Appendix Q

Noise and Vibration Impact Assessment

MARSHALL DAY Acoustics

TULLY BESS
NOISE ASSESSMENT

Rp 002 R01 20241144 | 28 May 2026

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Report No.:	**Rp 002 R01 20241144**

Document Control

Status:	Rev:	Comments	Date:	Author:	Reviewer:
Superseded	-	For client information	15 May 2026	J Gil	A Stoker
Complete	01	Minor typo correction	28 May 2026	J Gil	-

EXECUTIVE SUMMARY

Marshall Day Acoustics (Australia) Pty Ltd (MDA) has been engaged to prepare a noise and vibration assessment for the proposed Tully BESS (project). The project is proposed to be located on two freehold parcels (Lot 1 on RP735276 and Lot 1 on RP852238) in Tully, Queensland, within the Cassowary Coast Regional Council (CCRC) local government area.

MDA has been commissioned by Attexo on behalf of RWE Tully Battery Pty Ltd (proponent) to undertake an assessment of noise associated with the project. The noise assessment would support the development application to be submitted to SARA.[1]

Inputs for this assessment have been provided by the proponent, as far as they are available at this stage of the development process. Any and all assumptions and developed data have been reviewed by the proponent and approved as being representative for the project.

The noise and vibration assessment considers the primary noise generating equipment associated with the operation of the project, being the battery/inverter containers and transformers, and reflects a preliminary project design provided by the proponent. The assessment also considers major construction equipment that may be used.

Assessment of construction and operational noise and vibration from the project has been conducted in accordance with the requirements of performance outcome (PO) PO20 and PO21 of the Queensland SDAP State code 27 (State code 27).[2]

Operational noise and vibration

PO20 of State code 27 requires operational noise levels to meet the acoustic quality objectives set out by the EPP 2019 only.[3] No further reference to other aspects of the EPP 2019 is included in the performance outcome.

Based on the nominated project design and equipment selections, and generally conservative noise assessment assumptions, operational noise from the project is predicted to be below the acoustic quality objectives at all sensitive receptors, by a minimum margin of 5 dB.

With respect to cumulative noise, the existing Tully substations and their component transformers have been considered with an attended noise survey carried out to determine the existing noise contribution from these sources. Based on the noise survey, cumulative noise levels considering the project and Tully substations are indicated to be below the PO20 acoustic quality objectives at all receptors for both day/evening and night periods.

Notwithstanding the above, cumulative noise risks should continue to be considered as the project moves through subsequent stages of development.

The above outcomes indicate that the project is capable of being designed and operated to align with the operational noise requirements of State code 27, including PO20.

Notwithstanding the above, other aspects of the EPP 2019 have also been considered for assessment, including background creep and deterioration of the existing acoustic environment.

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1 Queensland Department of State Development, Infrastructure and Planning *State Assessment and Referral Agency* (SARA)

2 Queensland Department of State Development, Infrastructure and Planning *State Development Assessment Provisions v3.5* (SDAP); Queensland Department of State Development, Infrastructure and Planning *State Development Assessment Provisions v3.5 - State code 27: Battery storage facility* (State code 27);

3 *Environmental Protection (Noise) Policy 2019 Subordinate Legislation 2019 No. 154* (EPP 2019) made under the *Environmental Protection Act 1994.*

With respect to background creep and the existing acoustic environment, absolute predicted noise levels from the project are generally low. In addition, mitigation measures have been adopted into the candidate project design and the management intent and management hierarchy of the EPP 2019 have been followed. On this basis, no adverse impact is indicated with respect to background creep or deterioration of the existing acoustic environment.

The assessment herein has considered the effect of acoustic barriers and included noise mitigation measures for project transformers, by way of manufacturer performance requirements. Additional or alternative noise mitigation will be considered during subsequent detailed design stages once additional manufacturer information is available and detailed performance of the facility is known e.g. charge and discharge rates.

Ultimately, the primary method of mitigating noise for any BESS project is robust and holistic detailed design with a focus on noise minimisation. Given the early stage of project design development it is expected that further noise assessment should be conducted once a finalised project design, equipment selections and associated manufacturer's noise data are determined.

Operational vibration from BESS equipment is minimal and is not expected to be perceptible or otherwise adversely impact any receptors.

Construction noise and vibration

PO20 of State code 27 also requires construction noise levels to meet the acoustic quality objectives set out by the EPP 2019.

At this stage of the project only construction concepts are known. Project specific construction details will be determined once a main contractor is appointed and a detailed understanding of construction processes is established. On this basis the assessment of construction noise herein is conceptual for the purposes of establishing risk and the requirement or otherwise of additional detailed assessment at a later date.

Construction noise levels were calculated based on representative sound power levels and distances generally reflecting the closest point and middle of relevant work areas. Consequently, a range of construction noise levels are predicted.

Compliance with the EPP 2019 acoustic quality objectives is indicated at all receptors for typical works carried out in the middle to far parts of relevant work areas. Where equipment and plant are working at the closest portions of relevant work areas to receptors predicted noise levels up to 14 dB above the acoustic quality objectives are indicated. This is based on the conservative assumption that all machinery will operate concurrently. In practice, only a portion of nominated equipment will operate concurrently. This will result in lower real world noise levels than indicated by the current risk assessment.

Project specific noise mitigation measures and noise reducing work practices may be required to mitigate the construction noise during each phase as low as practicable.

To minimise construction noise below the acoustic quality objective, all feasible and reasonable work practices and mitigation measures should be implemented as part of a detailed construction noise and vibration management plan (CNVMP), to be drafted once a main contractor is appointed. Notwithstanding the recommendation for a later detailed and process specific construction noise assessment, this report provides preliminary and conceptual noise mitigation measures and recommendations to manage construction noise.

It should be noted that the EPP 2019 is intended to provide nuisance criteria for environmental noise emissions with a long term focus, such that the aims of the EP Act are satisfied.[4] The requirements of the EPP 2019, including the acoustic quality objectives, therefore typically apply to assessment of operational noise from a project, being the relevant long term noise factor. It is atypical to apply the requirements of the EPP 2019 to short-term, temporary noise sources such as construction noise.

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4 Queensland Government *Environmental Protection Act 1994* (EP Act)

For this reason the application of PO20 acoustic quality objectives represent onerous criteria for construction noise that is impractical to achieve in most cases.

Outside of the SDAP structure, including where an environmental impact statement (EIS) is required for high-risk projects, construction noise would ordinarily be assessed considering the Code of Practice Vol.2.[5]

This is a specific document established by the Department of Transport and Main Roads to set criteria for the assessment of road infrastructure construction noise to achieve the intent of the EP Act, in particularly the general environmental duty and protection of relevant environmental values.

Indicated construction noise levels are within the range indicated to be acceptable by the airborne construction noise criteria set out by the Code of Practice Vol.2.

Maintenance and decommissioning works have not been directly assessed, however, typical activities and processes would result in significantly lower noise levels than construction works.

Regarding PO21 and construction vibration; minimum distances between receptors and the project boundary are in the order of 480 m and more. The assessment indicates that construction vibration from main machinery, such as the drum roller, could potentially adversely affect residents only at distances smaller than 28 m. As a result no receptors are predicted to be affected by vibration that may cause comfort disturbance or cosmetic building damage.

Construction vibration impacts are therefore a negligible risk for the nearest receptors.

Assessment outcomes

The assessment in this report details one way by which the project could be designed and delivered whilst aligning with requirements of PO20 and PO21. The assessment also evaluates risk with respect to compliance with the EPP 2019. It has been determined that there is sufficient detailed design and engineering noise control opportunities available as the project progresses that compliance with acoustic quality objectives and broader requirements of the EPP 2019 is feasible.

Variations from the project layout and nominated equipment selections would not necessarily result in non-compliance but have not been reviewed or verified in this assessment.

Where changes from any aspect of the assessment detailed in this report occur, e.g. during design development, tender or procurement, the changes should be reviewed to verify continued compliance of the project.

To assist the ongoing development of the project the following recommendations are provided:

- Design development (including layout, equipment selections and noise mitigation measures) to align with the requirements of PO20 as the project progresses.
- Where project changes occur, acoustic compliance to be verified via updated noise modelling and reporting - this may comprise a final, *'for construction'* noise model and report.
- Preparation of an operational noise management plan and detailed compliance test plan.
- Preparation of a CNVMP including project and process specific noise mitigation design to meet the requirements of PO20 and PO21.

[5] Queensland Department of Transport and Main Roads *Transport Noise Management Code of Practice: Volume 2 – Construction Noise and Vibration,* dated May 2023 (Code of Practice Vol. 2)

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1.0 INTRODUCTION

Attexo are assisting RWE Tully Battery Pty Ltd (proponent) with the development application for a proposed battery energy storage system (BESS), identified as Tully BESS (project).

The project is located across a 27-ha site consisting of two freehold parcels, Lot 1 on RP735276 and Lot 1 on RP852238, in Tully, Queensland. It is proposed to comprise 200 MW/4 hr configuration BESS and associated infrastructure.

MDA have been commissioned by Attexo to undertake an assessment of noise and vibration associated with the project. The assessment is intended to supplement a development application to be submitted to SARA.[6]

The proponent has provided a preliminary project design comprising a defined layout of battery/inverter units, medium voltage (MV) transformers, and high voltage (HV) transformer. Predicted operational noise levels at relevant sensitive receptors have been determined based on a noise model adopting the proponent's project design and preliminary equipment nominations.

This report contains the details of the proposed project infrastructure and associated noise data, and evaluation of predicted noise levels at sensitive receptors against performance outcome PO20 and PO21 of State code 27 (State code 27), as well as broader requirements of the EPP 2019.[7]

A glossary of relevant acoustic terminology used within this report has been included in Appendix A.

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6 Queensland Department of State Development, Infrastructure and Planning *State Assessment and Referral Agency* (SARA)

7 Queensland Department of State Development, Infrastructure and Planning *State Development Assessment Provisions v3.5 - State code 27: Battery storage facility* (State code 27); *Environmental Protection (Noise) Policy 2019 Subordinate Legislation 2019 No. 154* (EPP 2019) made under the *Environmental Protection Act 1994;*

2.0 PROJECT OVERVIEW

2.1 Description

The proponent has advised the following equipment counts in the proposed preliminary 200 MW/4 hr configuration layout:

- 188 battery/inverter units
- 47 MV inverters
- one HV transformer.

The project site and surrounds is depicted in Figure 1.

An outline plan of the project layout with indicative noise source locations is provided in Figure 2.

2.2 Sensitive receptors

The EPP 2019 defines a sensitive receptor as being '*an area or place where noise is measured*'.

For the purpose of noise assessment under the EPP 2019, sensitive receptors are typically dwellings, educational establishments, hospitals, parks, and other places or spaces at which environmental values are expected to be enhanced or protected.

Attexo have provided a comprehensive list of 490 receptors within 3 km of the project boundary. The list was filtered to exclude non-sensitive receptors such as industrial buildings or sheds. For the purpose of this assessment, 343 sensitive receptors were considered, as shown in Figure 1. Coordinates of the sensitive receptors are shown in Appendix B.

Figure 1: Project site and surrounds

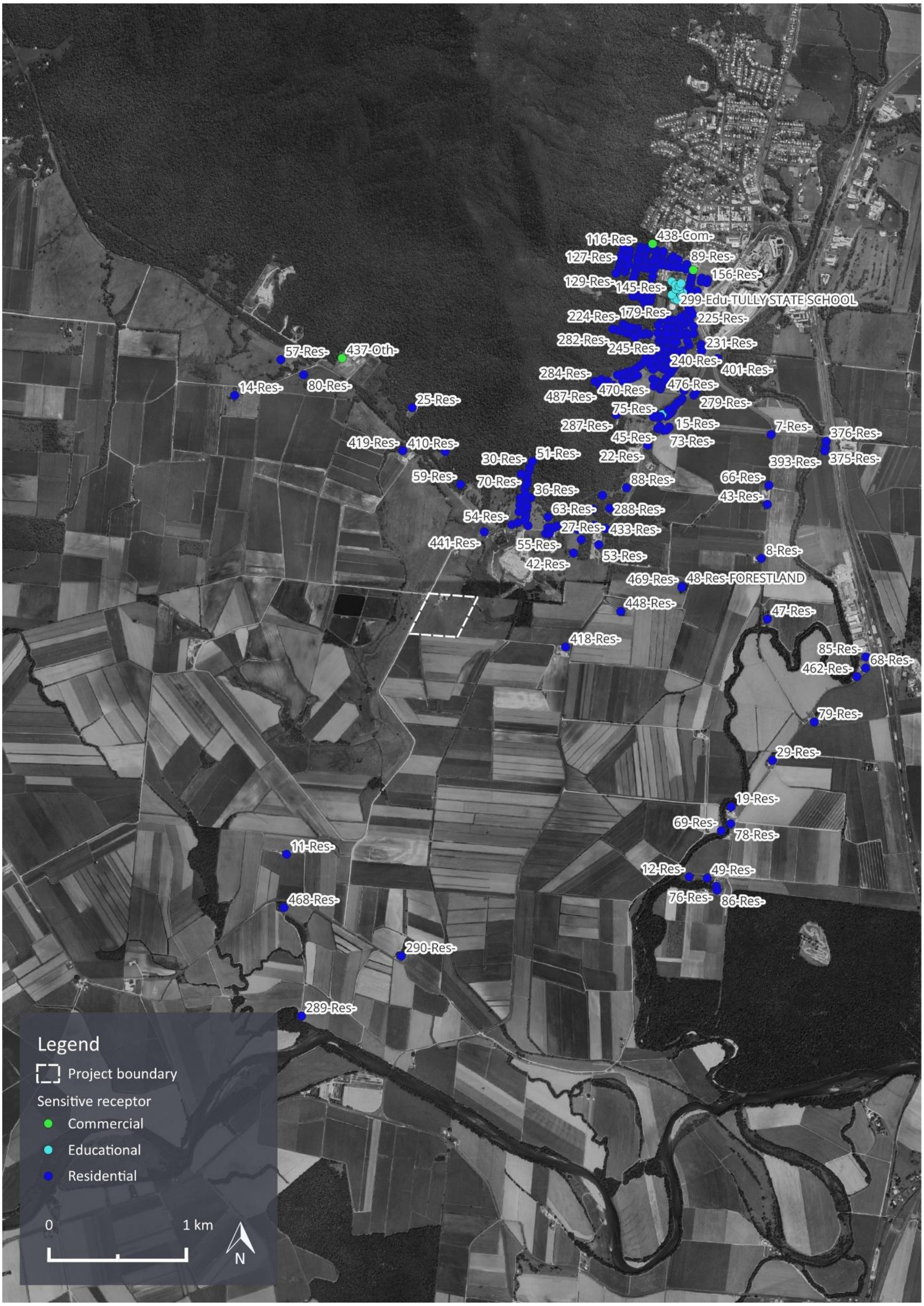

Figure 2: Project layout and indicative noise source locations

3.0 QUEENSLAND POLICY

3.1 State Development Assessment Provisions

The Queensland Department of State Development, Infrastructure and Planning released an updated version of the SDAP on 12 December 2025.[8] The updated SDAP includes the new State code 27 which applies to BESS projects with a capacity over 50 MW. The relevant approval authority is SARA.

