Noise Assessment

Tankgam Battery Energy Storage System
Oakey, QLD

TOOWOOMBA REGIONAL COUNCIL

APPROVED DOCUMENT

referred to in Council's Decision Notice dated

8 January 2024

This plan is subject to conditions of Approval Number

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Assessment Manager

TOOWOOMBA REGIONAL COUNCIL

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Assessment Manager

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MAC
Muller Acoustic Consulting

Document Information

Noise Assessment

Tangkam Battery Energy Storage System

Oakey, QLD

Prepared for: Tangkam BESS Pty Ltd

1 Sussex Street

Barangaroo NSW 2000

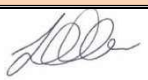
Prepared by: Muller Acoustic Consulting Pty Ltd

PO Box 678, Kotara NSW 2289

ABN: 36 602 225 132

P: +61 2 4920 1833

www.mulleracoustic.com

DOCUMENT ID	DATE	PREPARED	SIGNED	REVIEWED	SIGNED
MAC231878-01RP1V5	27 September 2023	Louis Abell		Oliver Muller	

CONTENTS

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1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by Tangkam BESS Pty Ltd to prepare a Noise Assessment (NA) for the proposed Tangkam Battery Energy Storage System near Oakey, QLD (the project). This report presents the methodology and findings of the NA for the construction and operation of the project.

1.1 Purpose and Objectives

A NA is required as part of the environmental assessment to be submitted to relevant government agencies for approval. The purpose of the NA is to quantify potential environmental noise emissions associated with the construction and operation of the project. Where impacts are identified, the assessment includes recommendations for potential noise mitigation and management measures.

1.2 Scope of the Assessment

The NA includes the following key tasks:

- review construction and operating activities to identify key noise generating plant, equipment, machinery or activities proposed to be undertaken as part of the project;
- identify the closest and/or potentially most affected receivers situated within the area of influence to the project;
- determine project-specific construction and operational noise criteria;
- undertake 3D noise modelling to predict levels that may occur as a result of the construction and operation of the project at the closest and/or potentially most affected receivers;
- provide a comparison of predicted noise levels against relevant construction and operational criteria;
- assess the potential noise impacts associated with construction and operational aspects of the project;
- assess the potential noise impacts associated with road traffic noise during construction; and
- provide feasible and reasonable noise mitigation and management measures, and monitoring options, where criteria may be exceeded.

The assessment has been undertaken in accordance with the following documents:

- State of Queensland Government, Environmental Protection Act 1994;
- State of Queensland Government, Environmental Protection (Noise) Policy 2019;
- State of Queensland Department of Environment and Science, Noise Measurement Manual (NMM) 2020;
- State of Queensland, Noise and vibration EIS information guideline 2022;
- Standards Australia AS 1055:2018 - Acoustics - Description and measurement of environmental noise - General Procedures; and
- International Standard ISO 9613:1996 - Acoustics - Attenuation of sound during propagation outdoors.

A glossary of terms, definitions and abbreviations used in this report is provided in **Appendix A.**

2 Project Description

2.1 Background

The proponent proposes to construct and operate a 100-Megawatt (MW)/ 200-Megawatt hour (MWh) Battery Energy Storage System (BESS) on Lot 4, SP112548, in the vicinity of the Tangkam substation approximately 6km southwest of Oakey, QLD.

2.2 Description of Proposed Construction Works

In Queensland, it is generally accepted that construction activities should be in accordance with general building work hours as described under Section 440R of the Environment Protection Act. Under the Environment Protection Act, no audible noise from construction is permitted:

- from 6.30pm to 6.30am, Monday to Saturday; and
- Sundays and public holidays.

The time restrictions are designed to strike a balance between protecting noise amenity and the need to start construction activities early in the morning.

It is anticipated that the project would be constructed in stages, with construction of two to three stages occurring at any one time. During the construction stage, there is expected to be personnel on site working from 6.30am to 6.30pm Monday to Saturday.

