victoria Planning Provisions and includes infrastructure used for telecommunications; to transmit or distribute gas or oil; to transmit, distribute or store power, including battery storage; to collect, treat, transmit, store, or distribute water; or to collect, treat, or dispose of storm or flood water, sewage, or sullage.*

Figure 6: Zoning levels for rural area method for CIT premises

Generating Zone ↓ / Receiving zone →	Green Wedge A GWAZ, Rural Conservation RCZ, Rural Living RLZ Group E CDZ, SUZ & UGZ (*)	Low Density Residential LDRZ Public Conservation and Resource PCRZ Public Park and Conservation PPCZ Public Use 2 & 5 PUZ2 & PUZ5 Urban Floodway UFZ	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 (*)	Commercial 1 Zone C1Z B1Z B2Z B5Z Commercial 3 Zone C3Z Mixed use Zone MUZ Activity Centre Zone ACZ Public Use Zone 1,3,4,6&7 PUZ1 PUZ3 PUZ4 PUZ6 & PUZ7 Road RDZ1 RDZ2 Group A CDZ, SUZ & UGZ (*)	Industrial 3 IN3Z Group C CDZ, SUZ & UGZ (*)	Commercial 2 Zone C2Z B3Z B4Z	Industrial 2 Zone IN2Z Industrial 1 Zone IN1Z Group D CDZ, SUZ, UGZ (*)
Low Density Residential LDRZ Public Conservation and Resource PCRZ Public Park and Conservation PPCZ Public Use 2,5 PUZ2 & PUZ5 Urban Floodway UFZ Group E CDZ, SUZ & UGZ (*)	Day 45 Evening 37 Night 32	Day 45 Evening 39 Night 34	Day 45 Evening 40 Night 35	Day 47 Evening 42 Night 37	Day 48 Evening 43 Night 38	Day 50 Evening 45 Night 40	Day 53 Evening 48 Day 43
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 45 Evening 38 Night 33	Day 47 Evening 40 Night 35	Day 48 Evening 41 Night 36	Day 50 Evening 43 Night 38	Day 50 Evening 45 Night 40	Day 52 Evening 47 Night 42	Day 54 Evening 49 Night 44
Commercial 1 CZ1 B1Z B2Z BZ5 Mixed Use MUZ Activity Centre Zone ACZ Public Use 1,2,3,4,6 & 7 PUZ1 PUZ3 PUZ4 PUZ6 PUZ7 Group A CDZ, SUZ & UGZ (*)	Day 45 Evening 40 Night 35	Day 47 Evening 42 Night 37	Day 48 Evening 43 Night 38	Day 50 Evening 45 Night 40	Day 52 Evening 47 Night 42	Day 53 Evening 48 Night 43	Day 55 Evening 50 Night 45
Industrial 3 IN3Z Group C CDZ, SUZ & UGZ (*)	Day 46 Evening 41 Night 36	Day 49 Evening 44 Night 39	Day 50 Evening 45 Night 40	Day 52 Evening 47 Night 42	Day 53 Evening 48 Night 43	Day 55 Evening 50 Night 45	Day 56 Evening 51 Night 46
Commercial 2 C2Z, B3Z, B4Z Commercial 3 C3Z	Day 48 Evening 43 Day 38	Day 50 Evening 45 Night 40	Day 52 Evening 47 Night 42	Day 54 Evening 49 Night 44	Day 55 Evening 50 Night 45	Day 56 Evening 51 Night 46	Day 57 Evening 52 Night 47
Industrial 1, 2 IN1Z IN2Z Group D CDZ, SUZ & UGZ (*)	Day 50 Evening 45 Night 40	Day 52 Evening 47 Night 42	Day 53 Evening 48 Night 43	Day 55 Evening 50 Night 45	Day 56 Evening 51 Night 46	Day 57 Evening 52 Night 47	Day 58 Evening 53 Night 48

(*) For Comprehensive Development Zone (CDZ), Special Use Zone (SUZ) and Urban Growth Zone (UGZ) refer to Table B.2.

Table 16: R2 21 Bowers Rd and R3 3576 Winton Glenrowan Rd limit derivation, dB

Step	Description		Day	Evening	Night
Zone levels	Generating Zone: FZ Farming	Receiving Zone: FZ Farming	46	41	36
Distance adjusted levels	Distance from receiver to generating zone boundary: n/a	Distance adjustment: 0 dB	46	41	36
Utilities	Clause 31 applies - Utility is in a Farming Zone, Rural Activity Zone or Green Wedge Zone		45	39	34
Background level assessment	Background noise levels, L_{A90}		45	41	32
	Background-adjusted limit		53	46	37
	Which is higher of the distance-adjusted levels and Utilities levels from above?		Bkg-adj.	Bkg-adj.	Bkg-adj.
	Limit review outcome, ENL		53	46	37
High traffic noise method for proposed developments	Free field traffic noise levels (refer Appendix E), L_{Aeq}		50	51	48
	Reference values for high traffic areas from Clause 26		55	50	45
	Noise limit for high traffic area as per Clauses 27 and 28, ENL		53	46	37
Check against EP Regulations base limits & maximum night limits	EP Regulations maximum night limit, ENL		-	-	55
	EP Regulations base limits, ENL		45	37	32
NP Rural method limits	**Effective Noise Level limit, ENL**		**53**	**46**	**37**

Table 17: R4 116 Lee Road and R6 84 Glenwest Lane limit derivation, dB

Step	Description		Day	Evening	Night
Zone levels	Generating Zone: FZ Farming	Receiving Zone: FZ Farming	46	41	36
Distance adjusted levels	Distance from receiver to generating zone boundary: n/a	Distance adjustment: 0 dB	46	41	36
Utilities	Clause 31 applies - Utility is in a Farming Zone, Rural Activity Zone or Green Wedge Zone		45	39	34
Background level assessment	Not undertaken for this receiver. This is a more conservative approach since background noise levels are used only to increase noise limits in rural areas.				
	Limit review outcome, ENL		45	39	34
High traffic noise method for proposed developments	Not considered relevant for this receiver due to distance from roads.				
Check against EP Regulations base limits & maximum night limits	EP Regulations maximum night limit, ENL EP Regulations base limits, ENL		- 45	- 39	55 34
NP Rural method limits	**Effective Noise Level limit, ENL**		**45**	**39**	**34**

APPENDIX D IMAGE OF NOISE LOGGER

Figure 7: R2 21 Bowers Road

APPENDIX E NOISE LOGGING DATA

The measured equivalent noise levels are provided in Table 18.