State code 27 establishes the relevant assessment benchmarks for proposed BESS developments which includes the POs which are defined in order to fulfil the purpose statement of the code. The purpose of the code is to ensure that development of a BESS:

> *1. Avoids and/or appropriately integrates risk mitigation strategies and responsive design measures to address potential fire hazards, and other environmental risks, ensuring long-term safety and resilience for people, surrounding land uses and the environment.*
>
> *2. minimises the loss or fragmentation of high-quality agricultural land.*
>
> *3. does not result in unacceptable adverse impacts on individuals, communities, the environment, adjacent sensitive land uses and sensitive receptors, landscape values and infrastructure and services.*
>
> *4. is decommissioned in a timely and efficient manner that reuses, recycles, and/or repurposes materials to the greatest extent possible and rehabilitates the environment.*

PO20 and PO21 of the code establishes the POs related to acoustic amenity and vibration:

- ***PO20*** *Construction, operation, maintenance and decommissioning meets the acoustic quality objectives for sensitive receptors on or adjacent to the site identified in the Environmental Protection (Noise) Policy 2019.*
- ***PO21*** *Construction, operation, maintenance and decommissioning does not cause vibration impacts that adversely affect the operational performance or sensitive receptors within or adjacent to the site.*

PO20 refers to acoustic quality objectives as defined in the EPP 2019. The acoustic quality objectives, as well as broader EPP 2019 requirements are summarised in Section 3.2. Further explanation on the EPP 2019 is provided in Appendix C.

Under PO20, the acoustic quality objectives are also applicable to construction noise. Construction noise, which is temporary in nature, is normally assessed against the EP Act and general environmental duty.[9] The PO20 requirements are significantly more onerous for this type of temporary noise than what is normally adopted, especially when considering construction works within standard daytime hours. Typical construction noise requirements, outside of the context of the code and compliant with the EP Act, are summarised for information in Appendix D.

PO21 does not give specific vibration requirements. The operation of BESS equipment is not associated with significant vibration that could have an adverse impact on people or buildings. Construction, maintenance and decommissioning vibration can have a potential adverse impact for receptors close to heavy machinery, like drum rollers, excavators, concrete breakers. Relevant Queensland construction vibration policy is summarised in Section 3.3. The policy relates to cosmetic building damage and human comfort.

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8 Queensland Department of State Development, Infrastructure and Planning *State Development Assessment Provisions v3.5* (SDAP)

9 Queensland Government *Environmental Protection Act 1994* (EP Act)

3.2 Environmental Protection (Noise) Policy 2019

The acoustic quality objectives are defined for indoor and outdoor amenity levels. The indoor acoustic quality objectives set out by the EPP 2019 are reproduced in Table 1. Only sensitive receptor types relevant for the local area are included.

Table 1: Indoor acoustic quality objectives, dB $L_{Aeq,adj,1hr}$

Sensitive receptor	Acoustic quality objective [a]	
	Day and evening	Night
Residence	35	30
Library and educational institution	35	-
Commercial and retail activity	45	-

a Day/evening is 07:00–22:00 hrs, Night is 22:00–07:00 hrs.

It is standard practice to predict noise levels external to a sensitive receptor and then establish an equivalent internal noise level based on an outdoor to indoor attenuation factor. This approach can also be reversed to established external noise criteria aligning with internal noise criteria.

Guidance on appropriate outdoor to indoor attenuation factors is provided in the Noise and Vibration EIS Information Guideline which states:[10]

> *When assessing outdoor to indoor noise attenuation at sensitive receptors, do not use the World Health Organisation guideline's value of 25dB as it was developed for European buildings with double-glazed windows. Instead, use an outdoor to indoor attenuation value of 7dB, which is appropriate for typical Queensland buildings with open windows.*

This results in the equivalent outdoor acoustic quality objectives set out in Table 2.

Table 2: Equivalent outdoor acoustic quality objectives, dB $L_{Aeq,adj,1hr}$

Sensitive receptor	Acoustic quality objective [a]	
	Day and evening	Night
Residence	42	37
Library and educational institution	42	-
Commercial and retail activity	52	-

a Day/evening is 07:00–22:00 hrs, Night is 22:00–07:00 hrs.

Predicted construction, operational and decommissioning noise levels below the equivalent outdoor acoustic quality objectives will mean compliance with PO20.

Under the EPP 2019 the acoustic quality objective for a sensitive receptor, means *'the maximum level of noise that should be experienced in the acoustic environment of the sensitive receptor'.* It is therefore considered a total noise amenity criterion for a sensitive receptor, considering the total noise from all sources.[11]

10 *Noise and Vibration EIS Information Guideline*, Queensland Government, dated 2022.

11 Excluding noise sources described in Schedule 1, Part 1, Section 1 of the EP Act. For the project excluded noise sources would be public roads or State-controlled roads.

On this basis assessment of noise from the project would require total noise from the project and other existing noise sources (primarily the existing Tully substations) to be below the equivalent outdoor acoustic quality objectives set out in Table 2.

3.2.1 Background creep and existing acoustic environment

PO20 of State code 27 requires operational noise levels to meet the acoustic quality objectives set out by the EPP 2019 only. No further reference to other aspects of the EPP 2019 is included in the performance outcome.

In an abundance of caution other aspects of the EPP 2019 have also been considered for assessment, namely background creep and deterioration of the existing acoustic environment.

The following sections provide discussions of the application of these elements of the EPP 2019 to the project. Summary information with respect to the EPP 2019 is provided in Appendix C.

The EPP 2019 also requires background creep to be assessed and provides guidance to do so, referencing a qualitative *management hierarchy* and *management intent* (refer Appendix C2).

The Explanatory Notes provide the following additional guidance:[12]

> *The acoustic quality objectives are not individual point source emission standards but are total levels of noise in the surrounding environment. It is not intended that, as part of achieving the acoustic quality objectives, any part of the existing acoustic environment be allowed to deteriorate. That means in using this policy for making decisions including under the Environmental Protection Act 1994, the acoustic quality objectives should not be seen as a noise limit without consideration of whether the acoustic environment is being allowed to deteriorate due to an existing acoustic environment that is better than the acoustic quality objective.*

These requirements are distinct from the subject of background creep. Specifically, deterioration of the existing acoustic environment relates to changes in the total sound of an environment, as measured by the equivalent noise level, L_{Aeq}. This aligns with the acoustic descriptor indicated in the acoustic quality objectives. In contrast, background noise creep relates to changes to the underlying sound level of an area (i.e. the quiet periods during lulls in the total ambient sound), as measured by the L_{A90}.

Background creep and the existing acoustic environment must therefore be considered in the context of the EPP 2019 and associated management framework. The framework is used to qualitatively evaluate the potential for background creep.

3.3 Construction vibration policy

Ground vibration from construction works associated with a project has the potential to give rise to impacts on:

- Building structures, including underground pipework – vibration which may compromise the condition of the structure itself
- Human comfort – vibration which inconveniences or interferes with the activities of the occupants or users of the building.

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12 *Environmental Protection (Noise) Policy 2019 Explanatory notes for SL 2019 No. 154* (Explanatory Notes), Queensland Government

In general, vibration limits for maintaining human comfort are more stringent than vibration limits aimed at lowering the potential risk of building damage. Building occupants will normally 'feel' vibration readily at levels well below those which may cause a risk of cosmetic or structural damage to a building.

Given the significant distance from the works to the nearest residences, construction vibration is likely to be imperceptible and well below any threshold for human comfort or building damage. However, the relevant thresholds are presented in the following sections for completeness.

3.3.1 Cosmetic building damage

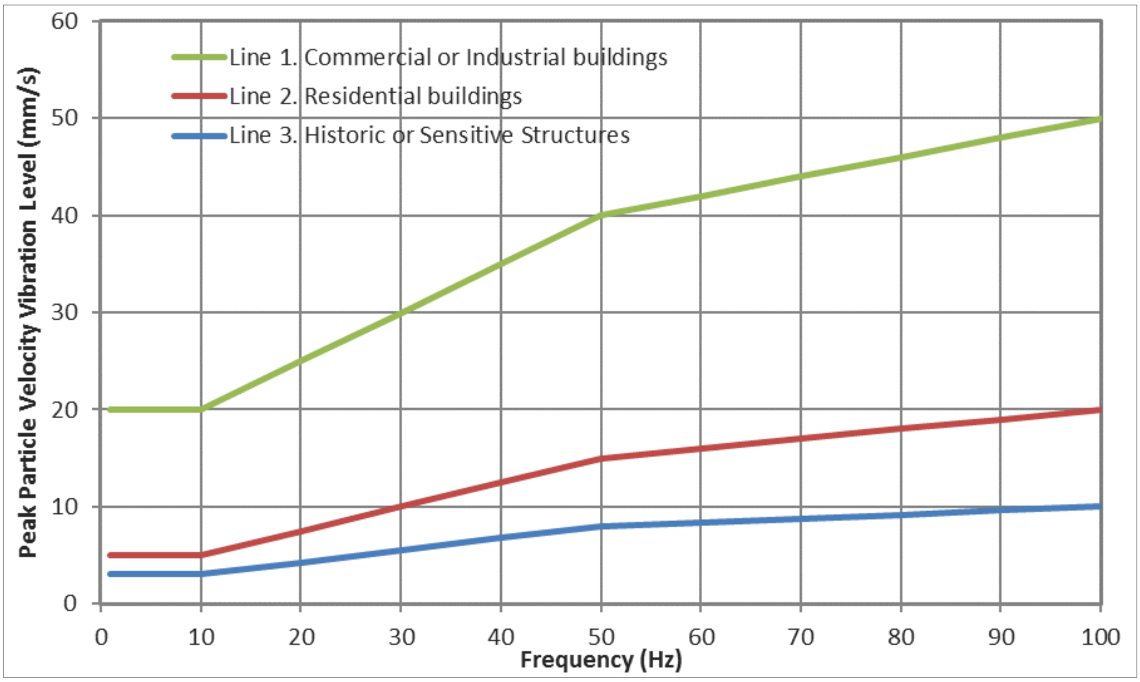
The German Standard DIN 4150-3:2016 is referred to in Code of Practice Vol.2 with regards to limits for avoiding cosmetic building damage, such as cracking in paint or plasterwork.[13] Cosmetic building damage effects are deemed 'minor damage' in DIN 4150-3 and can generally be easily repaired:

> *Experience has shown that if these values are complied with, damage that reduces the serviceability of the building will not occur.*

Much higher vibration levels, i.e. an order of magnitude higher, would be needed for there to be a substantial risk of potential structural damage.

The short-term (transient) vibration limits in Figure 3 apply at the building foundations assessed for any axis (X, Y, Z components of vibration).[14]

Figure 3: Short-term (transient) vibration at building foundations (Figure 1 of DIN 4150-3 2016)



The long-term (continuous) vibration limits in Table 3 apply at all floor levels, but levels are normally highest in horizontal axes on the top floor.[15]

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13 DIN 4150-3:2016 *Vibrations in buildings – Part 3: Effects of vibration on structures*, dated 1 December 2016 (DIN 4150-3); Department of Transport and Main Roads *Transport Noise Management Code of Practice: Volume 2 – Construction Noise and Vibration* dated May 2023 (Code of Practice Vol.2)

14 Short-term (transient) vibration is "*vibration which does not occur often enough to cause structural fatigue and which does not produce resonance in the structure being evaluated*"

15 Long-term (continuous) vibration includes types not covered by the short-term vibration definition

Table 3: Vibration at horizontal plane of highest floor (DIN 4150-3: Tables 1 and 4)

Building type	Peak particle velocity vibration level, mm/s	
	Short-term (transient)	Long-term (continuous)
Line 1 - Commercial or Industrial	40	10
Line 2 - Residential	15	5
Line 3 - Vibration sensitive	8	2.5

The applicable building type for the residential receptors considered in this assessment would be *Line 2 – Residential*.

3.3.2 Human comfort

BS 5228-2 provides guidance on the human related amenity effects of vibration.[16] The descriptions are reproduced in Table 4 and supplemented with a subjective description for 2 mm/s and 5 mm/s to bridge the gap between 1 mm/s and 10 mm/s in BS 5228-2. Vibration levels are defined in terms of peak particle velocity (PPV).

Table 4: Guidance on effects of vibration levels

PPV, mm/s	Subjective description
0.14	Vibration might be just perceptible in the most sensitive situations for most vibration frequences associated with construction. at lower frequencies, people are less sensitive to vibration.
0.3	Vibration might be just perceptible in residential environments.
1	it is likely that vibration of this level in residential environments will cause complaint but can be tolerated if prior warning and explanation has been given to residents.
2	Clearly perceptible but typically acceptable (during daytime only) in dwellings and workplaces if it occurs intermittently, and with effective prior engagement.
5	Highly unsettling in dwellings and workplaces. If prolonged, some occupants may want to leave the building. Computer screens will shake, and items could fall off shelves if they are not level.
10	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

[16] BS 5228-2:2009 *Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration*, dated June 2024 (BS 5228-2)

4.0 EXISTING NOISE ENVIRONMENT

The nearest sensitive receptors experience noise from the existing Tully substations, and from Bruce Highway, located approximately 3 km to the east. Locations further away from the project, within the town of Tully, are expected to experience local traffic noise, as well as commercial and industrial noise.

Receptors located to the south and north-west of the project are located within a rural environment. Existing background and ambient noise levels may be comparatively low.

An attended noise survey was conducted to evaluate existing noise from the Tully substations. The survey validated assumed substation sound power levels corresponding to '*reduced maximum*' sound power levels in accordance with AS 60076:10.[17]

The details of the survey are documented in Appendix E.