Minor earthworks would be completed for the preparation of the site and in most cases a concrete slab would be required to support the ancillary infrastructure. Most of the infrastructure would be prefabricated off-site, delivered and assembled on-site.

Construction activities associated with the BESS would involve the placement of a shipping containers at the appropriate location (by crane or crane truck) and is a negligible noise source/event.

During the peak construction period, the hourly traffic volume is expected to be up to thirteen heavy vehicles (medium rigid, heavy rigid, truck and dog, semi-trailers or B-doubles) and 25 light commercial vehicles or equivalent for worker transport during the morning and afternoon peaks. All vehicles would access the project site from Kowitz Road during construction and operational phases.

2.3 Description of Proposed Operation

The BESS and Inverters will be located centrally and connected by underground cables. The project will be contained solely within the site as shown in **Figure 1**.

The project would operate 24 hours a day, 7 days a week, with no permanent staff on site.

Key noise emissions from the operation of the project are associated with the inverter and transformer(s). The BESS typically consists of a lithium-ion battery rack in a shipping container fitted with relevant switches, controllers. As this equipment generates heat, a Heating Ventilation and Air Conditioning (HVAC) system is required to provide cooling and is the significant noise source associated with the BESS. The HVAC system consists of an air conditioner, heat exchanger and ventilation fans. It is noted that emissions from these sources are anticipated to be acoustically insignificant compared to ambient background noise levels at assessed receivers.

When required, maintenance activities will occur during standard working hours (except for emergencies) and are expected to include:

- repairs or replacement of infrastructure, as required; and
- land management to control vegetation as required.

Typical noise sources associated with maintenance activities would include light vehicle movements on site, maintenance of equipment, and noise associated with service vehicle movements (light trucks), e.g. waste removal, septic maintenance; which would be minimal and infrequent.