Table 18: Average hourly measured equivalent noise levels, dB $L_{Aeq,1hr}$

		R2 21 Bowers Road		
Day	**Date**	**Day**	**Eve**	**Night**
Tues	13 May 2025	-[a]	59	58
Wed	14 May 2025	53	59	59
Thu	15 May 2025	53	58	58
Fri	16 May 2025	53	55	54
Sat	17 May 2025	53	51	48
Sun	18 May 2025	-[b]	56	54
Mon	19 May 2025	52	57	59
Tues	20 May 2025	52	56	59
Wed	21 May 2025	50	55	53
Minimum		50	51	48

a The average for the day period on Tuesday 13 May was not calculated due to insufficient data.

b Day period is not calculated on Sundays, as the evening period is defined as 0700-2200 hrs.

E1 R2 21 Bowers Rd measured hourly noise levels

APPENDIX F NOISE MODELLING

F1 Noise prediction method

A computer model was created in the environmental noise modelling program SoundPLANnoise v9.1 to predict noise levels from the proposed development to relevant noise-affected receivers in the vicinity of the subject site. The noise model has been used to calculate noise levels at the nearest noise-affected premises in accordance with ISO 9613-2, which enables the calculation of noise levels over a wide area, and accounts for key considerations including site arrangement, terrain, and atmospheric conditions.[14]

The ISO 9613-2 standard specifies an engineering method for calculating noise at a known distance from a variety of sources under meteorological conditions that are favourable to sound propagation. The standard defines favourable conditions as downwind propagation where the source blows from the source to the receiver within an angle of +/-45 degrees from a line connecting the source to the receiver, at wind speeds between approximately 1 m/s and 5 m/s, measured at a height of 3 m to 11 m above the ground. Equivalently, the method accounts for average propagation under a well-developed moderate ground based thermal inversion.

Accordingly, predictions based on ISO 9613-2 account for the instances when local atmospheric conditions at the site favour the propagation of sound to surrounding receptor locations. Under alternative atmospheric conditions, such as when the wind is blowing from a receiver location to the development site, the noise levels would be lower than calculated.

To calculate far-field noise levels according to the ISO 9613-2, the noise levels of each source are firstly characterised in the form of octave band frequency levels. A series of octave band attenuation factors are then calculated for a range of effects including:

- geometric divergence
- air absorption
- reflecting obstacles
- screening
- ground reflections.

The octave band attenuation factors are then applied to the noise data to determine the corresponding octave band and total calculated noise level at relevant receiver locations.

In some case third octave band noise data is used to provide a preliminary assessment of potential tonality.

The geometries in the model are simplified representations of the built environment that have been configured to a level of detail that is appropriate for noise calculation purposes.

[14] ISO-9613-2:2024 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: Engineering method for the prediction of sound pressure levels outdoors*.

F2 Noise model configuration

The parameters detailed in Table 19 were utilised to develop the noise model.

Table 19: Noise model configuration

Feature	Description
Terrain data	Digital elevation model with a cell size of 10 m taken from the public national portal, Elevation Information System (ELVIS).
Environmental ground conditions	Ground conditions on the Project site were assigned a ground factor (G) of G = 0 representing *'hard ground'*. The surrounding area has been assigned a ground factor of G = 1 to reflect ground '*suitable for growth of vegetation'*. This aligns with guidance set out in Section 7.3.1 of ISO 9613-2.
Atmospheric conditions	Temperature 10°C and relative humidity 70%. These represent conditions which result in relatively low levels of atmospheric sound absorption, resulting in slightly higher predicted noise levels.
Site layout	"Layout 3" provided to MDA by NGH and noise walls shown in Figure 8.
Dwelling heights	Assumed to be single storey (based on aerial observations).
Receiver heights	1.5 m above ground.
Noise calculation method	Noise model calculated according to ISO 9613-2.
Noise data for all equipment	As detailed in Section 6.2 Noise data has been derived based on: • candidate manufacturer data provided by Avenis • empirical standards • previous noise data from MDA's library.
Operating duration	All equipment has been modelled considering maximum operational duty during all time periods. This is a significant conservative assumption.

Figure 8: Preliminary noise barrier configuration used for noise modelling

APPENDIX G TONALITY EVALUATION

Noise associated with the operation of inverters, batteries and transformers has the potential to be tonal in nature, as these equipment items can exhibit tonal characteristics at source.

There is no documented or recognised method for the prediction of tonality before construction. To evaluate risk associated with potential tonality, noise predictions at receivers have been repeated using one-third octave band sound power level data for noise sources. The resultant one-third octave band predictions at receivers have then been treated as indications of measurement results, with analysis for tonality then conducted per the objective method detailed in Annex C of the Noise Protocol.

Validation of the ISO 9613-2 method is limited to octave band data, therefore when using one-third octave band noise data the modelling software assumes the same attenuation factors for the adjacent 2 bands. This is a limitation of the method and may result in a minor variation in the results where one-third octave band data is used.