[17] AS 60076.10:2023 *Power transformers, Part 10: Determination of sound levels* (IEC 60076-10:2016 (ED. 2.0) MOD) (AS 60076:10)

5.0 NOISE PREDICTION METHOD

Operational noise levels from the project are predicted using:

- Noise emission data for the relevant equipment. This has been obtained directly from equipment manufacturers for the candidate equipment. The data is subject to confidentiality agreements.
- A 3D digital model of the site and the surrounding environment.
- A digital noise model of the project and the surrounding environment using proprietary noise modelling software SoundPLANnoise (version 9.1)
- Implementation of the environmental sound propagation method specified in ISO 9613-2.[18]

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 receptor, or a well-developed moderate ground-based temperature inversion.

Attexo have provided a terrain dataset with 1 m grid size encompassing the project site and surrounds. Publicly available 5 m grid size terrain data was used to extend the dataset provided by the proponent to establish a terrain model encompassing all sensitive receptors and intervening noise propagation paths.[19] The interface between both datasets was inspected for anomalies in terrain and none were found.

All equipment was modelled as omni-directional point sources at heights equivalent to the top of the equipment.

Additional information with respect to noise modelling is provided in Appendix F.

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[18] 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* (ISO-9613-2)

[19] Sourced from Spatial Services via Elvis – Elevation and Depth – Foundation Spatial Data - https://elevation.fsdf.org.au/

6.0 OPERATIONAL NOISE ASSESSMENT

At this stage, prior to planning approval, tender and procurement, it is not feasible to definitively determine equipment that will be installed at construction. This limitation is not unique to this project and is typical of any large-scale utility or infrastructure project.

Significant care has been taken to ensure that the adopted project design and equipment selections are representative of what is capable of being accommodated into the project at later stages. This has been confirmed by the proponent.

Separate noise models have been created for day/evening and night periods on the basis that the project will operate at lower cooling capacity during the night. This is in line with typical operations of a grid-scale BESS based at lower ambient temperatures.

During detailed design, the candidate equipment and associated assumptions must be reviewed, and the noise modelling and associated reporting should be updated where changes occur.

6.1 Noise sources

The proponent has prepared a detailed plan of the project which has been used as the basis of this assessment (refer Figure 2). Noise generating equipment has been indicated to comprise:

- battery/inverter units
- MV transformers
- HV transformer.

Noise data for the candidate equipment has been reviewed, with representative information adopted for the purposes of noise modelling. Since the details of manufacturer noise test documentation are confidential, only the octave band spectral information and the tested operational setpoint are reported herein.

Sound power levels for each item, as used in the noise model, are detailed in Table 5. The noise data is provided as un-weighted (linear) octave band spectra and A-weighted overall sound power level. Equipment counts and noise source heights are provided in Table 6.

Table 5: Sound power levels for project equipment items (per unit), dB L_W

Item	Octave band centre frequency, Hz							
	63	125	250	500	1,000	2,000	4,000	dBA
Battery/inverter unit								
Day/evening operation	--[a]	80	91	82	79	77	73	86
Night operation	--[a]	81	81	76	73	71	65	79
MV transformer (all time)	70	72	67	67	61	56	51	67
HV transformer (all time)	97	99	94	94	88	83	78	94

a Manufacturer data not available in 63 Hz frequency range

Table 6: Equipment counts and noise source height

Item	Quantity	Noise source height, m
Battery/inverter unit	188	3.3
MV transformer	47	2.4
HV transformer	1	5

Additional information with respect to the source of the noise data is provided in Table 7. All noise sources have been modelled as individual, omni-directional sources.

Table 7: Noise data descriptions (per unit)

Item	Description
Battery/inverter unit	Manufacturer third octave band sound power levels for 4MWh combined battery/inverter unit. ISO 3744:2010 is referenced in the test report provided by the proponent.[20] For the day/evening period, data associated with 50% cooling fan duty has been adopted. For the night period, data associated with 30% cooling fan duty has been adopted. The fan duty information was provided by the proponent and confirmed by the manufacturer as being appropriate for the expected ambient temperatures for the project. The manufacturer datasheet indicates a 1.2 dB uncertainty factor which has been included in noise modelling.
MV & HV transformers	The '*reduced maximum*' sound power levels for the 4.2 MVA MV transformer and the 360 MVA HV transformers were derived in accordance with AS 60076:10. Spectral data for both transformers was estimated by applying Bies & Hansen corrections from Table 11.27, (Location 1a for outdoor transformer noise) to the derived overall sound power levels. [21]

6.2 Noise mitigation measures

Noise mitigation should be considered by the proponent for multiple purposes including:

- Controlling noise levels such that the EPP 2019 acoustic quality objectives are not exceeded, per the requirements of PO20.
- Reducing noise levels to manage background creep.
- Minimising noise as a best practice and per the requirements of the general environmental duty of the EP Act.

The full extent of noise mitigation that might be required for the project cannot be determined at this stage. Mitigation and noise control design will be specific to the '*for construction*' project design that will be determined following detailed design, tender and procurement, post-approval.

On this basis limited mitigation has been considered herein, primarily aimed at managing noise levels to meet acoustic quality objectives.

The following noise mitigation measures have been included in the noise modelling:

- Provision of a 6 m tall noise barrier located directly to the north of the batteries/inverters, as indicated in Figure 2.
- Adoption of '*reduced maximum*' noise levels for MV and HV transformers.

The mitigation measures detailed above represent a single way in which required mitigation could be achieved.

[20] 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* (ISO 3744:2010)

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

It will be necessary to investigate additional and/or alternative noise mitigation and noise control measures as the project design progresses. The most effective mitigation measure for BESS projects is quality, holistic project design with a focus on minimising noise. This extends to:

- Preferencing quieter equipment, where feasible.
- Considering directivity of equipment and rotating preferentially to minimise noise spill.
- Improving noise models to reflect real world operational conditions.
- Providing manageable acoustic performance targets for transformer manufacturers.
- Detailed design development of acoustic barriers (where required).
- Careful consideration of tonality.

6.3 Predicted noise levels

Predicted operational noise levels at the sensitive receptors have been calculated based on the preliminary project design detailed in Section 2.0, the method detailed in Section 5.0, the operational noise source information detailed in Section 6.1, and noise mitigation detailed in Section 6.2.

The predicted noise levels are expressed as $L_{Aeq,adj,1\,hr}$ and must include any applicable adjustment for impulsive or tonal characteristics.

The equipment is not likely to include any impulsive characteristics.

The Noise Measurement Manual sets out adjustments applicable where tonal noise is a factor: [22]

> *If tonal components are clearly audible and they can be detected by a one third octave analysis the adjustment may be 5dB. If the components are only just detectable by the observer and demonstrated by narrow band analysis, an adjustment of 2-3dB may be appropriate.*

The Noise Measurement Manual gives an objective tonality test. This method involves assessing the one-third octave band spectrum at sensitive receptors.

Battery/inverter units and transformers can exhibit tonal characteristics at source. Crucially, the requirement or otherwise for the application of a tonality adjustment applies at the noise-affected premises only. There is no current, standardised method for carrying out tonality predictions, and any developed method for evaluating tonality pre-construction should be considered a general risk assessment only, and not an engineering method.

Notwithstanding this, preliminary noise modelling using 1/3 octave band manufacturer sound power data indicated a risk for tonality at most noise-affected premises. Predictions indicated an applicable tonality adjustment range between 2 dB and 3 dB for receptors within 1000 m of the project boundary. For simplicity and robustness, MDA has assumed tonality to be present at all noise-affected premises and applied a +3 dB adjustment to the predicted noise levels. This is a conservative approach that can be refined during detailed design.

[22] *Noise Measurement Manual*, Queensland Government, dated 2020.

The predicted noise levels are shown in Table 8 and Table 9 for the day/evening and night periods, respectively, at the 25 most affected receptors. Predicted noise contours are shown in Appendix G.

Table 8: Predicted operational noise levels for the day/evening period (50% battery/inverter fan speed), dB $L_{Aeq,adj,1hr}$

Sensitive receptor	Predicted noise level [a]	Equivalent external acoustic quality objective
4-Res-	32	42
6-Res-	34	42
10-Res-	34	42
13-Res-	33	42
24-Res-	34	42
27-Res-	33	42
28-Res-	34	42
31-Res-	35	42
34-Res-	34	42
36-Res-	33	42
38-Res-	34	42
42-Res-	34	42
54-Res-	35	42
55-Res-	34	42
58-Res-	34	42
59-Res-	33	42
60-Res-	33	42
63-Res-	33	42
65-Res-	34	42
72-Res-	33	42
74-Res-	35	42
81-Res-	33	42
87-Res-	34	42
418-Res-	36	42
441-Res-	37	42

a Includes +3 dB tonality adjustment

Table 9: Predicted operational noise levels for the night period (30% battery/inverter fan speed), dB $L_{Aeq,adj,1hr}$

Sensitive receptor	Predicted noise level [a]	Equivalent external acoustic quality objective
4-Res-	26	37
6-Res-	28	37
10-Res-	28	37
13-Res-	27	37
24-Res-	28	37
27-Res-	27	37
28-Res-	28	37
31-Res-	29	37
34-Res-	28	37
36-Res-	27	37
38-Res-	29	37
42-Res-	28	37
54-Res-	30	37
55-Res-	28	37
58-Res-	28	37
59-Res-	28	37
60-Res-	28	37
63-Res-	27	37
65-Res-	28	37
72-Res-	27	37
74-Res-	29	37
81-Res-	28	37
87-Res-	29	37
418-Res-	30	37
441-Res-	31	37

a Includes +3 dB tonality adjustment

7.0 OPERATIONAL NOISE - DISCUSSION

7.1 State code 27 PO20

Operational noise from the project is predicted to be below the equivalent external acoustic quality objectives at all sensitive receptors for both day/evening, and night periods.

The equivalent external acoustic quality objectives were derived in Table 2 to align with noise requirements set out in PO20.

A minimum margin of 5 dB or more during the day/evening period, and 6 dB or more during the night period is indicated, based on generally conservative modelling assumptions, including adjustments for tonality.

On this basis the project is capable of being designed and operated to align with the operational noise requirements of State code 27.

7.1.1 Cumulative noise

The acoustic quality objective for a sensitive receptor, means *"the maximum level of noise that should be experienced in the acoustic environment of the sensitive receptor".* This means that cumulative noise together with other projects (existing or planned) must be addressed when considering the requirements of PO20.

The existing Tully substations are both located in close to the project and therefore should be included in a cumulative assessment of noise. The location of the substations relative to the project and nearest receptors are shown in Figure 4.

Detailed information regards noise generating equipment at Tully substations was not available from the operator, Powerlink.

Attexo engaged MDA to carry out an attended noise survey of the substations.

Noise levels from the substations at receptors has been determined through a combination of site measurements and a calibrated noise model. Detailed information is set out in Appendix E.

The following information about main transformers in each substation was obtained from the proponent:

- North substation: 2x 132/22kV transformers. Power capacity from nameplate: 20 MVA
- South substation: 1x 275/132kV transformer. Power capacity from nameplate: 150/200/250 MVA.

The sound power levels associated with the substation transformers were derived considering AS 60076:10 based on the respective power capacity in MVA. This follows a similar approach to the project transformers (refer Table 7). The assumed '*reduced maximum'* sound power levels for transformers have been verified based on the site survey carried out at the existing Tully substations and surrounding area.

Figure 4: Location plan showing Tully substations

Predicted noise levels from the project and Tully substations were summed logarithmically to estimate the cumulative noise level at each receptor. The cumulative noise predictions are set out in Table 10 and Table 11 for the day/evening and night periods, respectively.

Table 10: Predicted cumulative noise levels, day/evening period, dB $L_{Aeq,adj,15min}$

Sensitive receptor	Project [a]	Substations [a]	Cumulative	Acoustic quality objective	Compliance?
31-Res-	35	31	36	42	✓
38-Res-	34	29	35	42	✓
54-Res-	35	33	37	42	✓
74-Res-	35	31	36	42	✓
441-Res-	37	33	38	42	✓

a Includes +3 dB tonality adjustment

Table 11: Predicted cumulative noise levels, night period, dB $L_{Aeq,adj,15min}$

Sensitive receptor	Project [a]	Substations [a]	Cumulative	Acoustic quality objective	Compliance?
31-Res-	29	31	33	37	✓
38-Res-	29	29	32	37	✓
54-Res-	30	33	35	37	✓
74-Res-	29	31	33	37	✓
441-Res-	31	33	35	37	✓

a Includes +3 dB tonality adjustment

The assessment indicates that the risk for cumulative noise from the project and Tully substations exceeding the acoustic quality objectives is limited. Predicted cumulative noise levels are indicated to be below the PO20 acoustic quality objectives at all receptors for both day/evening and night periods.

The application of a 3 dB tonality adjustment for substation noise is expected to be conservative with tonality not indicated to be a prominent feature of the noise environment at the receptors, albeit based on daytime observations.

Notwithstanding the above, cumulative noise risks should be considered as the project moves through subsequent stages of development.

7.2 Environmental Protection (Noise) Policy 2019

7.2.1 Background creep and deterioration of the existing acoustic environment

Background creep

The EPP 2019 provides a qualitative management framework comprising a *management hierarchy* - which establishes an approach to avoiding, minimising or managing noise (to the extent that it is reasonable to do so), and the *management intent* - being matters that must be considered by the administering authority when making an environmental management decision. The framework is used to qualitatively evaluate the potential for background creep.

The EPP 2019 also recognises that in some situations it may be reasonable to increase the background noise levels but only to the extent the environmental values of the area are still protected.

This requires the proponent must make all reasonable efforts to minimise or manage noise from the project, while ensuring that the environmental values of the area are protected. Protection of the environmental values is managed by compliance with the acoustic quality objectives.

Section 6.2 sets out various conceptual mitigation measures for the reasonable management of noise. Final '*for construction'* mitigation measures will be determined during the detailed design stage. The current project offers multiple material opportunities for noise minimisation.

The noise assessment indicates that with appropriate design development, the acoustic quality objectives applicable under the EPP 2019 are capable of being achieved, both in isolation and cumulatively.

On the basis that the acoustic quality objectives are capable of being achieved (therefore protecting the relevant environmental values) and that the proponent has demonstrated efforts to minimise noise where reasonable, background creep is capable of being managed in accordance with the management framework.