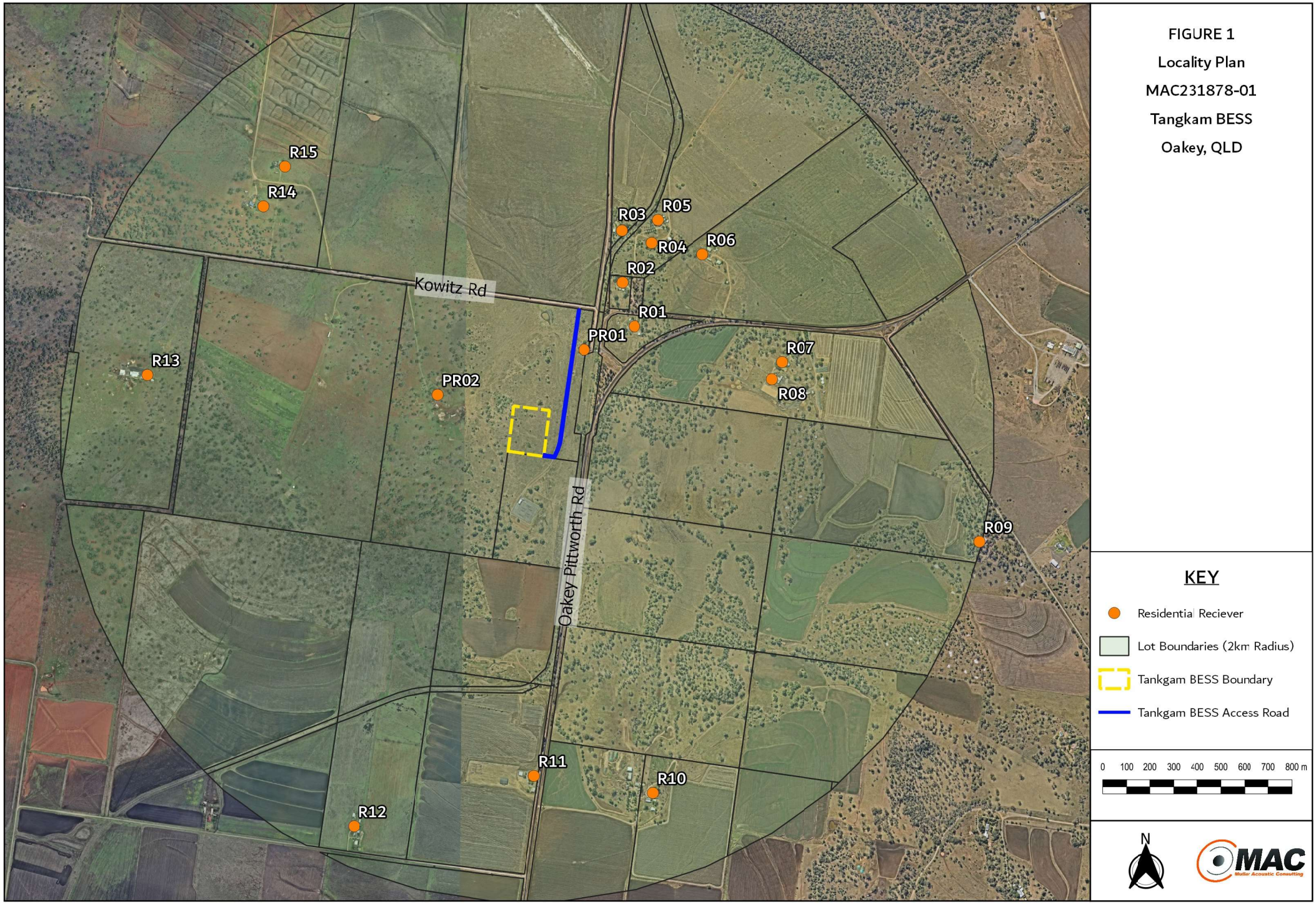
2.4 Receiver Review

Using aerial photography, geospatial information and other project design information, MAC has identified the following potentially sensitive receivers within 2km of the project that may be affected by noise from operation or construction activities. **Table 1** presents a summary of receiver identification, type, address and coordinates. These are reproduced visually in **Figure 1**.

Receivers PR01 and PR02 are project related as they share Lot 4 Plan SP112548 with the project. The resident of PR02 is the site owner and PR01 is a tenanted property. The tenant is aware of the project and that they share Lot 4 Plan SP112548 with the project. As such, these receivers are not required to meet the relevant noise impact assessment criteria, being part of the project, however predicted noise levels for project related receivers are provided in **Section 6** for overall context.

Table 1 Receiver Locations

Receiver	Description	Receiver Type	Coordinates (GDA94/MGA56)	
			Easting	Northing
PR01	Lot 4 Plan sp112548	Rural Residential	368815	6960418
PR02	Lot 4 Plan SP112548	Rural Residential	368193	6960233
R01	Lot 80 Plan RP839408	Rural Residential	369026	6960523
R02	Lot 183 Plan AG2280	Rural Residential	368975	6960708
R03	Lot 2 Plan RP186841	Rural Residential	368972	6960928
R04	Lot 1 Plan RP186841	Rural Residential	369100	6960876
R05	Lot 1 Plan RP186841	Rural Residential	369126	6960973
R06	Lot 2 Plan RP218392	Rural Residential	369314	6960827
R07	Lot 62 Plan RP839408	Rural Residential	369651	6960371
R08	Lot 62 Plan RP839408	Rural Residential	369608	6960299
R09	Lot 23 Plan RP24652	Rural Residential	370488	6959611
R10	Lot 2251 Plan A341012	Rural Residential	369105	6958547
R11	Lot 3 Plan RP36518	Rural Residential	368602	6958620
R12	Lot 1 Plan RP36521	Rural Residential	367839	6958406
R13	Lot 34 Plan RP24652	Rural Residential	366963	6960317
R14	Lot 1 Plan AG3779	Rural Residential	367454	6961031
R15	Lot 1 Plan AG3779	Rural Residential	367545	6961199