Existing acoustic environment

The nearest sensitive receptors experience noise from the existing Tully substations, and from Bruce Highway, located approximately 3 km to the east. An attended noise survey was conducted to evaluate existing noise from the Tully substations.

Predictions of noise associated with the Tully substations have been carried out and are summarised in Section 7.1.1.

Table 11 indicates that noise from the project during the night time is likely to be lower than existing noise from the Tully substations. Noise from the project is therefore not expected to lead to deterioration of the existing acoustic environment at night.

Day time predicted noise levels for the project are generally in the middle of the range of estimated noise levels from the Tully substations and are based on conservative assumptions. In addition, the acoustic environment at the sensitive receptors will include other local noise sources, likely leading to higher ambient noise environment than that of the substations alone.

Long term ambient noise monitoring was not carried out. Typical ambient noise levels for land use areas are generally not documented in Queensland policy or guidelines however there are other standards and state policies that can be referred to for context.

Appendix A of AS 1055.2-1997 provides estimated average background A-weighted noise levels (L_{A90}) for different areas with residences in Australia.[23] Indicated day-time levels range from 40-65 dB L_{A90}, with the lower of the range representing residences in areas with negligible transportation.

The NSW NPfI also provides typical existing background noise levels for receptor categories including '*Rural residential'*, indicating daytime levels of 40 dB L_{A90} (or less). [24]

In all external environments, ambient noise levels (L_{Aeq}) would be greater than background noise levels (L_{A90}). The above documents can therefore be used as a source of guidance of potential ambient noise levels, in the absence of long term background noise monitoring, and indicate that noise from the project is below the typical day time ambient levels that are indicated.

On this basis noise from the project is not expected to lead to deterioration of the existing acoustic environment during the day.

7.3 Summary

The predicted noise levels determined by the noise assessment indicate that, based on the information detailed in this report, the project is capable of being designed and operated such that:

- Predicted project noise levels are below the acoustic quality objectives, per PO20.
- Cumulative noise is likely to be below the PO20 acoustic quality objectives, subject to holistic design development.
- Background creep and deterioration of existing acoustic environment, assessed under the EPP 2019, is minimised.

The above meets PO20 and broader EPP 2019 provisions.

On the basis that the acoustic quality objectives are capable of being achieved (therefore protecting the relevant environmental values) and that the proponent has demonstrated efforts to minimise noise where reasonable, background creep and deterioration of existing acoustic environment is capable of being managed in accordance with the EPP 2019 management framework. This also conforms with the EPP management hierarchy for noise, with regards to project operation.

The operational noise assessment adopts the following operational fan duties for the battery/inverters:

- 50% fan duty during day/evening operation
- 30% fan duty during night operation.

This is to reflect the expected worst case fan operation during typical ambient temperatures based on information provided by the proponent. These fan duties have been confirmed by the battery manufacturer as being appropriate for the expected ambient temperatures in the area.

The assessment in this report details one of several ways in which the project could be designed and delivered whilst maintaining compliance with the applicable noise limits.

[23] AS 1055.2:1997 *Acoustics—Description and measurement of environmental noise Part 2: Application to specific situations* (superseded by AS 1055:2018 *Acoustics—Description and measurement of environmental noise).*

[24] NSW Environment Protection Authority, *Noise Policy for Industry*, October 2017 (NPfI)

Where changes from any aspect of the assessment detailed in this report occur, e.g. during design development, tender or procurement, the changes must be reviewed to verify continued compliance of this project. In particular, it is expected that further noise assessment should be conducted once a finalised project design, equipment selections and associated manufacturer's noise data are determined.

To assist the ongoing development of the project the following recommendations are provided:

- Design development (including layout, equipment selections and noise mitigation measures) to align with the requirements of the PO20 and EPP 2019 as the project progresses.
- Where project changes occur, acoustic compliance to be verified via updated noise modelling and reporting - this may comprise a final, '*for construction*' noise model and report.
- Preparation of an operational noise management plan and detailed compliance test plan.

8.0 CONSTRUCTION NOISE AND VIBRATION ASSESSMENT

The construction of the project will generate noise and vibration as a result of activities occurring on the project site. Construction noise levels are required to be below the acoustic quality objectives, per PO20. PO21 requires that the construction activities do not cause vibration impacts that adversely affect the operational performance or sensitive receptors.

On-site works include a range of activities such as site preparation, concreting and BESS installation.

As advised by the proponent, construction using any noisy equipment outside the standard hours (07:00 to 18:00 weekdays and 08:00 to13:00 Saturday) is unlikely to occur. Any construction activities outside these hours will be limited quiet activities, like commissioning, project management etc.

The following sections provide general information regarding the types of activities that are expected to be associated with the construction of the project, and reference data that should be considered as part of the preparation of a future CNVMP for the project, once a main contractor is appointed.

8.1 Construction activities

The proponent has provided a list of example machinery likely to be used in separate construction phases:

- site establishment,
- concreting and foundations,
- BESS installation.

The proponent has also provided indicative sound power levels for each equipment item. In addition, a sound power level range of construction equipment is also provided in AS 2436:2010.[25] The equipment sound power level ranges are documented in Appendix H.

Based on the groupings of major plant items during key construction tasks and available sound power level data, the total aggregated noise emissions range from 116 to 126 dB for site preparation, 107-121 dB for concreting and 105-120 dB for BESS installation.

There is no data available for maintenance and decommissioning machinery. Typical activities and processes would result in significantly lower noise levels than construction works.

The construction noise predictions reflect the closest point and middle of relevant work areas and conservatively assume that each item of plant associated with a task operates concurrently.

8.2 Construction noise assessment

Noise levels associated with each of the main construction tasks have been predicted at the nearest receptors to provide an indication of the upper range of noise levels. Predictions were carried out in accordance with the methods described in AS 2436:2010.

The precise equipment selections and methods of working would be determined during detailed design stage, once a main contractor is appointed. Noise levels associated with specific plant, activity and equipment location can vary significantly. Therefore, the predicted noise levels provided in the following sections represent an indicative range of levels which may occur in practice.

The predicted construction noise levels are shown in Table 12. For simplicity, only 4 representative and most exposed to noise receptors are included in this table.

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[25] AS 2436:2010 *Guide to noise and vibration control on construction, demolition and maintenance sites (AS2436)*

Table 12: Indicative range of construction noise predictions, dB L_{Aeq}

Construction phase	Most exposed receptors	Minimum distance (project boundary), m	Maximum distance (BESS construction site centroid), m	Predicted level range, $L_{Aeq,1hour}$ dB	Acoustic quality objective	Predicted level below/above acoustic quality objective[a]
Site preparation and establishment	441-Res-	480	740	41-56	42	-1 / 14
	54-Res-	580	880	39-54	42	-3 / 12
	42-Res-	770	1,070	37-51	42	-5 / 9
	418-Res-	730	890	39-51	42	-3 / 9
Concreting	441-Res-	480	740	32-51	42	-10 / 9
	54-Res-	580	880	30-49	42	-12 / 7
	42-Res-	770	1,070	28-46	42	-14 / 4
	418-Res-	730	890	30-47	42	-12 / 5
BESS installation	441-Res-	480	740	29-49	42	-13 / 7
	54-Res-	580	880	27-47	42	-15 / 5
	42-Res-	770	1,070	25-44	42	-17 / 2
	418-Res-	730	890	27-44	42	-15 / 2

The results indicate:

- Predicted levels reflective of works at the centre of site and using quieter machinery are below the acoustic quality objectives at all receptors.
- Predicted levels reflective of works at the project boundary using noisiest machinery are up to 14 dB above the acoustic quality objective.

The following sections describe project specific mitigation measures and universal practices aimed at reducing the construction noise to as low a level as practicable.

8.3 Evaluation of mitigation measures

Indicative construction noise mitigation measures have been evaluated for each major activity of construction in order to reduce construction noise levels to be below the acoustic quality objective.

These mitigation measures represent an initial estimate of all '*practical and feasible*' work practices suitable for consideration in the construction process. During detailed design of the construction process, a subsequent review of these mitigation measures should be conducted to determine whether these measures are still relevant to the developed construction process.

These mitigation measures consist of a combination of universal work practices that should be followed for all activities, as well as specific mitigation measures for individual construction activities.

This may require the completion of a construction noise and vibration management plan (CNVMP) to manage noise impacts.

8.3.1 Project specific construction noise mitigation

The following project specific construction noise mitigation measures are recommended:

Site preparation and establishment

- Selection of excavator, dozer, dump truck, compactor with lowest noise emissions from the range from AS 2436:2010, refer Table 25
- Schedule noisiest works, e.g. excavation and compaction during hours that will least adversely affect receptors, for example during normal working hours between 10:00 and 16:00.
- Erect temporary barriers as close to the noisiest works as possible, shielding the equipment to the north and east. Move barriers with the works, if feasible.
- Constructing the noise barrier that is part of the project design early in the project to afford mitigation against site noise.

Concreting

- Selection of excavator, concrete truck and crane with lowest noise emissions from the range from AS 2436:2010, refer Appendix H, Table 25
- Schedule concreting works during hours that will least adversely affect receptors, for example during normal working hours between 10:00 and 16:00.

BESS installation

- Selection of compressor, generator and crane with lowest noise emissions from the range from AS 2436:2010, refer Appendix H, Table 25

8.3.2 Universal work practices

The following noise mitigation work practices should be adopted at all times on site during all construction phases:

- Regularly train workers and contractors (such as at toolbox talks) to use equipment in ways to minimise noise.
- Ensure site managers periodically check the site and nearby residences for noise problems so that solutions can be quickly applied.
- Avoid the overuse of public address systems and radios.
- Avoid shouting, and minimise talking loudly and slamming vehicle doors
- Turn off all equipment/plant when not in use
- Regularly inspect and maintain plant to avoid increased noise levels from rattling hatches, loose fittings etc
- Check hatches/enclosures regularly to ensure that seals are in good working order and doors close properly against seals.
- Use non-tonal reversing/movement alarms such as broadband (non-tonal) alarms or ambient noise-sensing alarms.
- Minimise truck movements

Notwithstanding the above, a detailed CNVMP should be established based on known construction staging, work practices and project specific construction equipment items, once a main contractor is appointed.

8.4 Construction noise - Discussion

Compliance with the EPP 2019 acoustic quality objectives is indicated at all receptors for typical works carried out in the middle to far parts of relevant work areas. Where equipment and plant are working at the closest portions of relevant work areas to receptors predicted noise levels up to 14 dB above the acoustic quality objectives are indicated. This is based on the conservative assumption that all machinery will operate concurrently. In practice, only a portion of nominated equipment will operate concurrently. This will result in lower real world noise levels than indicated by the current risk assessment.

It should be noted that the EPP 2019 is intended to provide nuisance criteria for environmental noise emissions with a long term focus, such that the aims of the EP Act are satisfied. The requirements of the EPP 2019, including the acoustic quality objectives, therefore typically apply to assessment of operational noise from a project, being the relevant long term noise factor. It is atypical to apply the requirements of the EPP 2019 to short-term, temporary noise sources such as construction noise.

For this reason the application of PO20 acoustic quality objectives represent onerous criteria for construction noise that is impractical to achieve in most cases.

Outside of the SDAP structure, including where an environmental impact statement (EIS) is required for high-risk projects, construction noise would ordinarily be assessed considering the Code of Practice Vol.2.

This is a specific document established by the Department of Transport and Main Roads to set criteria for the assessment of road infrastructure construction noise to achieve the intent of the EP Act, in particularly the general environmental duty and protection of relevant environmental values. Further information is provided in Appendix D.

The predicted construction noise levels set out in Section 8.2 are below the minimum upper limit of 65 dB, as specified in Code of Practice Vol.2

Project specific mitigation, as well as universal work practices are recommended to minimise the construction noise levels. All feasible and reasonable work practices and mitigation measures should be implemented as part of a detailed CNVMP, to be drafted once a main contractor is appointed.

8.5 Construction vibration assessment

Vibration propagation through the ground arising from construction activity is complex and depends on several factors including damping, reflection and impedance in ground conditions. Therefore, a detailed vibration propagation assessment is site-specific and will require a combination of empirical (site measurements) and analytical methods.

In lieu of complex empirical predictions, MDA uses its own historic measurements and vibration level over distance regression curves to estimate safe setback distances.

Table 13 details approximate setback distances from high-vibration construction activities at which performance standards may be approached. The levels were calculated with reference to the long term (continuous) cosmetic building damage criteria set in DIN 4150-3 and shown in Table 3, as well as BS 5228-2 human comfort criteria shown in Table 4. The below table identifies the equipment that requires mitigation and/or management, and the source-receptor distances where the risk begins.

Table 13: Indicative distances to comply with vibration limits at building foundations

Equipment	Human comfort setback, m [a]		Cosmetic building damage setback, m [b]		
	1 mm/s PPV	2 mm/s PPV	Sensitive 2.5 mm/s PPV	Residential 5 mm/s PPV	Commercial 10 mm/s PPV
Drum roller (10-12T vibro function)	28	13	22	10	5
Plate compactor (450 kg)	12	7	10	6	3
Excavator	23	7	15	4	1

a Based on regression analysis of available vibration measurements, no safety factor (representative)

b Based on regression analysis of available vibration measurements, plus a 100% safety factor (conservative)

8.6 Construction vibration - Discussion

Minimum distances between receptors and the project boundary are in the order of 480 m and more.

The assessment indicates that construction vibration from main machinery, such as the drum roller, could potentially adversely affect residents only at distances smaller than 28 m.

As a result no receptors are predicted to be affected by vibration that may cause comfort disturbance or cosmetic building damage.

8.7 Construction noise and vibration recommendations

Until a detailed construction plan is developed only a preliminary assessment of construction noise and vibration impact risk is feasible. Once a more detailed schedule of equipment and plant items, construction method and work areas are known, a detailed CNVMP should be prepared.

Any future CNVMP should include site and process specific noise management work practices designed to mitigate the impact of construction noise activities.

The Code of Practice Vol. 2 provides extensive details and guidance with respect to noise mitigation including:

- administrative procedures
- plant and equipment
- transmission path
- facility layout
- respite
- temporary relocation and architectural treatment.

All of the above items should be considered as part of a future CNVMP.

As with most construction projects works in any one location is typically of short duration with any adverse noise impact or disturbance being temporary. With reasonable and feasible work practices implemented it is expected that noise associated with the construction and decommissioning of the project can be acceptably managed.

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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 our 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 Hertz (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.
Hertz (Hz)	The unit of frequency, 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_{A90}	The A-weighted sound level exceeded for 90 % of the measurement period, measured in dB. Commonly referred to as the background noise level.
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.

The basic quantities used within this document to describe noise adopt the conventions outlined in ISO 1996-1:2016.[26]

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.

[26] ISO 1996-1:2016 *Acoustics - Description measurement and assessment of environmental noise – Basic quantities and assessment procedures* (ISO 1996-1:2016)

APPENDIX B SENSITIVE RECEPTORS

Table 14 sets out the 343 sensitive receptors identified by the proponent within 3 km of the project boundary, together with their respective distance to the project boundary.

Terrain elevation information is taken from correlating the geographic position of receptor and topographical data referenced in Section 5.0.

Table 14: Sensitive receptor co-ordinates, GDA2020 MGA zone 55

Sensitive receptor	Easting, m	Northing, m	Terrain elevation, m	Distance to project boundary, m
3-Res-	385,769	8,015,413	20	1,970
4-Res-	384,695	8,014,860	52	880
5-Res-	385,838	8,015,496	18	2,070
6-Res-	384,705	8,014,689	24	730
7-Res-	386,486	8,015,236	15	2,440
8-Res-	386,415	8,014,334	13	2,080
10-Res-	384,880	8,014,559	21	730
11-Res-	382,959	8,012,178	11	1,840
12-Res-	385,889	8,012,014	12	2,430
13-Res-	384,703	8,014,743	30	780
14-Res-	382,581	8,015,521	23	2,020
15-Res-	385,757	8,015,394	20	1,940
16-Res-	385,661	8,015,279	21	1,800
17-Res-	385,701	8,015,267	21	1,820
18-Res-	385,337	8,015,596	56	1,830
19-Res-	386,196	8,012,524	12	2,350
20-Res-	384,724	8,014,966	68	990
21-Res-	385,790	8,015,449	19	2,010
22-Res-	385,588	8,015,158	23	1,660
23-Res-	385,665	8,015,360	22	1,860
24-Res-	384,861	8,014,559	21	720
25-Res-	383,873	8,015,432	41	1,360
26-Res-	385,826	8,015,479	19	2,050
27-Res-	384,928	8,014,569	19	780
28-Res-	384,657	8,014,721	27	740
29-Res-	386,496	8,012,862	13	2,450
30-Res-	384,730	8,014,999	71	1,020
31-Res-	384,716	8,014,573	22	640

Sensitive receptor	Easting, m	Northing, m	Terrain elevation, m	Distance to project boundary, m
32-Res-	385,649	8,015,379	22	1,860
33-Res-	384,711	8,014,935	64	950
34-Res-	384,700	8,014,663	24	710
35-Res-	385,723	8,015,369	21	1,900
36-Res-	384,735	8,014,774	32	820
38-Res-	384,844	8,014,514	20	680
39-Res-	385,199	8,014,574	23	1,000
40-Res-	385,743	8,015,382	20	1,930
41-Res-	385,803	8,015,466	19	2,030
42-Res-	385,048	8,014,372	15	770
43-Res-	386,459	8,014,727	15	2,210
44-Res-	384,667	8,014,947	56	950
45-Res-	385,676	8,015,296	22	1,820
46-Res-	385,259	8,014,793	53	1,170
47-Res-	386,459	8,013,892	13	2,110
48-Res-FORESTLAND	385,838	8,014,130	14	1,490
49-Res-	386,021	8,012,004	11	2,530
51-Res-	384,749	8,015,041	70	1,070
52-Res-	385,778	8,015,436	20	1,990
53-Res-	385,232	8,014,433	18	960
54-Res-	384,599	8,014,580	21	580
55-Res-	384,872	8,014,514	20	700
56-Res-	385,924	8,015,523	17	2,150
57-Res-	382,918	8,015,781	26	2,020
58-Res-	384,700	8,014,636	24	680
59-Res-	384,225	8,014,872	31	810
60-Res-	384,903	8,014,557	20	750
61-Res-	385,449	8,015,640	39	1,930
62-Res-	385,744	8,015,289	21	1,860
63-Res-	384,862	8,014,636	24	780
64-Res-	385,852	8,015,558	18	2,130
65-Res-	384,651	8,014,673	24	690
66-Res-	386,470	8,014,866	15	2,270

Sensitive receptor	Easting, m	Northing, m	Terrain elevation, m	Distance to project boundary, m
67-Res-	385,738	8,015,416	20	1,950
68-Res-	387,174	8,013,535	13	2,870
69-Res-	386,124	8,012,349	12	2,380
70-Res-	384,693	8,014,834	48	850
71-Res-	384,545	8,014,880	36	850
72-Res-	384,659	8,014,773	35	780
73-Res-	385,723	8,015,268	21	1,830
74-Res-	384,643	8,014,595	22	620
75-Res-	385,680	8,015,367	22	1,870
76-Res-	386,088	8,011,945	12	2,620
77-Res-	385,118	8,014,557	20	920
78-Res-	386,192	8,012,400	12	2,410
79-Res-	386,800	8,013,142	13	2,610
80-Res-	383,084	8,015,672	27	1,840
81-Res-	384,710	8,014,715	25	750
83-Res-	385,631	8,015,365	23	1,830
84-Res-	384,711	8,014,905	59	930
85-Res-	387,175	8,013,616	14	2,860
86-Res-	386,092	8,011,916	11	2,640
87-Res-	384,692	8,014,610	23	660
88-Res-	385,434	8,014,848	29	1,350
89-Res-	385,872	8,016,475	26	2,860
90-Res-	385,865	8,016,441	26	2,830
91-Res-	385,822	8,016,453	27	2,820
92-Res-	385,795	8,016,457	28	2,810
93-Res-	385,810	8,016,510	28	2,860
94-Res-	385,756	8,016,517	29	2,840
95-Res-	385,761	8,016,497	29	2,820
96-Res-	385,758	8,016,459	29	2,790
97-Res-	385,732	8,016,465	31	2,780
98-Res-	385,703	8,016,472	31	2,770
99-Res-	385,683	8,016,472	33	2,760
100-Res-	385,693	8,016,509	32	2,800

Sensitive receptor	Easting, m	Northing, m	Terrain elevation, m	Distance to project boundary, m
101-Res-	385,691	8,016,535	32	2,820
102-Res-	385,695	8,016,552	32	2,840
103-Res-	385,702	8,016,569	32	2,860
104-Res-	385,646	8,016,581	33	2,840
105-Res-	385,644	8,016,564	34	2,830
106-Res-	385,650	8,016,541	34	2,810
107-Res-	385,645	8,016,523	35	2,790
108-Res-	385,644	8,016,501	35	2,770
109-Res-	385,613	8,016,491	37	2,750
110-Res-	385,583	8,016,494	39	2,740
111-Res-	385,562	8,016,499	41	2,730
112-Res-	385,566	8,016,534	39	2,760
113-Res-	385,573	8,016,550	38	2,780
114-Res-	385,579	8,016,575	37	2,810
115-Res-	385,584	8,016,594	37	2,830
116-Res-	385,536	8,016,600	40	2,810
117-Res-	385,532	8,016,580	41	2,790
118-Res-	385,522	8,016,544	41	2,750
119-Res-	385,521	8,016,525	42	2,740
120-Res-	385,516	8,016,503	43	2,720
121-Res-	385,457	8,016,577	47	2,760
122-Res-	385,454	8,016,537	47	2,720
123-Res-	385,412	8,016,589	51	2,750
124-Res-	385,401	8,016,551	51	2,710
125-Res-	385,394	8,016,528	52	2,690
126-Res-	385,389	8,016,488	55	2,650
127-Res-	385,390	8,016,471	56	2,630
128-Res-	385,378	8,016,448	58	2,610
129-Res-	385,378	8,016,430	58	2,590
130-Res-	385,357	8,016,410	60	2,560
131-Res-	385,423	8,016,421	54	2,600
132-Res-	385,430	8,016,442	53	2,620
133-Res-	385,432	8,016,462	52	2,640

Sensitive receptor	Easting, m	Northing, m	Terrain elevation, m	Distance to project boundary, m
134-Res-	385,451	8,016,477	50	2,660
135-Res-	385,510	8,016,465	46	2,680
136-Res-	385,502	8,016,443	47	2,660
137-Res-	385,499	8,016,426	47	2,640
138-Res-	385,495	8,016,406	47	2,620
139-Res-	385,483	8,016,370	48	2,580
140-Res-	385,550	8,016,453	43	2,680
141-Res-	385,570	8,016,447	41	2,690
142-Res-	385,591	8,016,445	40	2,700
143-Res-	385,612	8,016,441	38	2,700
144-Res-	385,632	8,016,439	37	2,710
145-Res-	385,624	8,016,389	36	2,660
146-Res-	385,908	8,016,389	24	2,810
147-Res-	385,904	8,016,367	23	2,790
148-Res-	385,900	8,016,345	23	2,770
149-Res-	385,898	8,016,324	23	2,750
150-Res-	385,891	8,016,306	23	2,730
151-Res-	385,886	8,016,286	24	2,710
152-Res-	385,949	8,016,281	21	2,740
153-Res-	385,977	8,016,350	21	2,820
154-Res-	385,982	8,016,375	22	2,840
155-Res-	386,023	8,016,364	20	2,850
156-Res-	386,018	8,016,343	20	2,830
157-Res-	385,610	8,016,335	38	2,610
158-Res-	385,622	8,016,317	38	2,600
159-Res-	385,622	8,016,294	38	2,580
160-Res-	385,618	8,016,270	40	2,560
161-Res-	385,612	8,016,238	42	2,520
162-Res-	385,606	8,016,208	42	2,500
163-Res-	385,592	8,016,238	45	2,510
164-Res-	385,575	8,016,259	48	2,530
165-Res-	385,563	8,016,282	49	2,540
166-Res-	385,546	8,016,287	50	2,540

Sensitive receptor	Easting, m	Northing, m	Terrain elevation, m	Distance to project boundary, m
167-Res-	385,526	8,016,294	51	2,530
168-Res-	385,479	8,016,244	56	2,470
169-Res-	385,507	8,016,243	55	2,480
170-Res-	385,530	8,016,244	54	2,490
171-Res-	385,546	8,016,232	52	2,490
172-Res-	385,554	8,016,214	48	2,480
173-Res-	385,569	8,016,192	43	2,460
174-Res-	385,586	8,016,161	34	2,440
175-Res-	385,689	8,016,078	24	2,430
176-Res-	385,712	8,016,075	24	2,440
177-Res-	385,734	8,016,076	24	2,450
178-Res-	385,760	8,016,067	21	2,460
179-Res-	385,782	8,016,069	20	2,470
180-Res-	385,801	8,016,046	19	2,470
181-Res-	385,811	8,016,031	19	2,460
182-Res-	385,820	8,016,005	18	2,440
183-Res-	385,778	8,016,007	19	2,420
184-Res-	385,754	8,016,016	19	2,420
185-Res-	385,725	8,016,014	19	2,400
186-Res-	385,876	8,016,195	22	2,630
187-Res-	385,887	8,016,162	21	2,610
188-Res-	385,879	8,016,241	22	2,670
189-Res-	385,935	8,016,226	20	2,690
190-Res-	385,860	8,016,110	21	2,550
191-Res-	385,880	8,016,082	20	2,540
192-Res-	385,892	8,016,064	19	2,540
193-Res-	385,860	8,016,041	19	2,500
194-Res-	385,849	8,016,064	20	2,510
195-Res-	385,829	8,016,089	21	2,520
196-Res-	385,901	8,016,138	20	2,600
197-Res-	385,915	8,016,112	20	2,590
198-Res-	385,806	8,015,960	18	2,400
199-Res-	385,788	8,015,963	18	2,390

Sensitive receptor	Easting, m	Northing, m	Terrain elevation, m	Distance to project boundary, m
200-Res-	385,765	8,015,965	18	2,380
201-Res-	385,709	8,015,970	20	2,350
202-Res-	385,685	8,015,972	20	2,340
203-Res-	385,662	8,015,976	21	2,330
204-Res-	385,669	8,015,919	22	2,290
205-Res-	385,686	8,015,917	22	2,290
206-Res-	385,705	8,015,915	21	2,300
207-Res-	385,723	8,015,914	21	2,310
208-Res-	385,752	8,015,916	19	2,330
209-Res-	385,770	8,015,907	19	2,340
210-Res-	385,798	8,015,907	18	2,350
211-Res-	385,825	8,015,962	18	2,410
212-Res-	385,597	8,015,966	24	2,290
213-Res-	385,574	8,015,976	24	2,280
214-Res-	385,557	8,015,964	25	2,260
215-Res-	385,532	8,015,968	28	2,250
216-Res-	385,516	8,016,009	28	2,280
217-Res-	385,494	8,016,007	31	2,270
218-Res-	385,476	8,016,013	33	2,260
219-Res-	385,473	8,015,965	32	2,220
220-Res-	385,494	8,015,944	28	2,210
221-Res-	385,447	8,015,973	35	2,210
222-Res-	385,433	8,015,976	36	2,210
223-Res-	385,395	8,015,989	40	2,200
224-Res-	385,409	8,016,038	38	2,250
225-Res-	385,921	8,016,023	17	2,520
226-Res-	385,872	8,015,976	17	2,450
227-Res-	385,876	8,015,953	17	2,440
228-Res-	385,888	8,015,889	17	2,400
229-Res-	385,978	8,015,891	17	2,460
230-Res-	385,977	8,015,873	17	2,440
231-Res-	385,981	8,015,845	17	2,420
232-Res-	385,842	8,015,847	17	2,330

Sensitive receptor	Easting, m	Northing, m	Terrain elevation, m	Distance to project boundary, m
233-Res-	385,835	8,015,825	17	2,310
234-Res-	385,827	8,015,797	17	2,290
235-Res-	385,817	8,015,783	17	2,270
236-Res-	385,806	8,015,766	17	2,250
237-Res-	385,792	8,015,844	17	2,300
238-Res-	385,769	8,015,845	18	2,290
239-Res-	385,748	8,015,847	18	2,280
240-Res-	385,725	8,015,853	18	2,270
241-Res-	385,702	8,015,854	18	2,250
242-Res-	385,768	8,015,801	18	2,250
243-Res-	385,749	8,015,803	18	2,240
244-Res-	385,723	8,015,805	18	2,230
245-Res-	385,700	8,015,807	19	2,210
246-Res-	385,671	8,015,805	20	2,200
247-Res-	385,672	8,015,855	19	2,240
248-Res-	385,649	8,015,856	19	2,220
249-Res-	385,608	8,015,853	20	2,200
250-Res-	385,603	8,015,845	20	2,190
251-Res-	385,597	8,015,827	21	2,170
252-Res-	385,587	8,015,812	21	2,150
253-Res-	385,576	8,015,795	23	2,130
254-Res-	385,569	8,015,777	24	2,110
255-Res-	385,634	8,015,784	22	2,160
256-Res-	385,621	8,015,764	23	2,130
257-Res-	385,606	8,015,740	24	2,100
258-Res-	385,538	8,015,744	28	2,070
259-Res-	385,516	8,015,728	30	2,040
260-Res-	385,496	8,015,713	33	2,020
261-Res-	385,453	8,015,695	38	1,980
262-Res-	385,433	8,015,690	39	1,960
263-Res-	385,473	8,015,647	37	1,950
264-Res-	385,493	8,015,657	35	1,970
265-Res-	385,407	8,015,627	45	1,900

Sensitive receptor	Easting, m	Northing, m	Terrain elevation, m	Distance to project boundary, m
266-Res-	385,677	8,015,773	21	2,170
267-Res-	385,670	8,015,757	21	2,160
268-Res-	385,676	8,015,728	20	2,140
269-Res-	385,699	8,015,716	19	2,140
270-Res-	385,717	8,015,710	18	2,150
271-Res-	385,707	8,015,776	20	2,190
272-Res-	385,726	8,015,762	19	2,200
273-Res-	385,746	8,015,753	18	2,200
274-Res-	385,758	8,015,778	18	2,230
275-Res-	385,785	8,015,732	18	2,210
276-Res-	385,773	8,015,715	18	2,190
277-Res-	385,762	8,015,702	18	2,170
278-Res-	385,751	8,015,684	18	2,150
279-Res-	385,941	8,015,549	17	2,180
280-Res-	385,372	8,015,996	43	2,200
281-Res-	385,354	8,016,001	45	2,190
282-Res-	385,334	8,016,004	49	2,190
283-Res-	385,427	8,016,029	37	2,250
284-Res-	385,204	8,015,623	71	1,790
285-Res-	385,296	8,015,625	59	1,840
286-Res-	385,318	8,015,583	57	1,810
287-Res-	385,359	8,015,381	40	1,670
288-Res-	385,310	8,014,699	40	1,160
289-Res-	383,068	8,011,000	12	2,890
290-Res-	383,795	8,011,437	11	2,350
320-Res-	385,728	8,015,968	19	2,360
325-Res-	385,458	8,016,015	35	2,250
329-Res-	385,877	8,015,918	17	2,410
330-Res-	385,923	8,015,970	17	2,480
339-Res-	385,775	8,016,531	28	2,860
340-Res-	385,664	8,016,034	21	2,380
352-Res-	385,442	8,016,515	48	2,690
368-Res-	385,079	8,014,545	19	880

Sensitive receptor	Easting, m	Northing, m	Terrain elevation, m	Distance to project boundary, m
375-Res-	386,882	8,015,140	14	2,760
376-Res-	386,887	8,015,187	14	2,780
393-Res-	386,877	8,015,117	14	2,740
401-Res-	386,097	8,015,789	17	2,460
410-Res-	384,114	8,015,112	31	1,040
418-Res-	384,991	8,013,688	13	730
419-Res-	383,805	8,015,118	26	1,060
433-Res-	385,281	8,014,552	24	1,060
441-Res-	384,398	8,014,527	19	480
448-Res-	385,392	8,013,947	13	1,050
458-Res-	385,105	8,014,470	18	860
462-Res-	387,110	8,013,472	13	2,820
466-Res-	384,699	8,014,801	40	830
467-Res-	385,192	8,014,692	30	1,060
468-Res-	382,940	8,011,789	11	2,190
469-Res-	385,837	8,014,122	14	1,490
470-Res-	385,626	8,015,640	23	2,040
471-Res-	385,658	8,015,622	20	2,040
472-Res-	385,634	8,015,589	23	2,000
473-Res-	385,680	8,015,568	19	2,020
474-Res-	385,686	8,015,588	19	2,040
475-Res-	385,693	8,015,599	19	2,050
476-Res-	385,702	8,015,610	18	2,060
477-Res-	385,710	8,015,621	18	2,080
478-Res-	385,717	8,015,634	18	2,090
479-Res-	385,724	8,015,645	18	2,100
480-Res-	385,626	8,015,711	21	2,090
481-Res-	385,513	8,015,666	32	1,990
482-Res-	385,411	8,015,680	42	1,940
483-Res-	385,389	8,015,675	45	1,930
484-Res-	385,367	8,015,669	48	1,910
485-Res-	385,298	8,015,569	57	1,790
486-Res-	385,251	8,015,638	64	1,820

Sensitive receptor	Easting, m	Northing, m	Terrain elevation, m	Distance to project boundary, m
487-Res-	385,242	8,015,591	62	1,780
489-Res-	384,709	8,014,872	53	900
Educational				
50-Edu-	385,694	8,015,384	21	1,890
292-Edu-ST CLARES SCHOOL TULLY	385,763	8,016,350	26	2,700
293-Edu-TULLY STATE SCHOOL	385,784	8,016,224	26	2,600
294-Edu-TULLY STATE SCHOOL	385,803	8,016,218	25	2,610
295-Edu-TULLY STATE SCHOOL	385,764	8,016,254	25	2,620
296-Edu-TULLY STATE SCHOOL	385,844	8,016,269	24	2,670
297-Edu-TULLY STATE SCHOOL	385,832	8,016,251	24	2,650
298-Edu-TULLY STATE SCHOOL	385,818	8,016,289	24	2,680
299-Edu-TULLY STATE SCHOOL	385,794	8,016,295	24	2,670
300-Edu-TULLY STATE SCHOOL	385,791	8,016,325	24	2,690
301-Edu-TULLY STATE SCHOOL	385,818	8,016,315	24	2,700
302-Edu-TULLY STATE SCHOOL	385,831	8,016,337	25	2,720
465-Edu-TULLY STATE SCHOOL	385,837	8,016,236	23	2,640
Commercial				
308-Com-Community Centre	385,920	8,016,435	24	2,850
438-Com-	385,624	8,016,625	33	2,870

APPENDIX C ENVIRONMENTAL PROTECTION (NOISE) POLICY 2019 SUMMARY

The EP Act forms part of a legislative framework that regulates noise from domestic, commercial and industrial premises. Noise is regulated under the EP Act and subordinate legislation including the EP Regulation, and the EPP 2019.[27]

C1 Environmental values and acoustic quality objectives

The EPP 2019 provides a framework for making consistent and informed decisions that relate to the acoustic environment, specifically for the enhancement and protection of relevant environmental values.

The environmental values to be enhanced or protected include:

(a) *the qualities of the acoustic environment that are conducive to protecting the health and biodiversity of ecosystems; and*

(b) the qualities of the acoustic environment that are conducive to human health and wellbeing*, including by ensuring a suitable acoustic environment for individuals to do any of the following:*

(i) sleep;

(ii) study or learn;

(iii) be involved in recreation, including relaxation and conversation; and

(c) the qualities of the acoustic environment that are conducive to protecting the amenity of the community.

The EPP 2019 defines acoustic quality objectives (assessed at sensitive land uses) to achieve the above environmental values. The acoustic quality objective for a sensitive receptor, means *'the maximum level of noise that should be experienced in the acoustic environment of the sensitive receptor '.*

The acoustic quality objectives are derived from the WHO (World Health Organization) aspirational targets and exclude noise from transportation, safety devices, domestic, and occupational noise sources – i.e., they apply to noise from industrial/commercial/trade premises.

The relevant environmental values set out in the EPP 2019 are detailed in Table 15 alongside associated acoustic quality objectives. Only relevant sensitive receptor classifications are reproduced.

[27] Queensland Government *Environmental Protection Regulation 2019* (EP Regulation)

Table 15: Acoustic quality objectives

Sensitive receptor	Time of day	Acoustic quality objectives, dB [a]			Environmental value
		$L_{Aeq,adj,1hr}$	$L_{A10,adj,1hr}$	$L_{A1,adj,1hr}$	
Residence (outdoors)	Day and evening 0700-2200 hrs	50	55	65	Health and wellbeing
Residence (indoors)	Day and evening 0700-2200 hrs	35	40	45	Health and wellbeing
Residence (indoors)	Night 2200-0700 hrs	30	35	40	Health and wellbeing, in relation to the ability to sleep
Library or educational institution (indoors)	When open for business or classes being offered	35	--	--	Health and wellbeing
School or playground (outdoors)	When the children usually play outside	55	---	---	Health and wellbeing, and community amenity
Commercial and retail activity (for indoors)	When the activity is open for business	45	---	---	Health and wellbeing, in relation to the ability to converse

a Applicable at the sensitive receptor

Due to the typical characteristics of noise generation associated with the project, being steady state continuous noise generated by operation of facility equipment, the $L_{Aeq,adj,1hr}$ descriptor is primarily relevant. The $L_{Aeq,adj,1hr}$ is the A-weighted sound pressure level of a continuous steady sound, adjusted for tonal character or impulsiveness.

The EPP 2019 acoustic quality objectives provide objectives for both internal acoustic amenity within a residence and acoustic amenity for outdoor areas (e.g. relaxation and conversation outdoors). For this reason, no objective for external amenity is provided at night.

It is necessary to consider both the internal and external objectives since the outdoor objective is **not** the same as the *'equivalent outdoor level'* to the internal objective. Hence it is still possible to be exceeding the internal objectives even when the outdoor objectives are complied with.

Further guidance can be found in the Noise and Vibration EIS Information Guideline which states:

> *When assessing outdoor to indoor noise attenuation at sensitive receptors, do not use the World Health Organisation guideline's value of 25dB as it was developed for European buildings with double-glazed windows. Instead, use an outdoor to indoor attenuation value of 7dB, which is appropriate for typical Queensland buildings with open windows.*

This has implications in defining external acoustic quality objectives applicable during the night and constraining acoustic quality objectives applicable during the day and evening periods, such that the indoor acoustic quality objectives can be achieved.

Based on the Noise and Vibration EIS Information Guideline the revised acoustic quality objectives relevant for assessment of the project, applying outdoors at all nominated receptors are:

Residential

- Day and evening: 42 dB $L_{Aeq,adj,1hr}$
- Night: 37 dB $L_{Aeq,adj,1hr}$

Library or educational institution

- When open for business or classes being offered: 42 dB $L_{Aeq,adj,1hr}$

Commercial

- When the activity is open for business: 52 dB $L_{Aeq,adj,1hr}$

The EPP 2019 also does not define the actual point of assessment for external objectives. In some jurisdictions it is within 10 m of the dwelling or at the nearest boundary, whichever is closer, but given the large scale of many rural Queensland grazing or farming properties, the general industry practise is to conduct the assessment in the vicinity of the dwelling and not at a boundary, which in many cases might be several kilometres away from the dwelling.

The Noise Measurement Manual, as referenced in the EPP 2019, prescribes the processes required to measure noise in accordance with the EP Act and relevant legislation and subordinate policies which include the EPP 2019.[28] This includes procedures for adjusting measured noise levels for audible characteristics including tonality, impulsiveness, and low frequency noise.

The EPP 2019 acoustic quality objectives are directly referenced for the assessment of noise from construction, operation, maintenance and decommissioning of the project.

C2 Background creep

While not specifically referenced in PO20, the broader EPP 2019 also defines the management intent for noise and states the following at Clause (2) of Section 9:

> *(a) To the extent it is reasonable to do so, noise must be dealt with in a way that ensures –the noise does not have any adverse effect, or potential adverse effect, on an environmental value under this policy; and*
>
> *(b) background creep in an area or place is prevented or minimised.*

Clause (4) of Section 9 then states:

> *In this section –*
>
> ***background creep**, for noise in an area or place, means a gradual increase in the total amount of background noise in the area or place as measured under the document called the 'Noise measurement manual' published on the department's website.*

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[28] Queensland Government Department of Environment and Science *Noise Measurement Manual* (Noise Measurement Manual), dated 2020.

Further guidance with respect to background creep is provided in the EPP Explanatory Notes which state:

> *The intent is to prevent or minimise background creep so that the background noise does not increase higher and higher over time to a point where it is unreasonable for the area or place….*
>
> *In some situations it may be reasonable to allow a greater increase to the background noise in an area or place. That may be the case in an area or place with very low background noise where an activity will increase the background noise levels but only to the extent the environmental values of the area are still protected.*

Specific numerical criteria for the assessment of background creep are not provided in the EPP 2019.

A management framework is however provided comprising a *management hierarchy* - which establishes an approach to avoiding, minimising or managing noise (to the extent that it is reasonable to do so), and the *management intent* - being matters that must be considered by the administering authority when making an environmental management decision. The framework is used to qualitatively evaluate the potential for background creep.

APPENDIX D GENERAL CONSTRUCTION NOISE POLICY

Construction noise in Queensland is normally addressed by the general environmental duty described in the EP Act, which requires a person not to:

> *[...] carry out any activity that causes, or is likely to cause, environmental harm unless that personal takes all reasonable and practicable measures to prevent or minimise the harm.*

Section 440R of the EP Act includes default noise standards that are referred to in cases where no defined criteria are set.

D1 EP Act Section 440R

The EP Act Section 440R Building Work states:

(1) A person must not carry out building work in a way that makes an audible noise-

a) On a business day or Saturday, before 6:30 a.m. or after 6:30 p.m; or

b) On any other day, at any time.

The Queensland Government's publication Information Sheet clarifies further:

The noise standard for building work in section 440R of the Act applies for complaints the Department of Environment, Science and Innovation is responsible for investigating. It also applies to complaints Council is responsible for investigating when Council has not set an alternative noise standard through a local law. A person must not unlawfully contravene a noise standard (offence under section 440Q of the Act). However, a contravention of a noise standard is not unlawful if it is authorised under a development condition of a development approval (see section 493A of the Act and the relevant definitions in schedule 4 of the Act).[29]

Section 440R is more commonly applied to small-scale building works, e.g. domestic construction, and is challenging to apply for a larger-scale construction project, particularly for out of hours works. This is because the Section 440R requirement is written in terms of "audible noise" which is a subjective criterion that depends on the hearing sensitivity of the receptor. It is therefore very difficult to state definitively whether a noise source would or would not be audible at a receptor location, except in cases where a noise source is either well above or well below the background noise level.

To provide more definitive indications of noise impact or otherwise, an objective, numerical construction noise criterion should be adopted to allow for transparency in assessing potential impacts from the construction works.

D2 Code of Practice

The Code of Practice Vol.2 is primarily used to address transport infrastructure construction noise and vibration. However, in the absence of objective noise limits in the EP Act, the Code of Practice Vol.2 has been historically used to also assess construction noise and vibration from sites not related to transport infrastructure.

MDA considers the Code of Practice Vol.2 to represent current best practice for the assessment of construction noise and vibration from projects in Queensland.

The Code of Practice Vol.2 is gazetted under Section 551 of the EP Act. This means that compliance with the Code of Practice Vol.2 in full is deemed to satisfy the general environmental duty under the EP Act for assessing potential environmental harm from construction works.

[29] EPA Act 1994 Information Sheet – Building work under the noise standard, Version 1.01, dated 25 November 2025,

As the subjective characteristics of noise from general construction sites would be similar to construction associated with a transport project, it is considered reasonable to adopt the Code of Practice Vol.2 to demonstrate compliance of construction noise associated with the project with the general environmental duty under the EP Act.

Noise criteria in the Code of Practice Vol.2 are defined as lower and upper limits which are assessed adjacent to external facades. The noise criteria are defined for the following work periods:

- Standard hours – work within Standard hours shall be encouraged where possible
- Non-Standard hours

All reasonable and practicable measures shall be implemented to achieve the lower limit for Standard and Non-Standard hours. Exceedance of the upper limit requires the proponent to determine any reasonable and practical respite, temporary relocation and architectural treatment requirements.

Generally, noise criteria consider rating background levels (RBL). The rating background level is derived from the measured ambient background noise level based on the guidance and procedures detailed in Section 5.1.3.1 of the Code of Practice Vol.2.

These noise criteria are assessed using the $L_{Aeq,adj,15min}$ parameter, which is the 15-minute construction noise level adjusted for modifying factors (for example, low frequency noise, impulsivity, tonality, intermittency and modulation) which subjectively increase the annoyance of the noise. These criteria apply to airborne noise from general construction which includes construction traffic within the project boundary.

Work periods for construction activities are defined in Table 3.1.3 of the Code of Practice Vol.2, which is reproduced below as Table 16.

Table 16: Work periods for construction activities

Work period	General construction [a]		Blasting
Standard hours	Monday – Friday	07:00 – 18:00 hrs	Monday – Friday 09:00-17:00 hrs
	Saturday	08:00 – 13:00 hrs	
Non-Standard hours Day/evening	Monday – Friday	18:00 – 22:00 hrs	Generally blasting is not to be conducted outside Standard hours
	Saturday	07:00 – 08:00 hrs	
		13:00 – 22:00 hrs	
	Sunday	07:00 – 22:00 hrs	
Non-Standard hours Night	Monday – Sunday	22:00 – 07:00 hrs	

a Including construction traffic within the project boundary.

External construction noise criteria are defined in Table 3.2.1.1(a) of the Code of Practice Vol.2, which is reproduced as Table 17.

Table 17: External construction noise criteria

Work period	General construction [a]		External noise level, dB $L_{Aeq,adj,15\ minute}$ [e, f] Lower limit	Upper limit
Standard hours	Monday – Friday Saturday	07:00 – 18:00 hrs 08:00 – 13:00 hrs	RBL + 10 [b c d]	75 Where: RBL > 55 70 Where: 40 < RBL ≤ 55 65 Where: RBL ≤ 40
Non-Standard hours Day/evening	Monday – Friday Saturday Sunday	18:00 – 22:00 hrs 07:00 – 08:00 hrs 13:00 – 22:00 hrs 07:00 – 22:00 hrs	RBL + 5 [c]	RBL + 5 [c]
Non-Standard hours Night	Monday – Sunday	22:00 – 07:00 hrs	RBL + 5 [c]	RBL + 5 [c]

a Including construction traffic within the project boundary

b RBL + 5 dB should be considered where a facility, equipment and long-term earthworks are required in an area for greater than six months. Where this occurs, the minimum lower limit is 45 dB for Standard hours.

c Where the lower limit value exceeds the upper limit value, the lower limit is taken to equal the upper limit value.

d Minimum lower limit is 50 dB for standard hours and 45 dB for non-standard hours. A maximum lower/upper limit of 75 dB applies to non-standard hours.

e Noise contribution from construction activity determined as the component level (that is, noise from construction activity only).

f The noise level from construction includes adjustment factors from Table 2.1.2.1(b) (for example, low frequency noise, impulsivity, tonality, intermittency and modulation)

In the absence of measured background noise levels and RBL, the minimum lower limit and upper limit is used.

If construction noise activities are below the lower limit, no significant noise impacts are expected to occur, and no further action is required.

Construction noise activities that would exceed the lower limit are activities which may result in construction noise impacts to sensitive receptors. The Code of Practice Vol.2 requires all 'practicable and reasonable' noise mitigation measures to be implemented, with the aim of reducing noise levels to below the lower limit.

The Code of Practice Vol.2 recognises that in some cases this may not be feasible. Where all practicable and reasonable mitigation measures are implemented and noise levels still exceed the lower limit, then no additional actions are required.

The upper limit represents the threshold above which significant construction noise impacts may be expected. If noise levels are predicted to exceed the upper limit, immediate action should be taken to reduce the noise levels by applying all practicable and reasonable mitigation measures.

If, after all practicable and reasonable mitigation measures have been applied, noise levels still exceed the upper limit, further management measures are required, to be determined via consultation with affected receptors.

D3 Conclusion

General Queensland construction noise policy is given in this appendix for information and broader context only, as it is not directly relevant to State code 27 PO20. It is noted that the PO20 acoustic quality objectives, normally intended for long-term operational noise are significantly more onerous than the typically applied criteria for construction noise, which is temporary in nature.

APPENDIX E TULLY SUBSTATIONS SURVEY

The noise survey was carried out between 23:15 on 15 October 2025 and 12:30 on 16 October 2025. The weather conditions during the noise survey were appropriate for assessment, with low easterly wind (below 5 m/s) and occasional light drizzle.

The measurement instrumentation is documented in Table 18. All equipment was calibrated before and after measurements with no significant drift (<1 dB) indicated.

Table 18: Survey equipment details

Equipment	Application	Model	Serial number	Independent calibration date [a]
Noise monitor	Noise logging	NTi XL3	A3A-01250-F0	03/09/2024
Sound level meter	Hand-held measurements	Brüel & Kjær Type 2250	3009588	13/12/2024
Calibrator	Calibration	01 dB Cal 21	34924044	12/09/2025

a Independent (laboratory) calibration date to be within 2 years of measurement period as per AS 1055:2018 [30]

The noise measurement locations are shown in Figure 5 and tabulated in Table 19 and Table 20.

Table 19: Noise measurement locations – Intermediate locations

Location	Address	Approximate distance to project, m	Approximate distance to nearest transformer, m
A [noise logging]	-	-	35
B	-	-	85
C	-	-	30

Table 20: Noise measurement locations – Residential receptors

Location	Address	Approximate distance to project, m	Approximate distance to nearest transformer, m
441-Res-	8 Sandy Creek Road	480	105
31-Res-	156 Tully Gorge Road	640	180
74-Res-	3 Maple Terrace	620	115
54-Res-	170 Tully Gorge Road	580	75

30 AS 1055:2018 *Acoustics – Acoustics—Description and measurement of environmental noise*

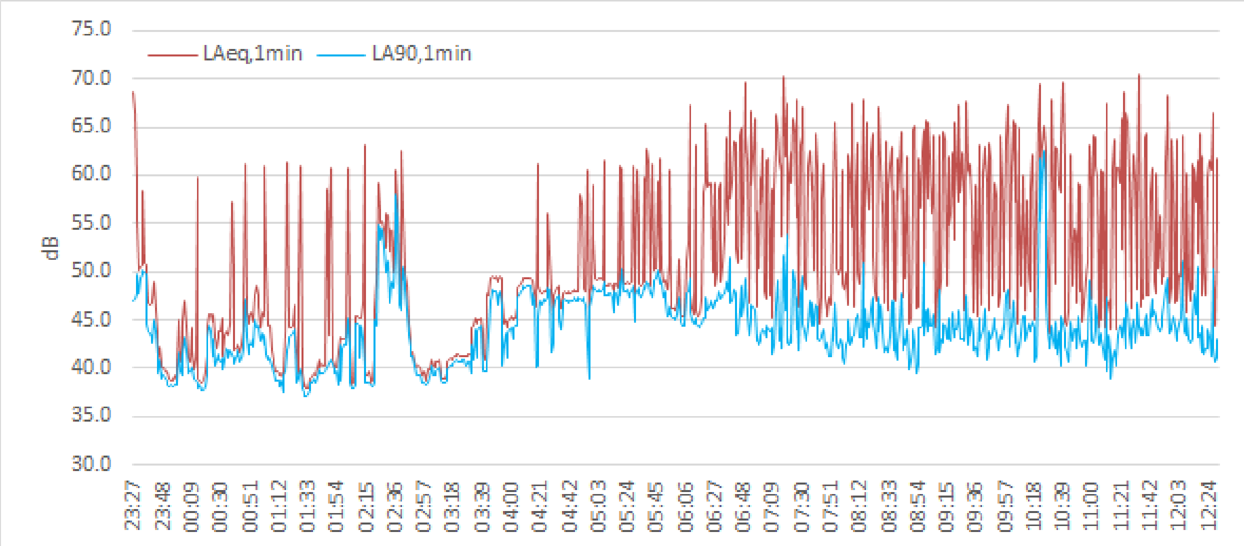
Figure 5: Tully substation noise survey location plan

E1 Noise logging

Noise levels and audio were recorded continuously throughout the noise survey at location A. The recording of audio allows for review and validation during post-processing.

A graph of noise logging results at location A is provided in Figure 6.

Figure 6: Noise logging results



Ambient noise levels are clearly dominated by transient noise events. During the night these were associated with sporadic local traffic on Tully Gorge Road, distant traffic activity on Bruce Highway, and localised insects and frogs. During the day period ambient noise levels were dominated by localised traffic activity on Tully Gorge Road.

Noise from the nearest transformer was clearly audible during night hours, when ambient noise levels were lower, and was characterised by typical transformer hum.

Noise from the transformer was marginally audible during the day due to elevated ambient noise levels.

Noise generated by the transformer is continuous and steady state and is not characterised by transient events. On this basis it is reasonable to determine that the L_{Aeq} ambient noise level fluctuations are driven by noise sources other than the transformer, specifically the distant and localised noise sources previously described.

Consideration of the measured L_{A90} is therefore appropriate given the ability of the L_{A90} metric to reduce the influence of transient extraneous noise events, and the steady state nature of the transformer noise sources.

Measured $L_{A90\ 1\ min}$ noise levels have been reviewed across the night-period of the noise logging survey, being the time of day when extraneous noise sources are likely to be reduced. Even with this approach the measured L_{A90} is likely to include a proportion of transformer noise and noise from other background noise sources. The review therefore concentrated on periods at which the L_{Aeq} and L_{A90} were concurrently low in level, indicating reduced extraneous noise.

Recordings conducted at approximately 01:32 indicated measured levels of 37 dB $L_{A90\ 1\ min}$ and 38 dB $L_{Aeq\ 1\ min}$.

Review of the audio recording at this time indicated transformer noise to be the dominant noise source with limited extraneous noise that may influence the L_{A90} i.e. distant traffic, or localised frog or insect noise. This is reflected in the concurrent close L_{A90} and L_{Aeq} noise levels.

E2 Attended measurements – Intermediate locations

Attended measurements were conducted directly at location A and 3 other intermediate locations close to the northern substation. These were the closest feasible positions to the transformers in the substations.

Measurements at the intermediate locations were generally conducted at night, allowing for lower ambient and background noise levels and times when noise from the transformers was expected to be more dominant of the total noise environment at the measurement position.

The logging data and attended intermediate measurements have generally been used for estimating noise levels for the existing substation and transformers.

Table 21 provides measured L_{Aeq} and L_{A90} noise levels at the respective locations, alongside site notes from the attending consultant. Estimates of transformer noise levels at the subject measurement position are provided, where feasible.

Table 21: Attended measurement summary – Intermediate locations

Location	Time	Duration [mm:ss]	L_{Aeq}	L_{A90}	Notes
A	23:40	10:00	40	37	Logger location, approximately 35 m from nearest transformer (north transformer in northern substation). Transformer hum clearly audible and measurable. Total noise around 36-37 dB L_{AF} during periods of low ambient noise, including transformers and insects/frogs. Transformer noise estimated to be 1-2 dB below, based on consultant judgement of comparative levels i.e. around 34-36 dB. Noise primarily from a single transformer.
B	23:58	10:05	38	36	Northwest corner of northern substation. Transformer noise just audible. Transformer noise judged to be associated with south transformer in northern substation. Northern transformer in north substation partially blocked by containers in site. Total noise around 35-37 dB L_{AF} during periods of low ambient noise. Transformer noise estimated approximately 3-4 dB below that, i.e. around 31-34 dB. Likely from 2 transformers.
C	00:15	08:56	39	37	West boundary of northern substation, approximately 85 m away from nearest transformer. Transformer noise generally just audible primarily associated with south transformer in northern substation with shielding of north substation transformers. Extraneous noise from frogs and insects. Total noise around 36-37 dB L_{AF} during periods of low ambient noise . Transformer noise estimated approximately 1-3 dB below that, i.e. around 33-36 dB. Likely from 2 transformers.

E3 Attended measurements – Receptor locations

Attended hand-held measurements were conducted by the attending consultant at locations representing nearby residential receptors, using a sound level meter.

Measurements during the night period were not feasible due to significant noise from barking dogs, triggered by the attending consultant's presence. Measurements were therefore conducted during the day period.

Table 22 provides measured L_{Aeq} and L_{A90} noise levels at the respective locations, alongside site notes from the attending consultant. Estimates of transformer noise levels at the subject measurement position are provided, where feasible.

Table 22: Attended measurement summary – Receptor locations

Location	Time	Duration [mm:ss]	L_{Aeq}	L_{A90}	Notes
441-Res-	10:14	10:00	44	40	Transformer noise ranging from inaudible to just audible. Ambient noise levels dominated by occasional local traffic, distant traffic noise (likely from the highway) and bird noise. Transformer noise just audible in total noise level of 42 dB L_{AF}. Transformer noise inaudible in total noise level of 44 dB L_{AF}. Transformer noise therefore estimated to be 30-32 dB.
54-Res-	11:47	05:02	48	43	Line of sight to north transformer in northern substation. Southern transformer in northern substation visible but inaudible in ambient noise levels of 41 dB L_{AF}. Transformer noise therefore estimated to be 30 dB, or less.
74-Res-	11:36	05:15	46	42	Line of sight to north transformer in northern substation. Southern transformer in northern substation visible but inaudible in ambient noise levels of 41-43 dB L_{AF}. Transformer noise therefore estimated to be 30 dB, or less.
31-Res-	11:26	05:01	44	40	Transformer generally inaudible during lowest lulls in ambient noise, around 38-40 dB L_{AF}. Transformer noise therefore estimated to be 28-30 dB, or less.

E4 Validation of assumed transformer sound power levels

Sound power levels for transformers in the existing substations have been initially estimated, based on derivation from provided MVA ratings, in accordance with the calculation method set out in AS 60076:10.

The *'reduced maximum'* sound power level calculation was adopted, as the '*standard maximum'* noise level set out by the standard tends to be overly conservative.

Spectral data for the transformers was estimated by applying Bies & Hansen corrections to the derived overall sound power levels.[31]

The derived '*reduced maximum'* transformer sound power levels are given in Table 23.

Table 23: Assumed transformer sound power level, per unit, dB L_w

Item	Octave band centre frequency, Hz							
	63	**125**	**250**	**500**	**1,000**	**2,000**	**4,000**	**A**
Northern substation: 20 MVA transformer	79	81	76	76	70	65	60	76
Southern substation: 250 MVA transformer	95	97	92	92	86	81	76	92

Definitive sound power levels for the existing transformers would need to be determined by conducting near-field noise measurements within the substation sites following the detailed method set out by AS 60076:10. This would require access to locations within 10 m or less of each transformer and comprises an exhaustive engineering method that is excessively detailed for the purpose of this survey.

The measurements conducted at the intermediate locations can however be used to derive approximate overall sound power levels for the transformers, to validate and verify the previously derived assumed sound power levels.

In particular the derived 37 dB L_{A90} sound pressure level extracted from the noise logging data appears to provide robust isolation of dominant transformer noise contributions and minimal extraneous noise influence. Based on the conservative assumption that the total noise energy can be attributed to the single nearest transformer (being the northern transformer in the north substation) an overall sound power level of 76 dB L_{WA} is derived. This is consistent with the assumed sound power level set out in Table 23.

Alternative derivations of transformer sound power level taking into account the indicated transformer sound pressure levels at intermediate locations set out in Table 21 are generally consistent with 76 dB L_{WA} with limited (1 dB) variance.

The noise logging and attended measurements therefore confirm that the assumed sound power levels for the northern substation transformers are reasonable and valid.

Validations of transformer noise associated with the southern substation as less readily feasible, due to limited access to locations close to the transformer. However, predictions at receptors adopting the assumed sound power level detailed in Table 23 result in sound pressure levels at receptors consistent with the commentary summarised in Table 22. On this basis the assumed sound power levels for the southern substation transformer are expected to be reasonable and valid, and consistent with the surveyed environmental noise environment.

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

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 receptors 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.

The noise model enables the calculation of noise levels over a wide area, and accounts for key considerations including site arrangement, terrain, and atmospheric conditions.

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 receptor within an angle of ±45 degrees from a line connecting the source to the receptor, 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 receptor location to the development site, the noise levels would be lower than calculated.

To calculate far-field noise levels according to 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 receptor 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.

F2 Noise model configuration

The parameters detailed in Table 24 were utilised to develop the noise model.

Table 24: Noise model configuration

Feature	Description
Terrain data	Digital elevation model (DEM) with 1m grid size provided by the proponent, supplemented by 5 m grid size DEM from publicly available information (Elvis Elevation and Depth).[32] The interface between the DEM datasets was inspected for discrepancies and none were found.
Environmental ground conditions	Ground conditions on the project site were assigned a ground factor (G) of 0 representing '*hard ground*' The surrounding area has been assigned a G of 1 to reflect porous 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.
Candidate project layout	Provided by the proponent.
Dwelling height	Assumed to be single storey (based on aerial observations).
Receptor height	1.5 m above ground.
Noise calculation method	Noise model calculated according to ISO 9613-2.
Noise data for all equipment	Detailed in Section 6.1. Noise data has been derived based on: • candidate manufacturer data provided by the proponent • empirical standards.
Reflection order	3

[32] Online at https://elevation.fsdf.org.au/

APPENDIX G NOISE CONTOURS

Figure 7: Predicted noise contours, 50% battery/inverter fan duty (day/evening operation)

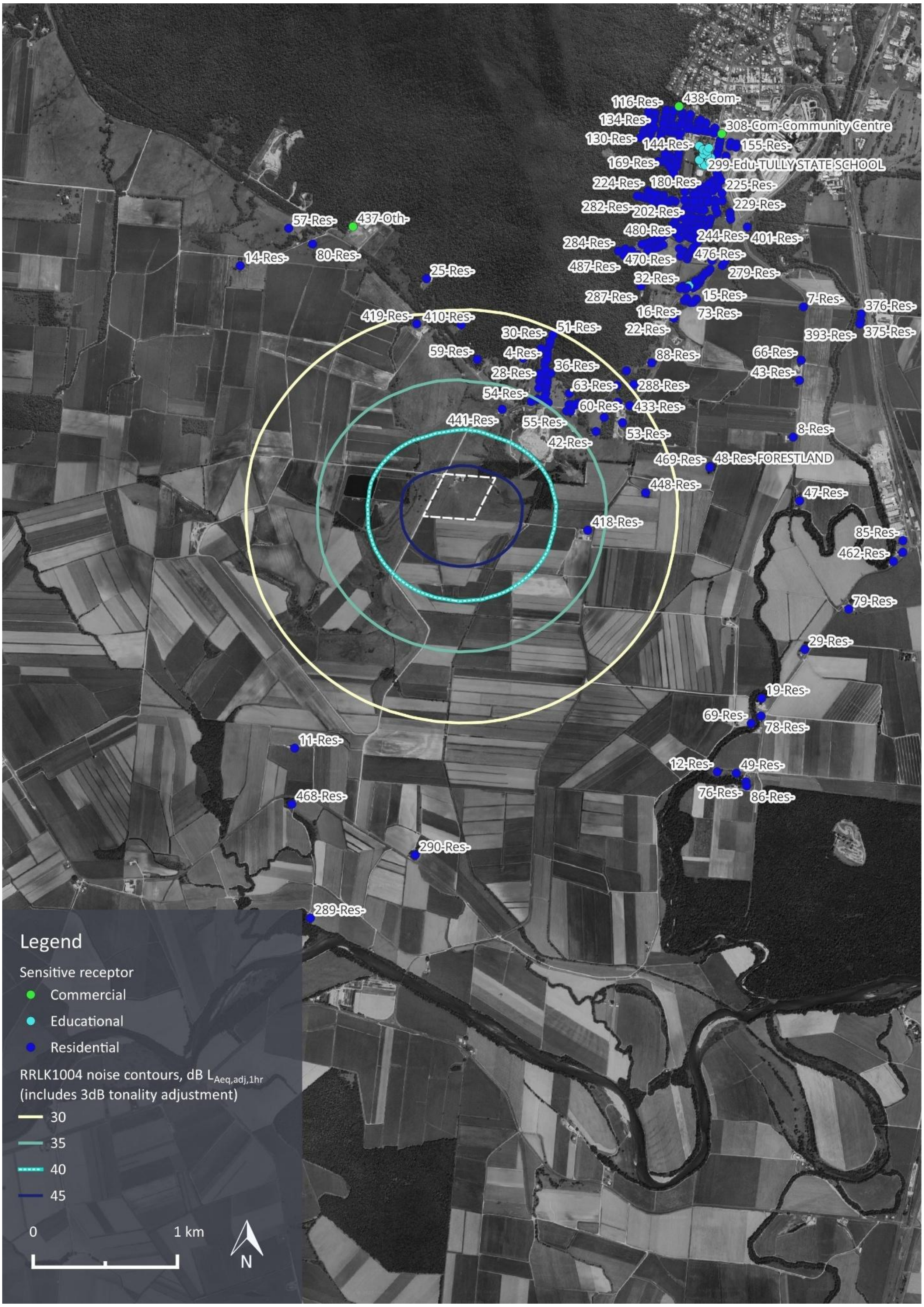
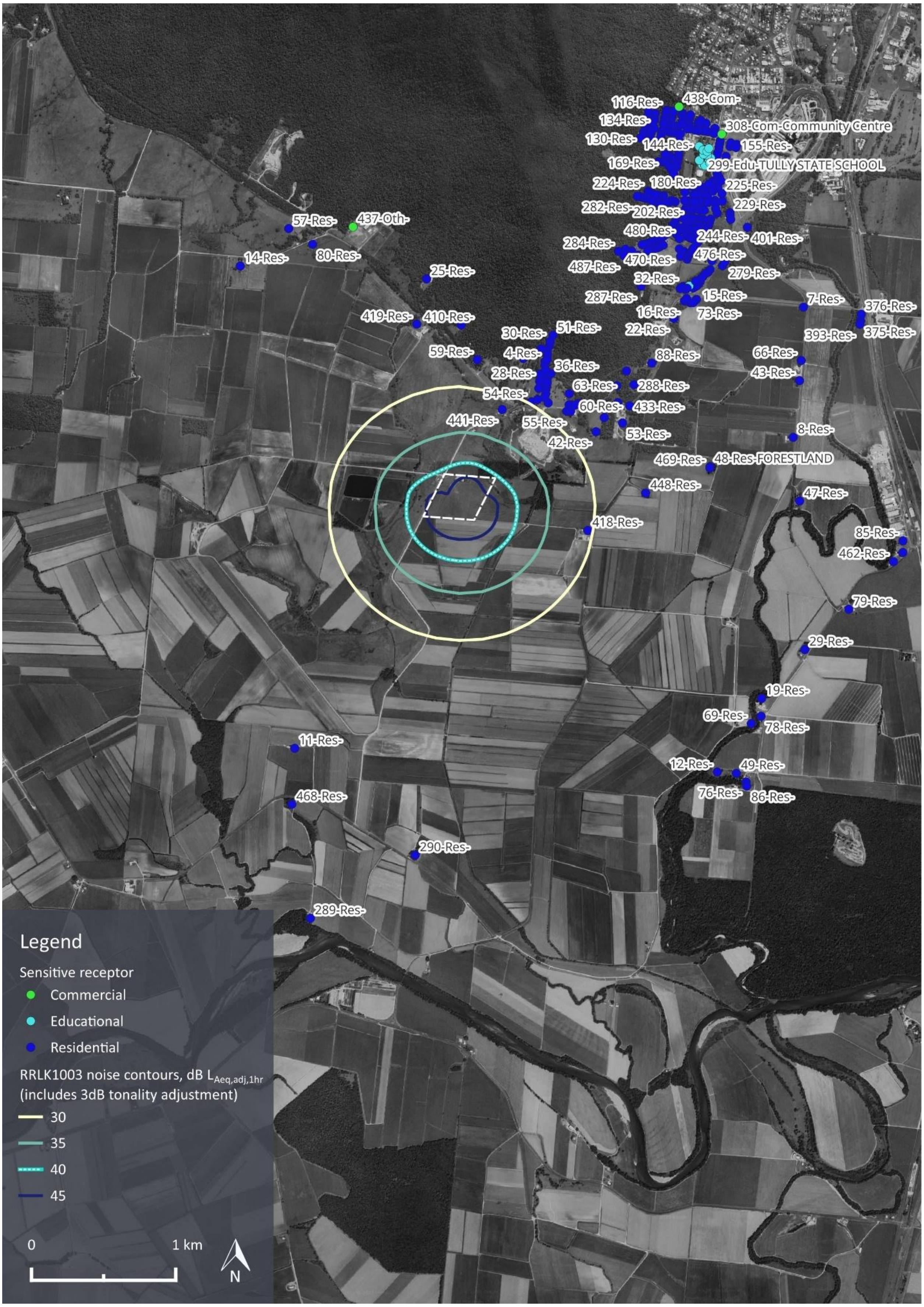


Figure 8: Predicted noise contours, 30% battery/inverter fan duty (night operation)



APPENDIX H CONSTRUCTION EQUIPMENT, WORK STAGES AND ACOUSTIC DATA

It is anticipated that a variety of construction equipment would be used for this project.

Sound power levels for the types of example equipment used to construct the project have been determined based on information provided by the proponent and data sources including AS 2436:2010.[33]

Table 25 summarises the noise emissions used to represent key items of plant associated with construction.

Table 25: Construction noise sources sound power data per source, dB L_{WA}

Phase	Equipment	Quantity	Duty factor	Proponent provided sound power level, L_{WA}, dB	Typical sound power level range L_{WA}, dB[a]
Site preparation and establishment	excavator	1	75%	104	97-117
	dozer	1	50%	110	107-109
	light vehicle	2	50%	76	100-111
	front end loader	1	50%	105	110-115
	road truck (deliveries)	1	50%	103	107
	dump truck	2	50%	108	117
	grader	1	75%	108	105-115
	roller	1	75%	116	103-112
	compactor	1	50%	112	110-115
	crane	1	75%	106	95-113
	forklift	1	50%	106	106
	water truck	1	50%	96	106-108
	generator	2	50%	98	84-113
Concreting and foundations	road truck (deliveries)	1	50%	103	107
	crane	1	75%	106	95-113
	excavator	1	75%	104	97-117
	concrete truck	1	75%	113	103-113
	light vehicle	2	50%	76	100-111
BESS installation	Powered hand tools	1	75%	97	95-110
	Compressor	1	75%	108	93-110
	Generator	1	50%	98	84-113
	Crane	1	50%	106	95-113
	Road truck (deliveries)	1	50%	103	107
	Light vehicle	2	50%	76	100-111

a in accordance with AS 2436

The equipment tabulated above is preliminary. The actual equipment choices and equipment numbers for each task may change, and therefore the equipment schedule is presented solely as an indication of construction noise levels.

33 Australian Standard AS 2436:2010 *Guide to noise and vibration control on construction, demolition and maintenance sites* (AS 2436:2010)