R15
R14
R03
R05
R04
R06
R02
Kowitz Rd
R01
PR01
R07
R13
PR02
R08
Oakey Pittworth Rd
R09
R11
R10
R12
FIGURE 1
Locality Plan
MAC231878-01
Tangkam BESS
Oakey, QLD
KEY
Residential Reciever
Lot Boundaries (2km Radius)
Tankgam BESS Boundary
Tankgam BESS Access Road
0 100 200 300 400 500 600 700 800 m
N
MAC
Muller Acoustic Consulting

3 Noise Policy and Guidelines

3.1 Environmental Protection (Noise) Policy 2019

The Queensland Government released the Environmental Protection (Noise) Policy (EPP) in 2019 which provides a process for establishing noise criteria for consents and licenses enabling the regulation of noise emissions from premises.

The objectives of the EPP are to:

- achieve the object of the Act in relation to the acoustic environment;
- the purpose is achieved by-
  - (i) identifying and declaring the environmental values of the acoustic environment;
  - (ii) stating acoustic quality objectives that are directed at enhancing or protecting the environmental values; and
  - (iii) providing a framework for making consistent, equitable and informed decisions that relate to the acoustic environment.

The environmental values to be enhanced or protected under this policy are:

- the qualities of the acoustic environment that are conducive to protecting the health and biodiversity of ecosystems;
- 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
- the qualities of the acoustic environment that are conducive to protecting the amenity of the community.

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4 Noise Assessment Criteria

4.1 Schedule 1 Acoustic Quality Objectives

The relevant acoustic quality objectives have been established for the sensitive receptors surrounding this project in accordance with Schedule 1 of the EPP. The relevant acoustic quality objectives are reproduced from Schedule 1 of the EPP in **Table 2**.

Table 2 Schedule 1 Acoustic Quality Objectives

Sensitive Receptor	Time[2] of Day	Acoustic Quality Objectives dBA[1]			Environmental Value
		LAeq, adj,1hr	LAeq, adj,1hr	LAeq, adj,1hr	
Residence (Outdoors)	Daytime & Evening	50	55	65	health and wellbeing
Residence (Indoors)	Daytime & Evening	35	40	45	health and wellbeing
	Night-time	30	35	40	health and wellbeing, in relation to the ability to sleep

Note 1: Measured/predicted at receptor.

Note 2: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

4.1.1 External to Internal Transmission Loss

Noise transmission into internal areas of a residence is typically assumed to reduce by approximately 7dB when a window is partially open. This assumption is based on the understanding that a partially open window acts as a barrier that provides some level of sound insulation. By reducing the size of the opening, the window restricts the direct transmission of noise while still allowing some airflow. While the exact reduction may vary depending on factors such as the window type and the specific characteristics of the residence building materials, a reduction of approximately 7dB is a commonly used estimate and referenced in the State of Queensland Noise and Vibration EIS information guideline 2022.

4.1.2 Noise Assessment Parameters

It should be noted that while the plant associated with BESS units, inverter stations and MV transformers may fluctuate in noise emissions due to load requirements of the system, they have been modelled as a continuous noise source running at maximum capacity. These sources would exhibit minimal variation between LAeq (equivalent continuous sound level), LA10 (sound level exceeded for 10% of the time), and LA1 (sound level exceeded for 1% of the time) because a constant noise source produces a steady and consistent sound level over time.

It is common to primarily assess noise impacts against the LAeq criterion as it provides a balanced and representative measure of noise exposure, making it a preferred parameter for evaluating and comparing noise impacts in various environments and settings.

4.2 Proposed Noise Criteria

Based on a façade reduction of 7dB (7dB reduction in noise levels from outside a house to inside a house when windows are open), and the characteristics of the noise sources associated with the project, the external noise objectives displayed in **Table 3** will be adopted as the noise criteria for both operational and construction noise impacts associated with the project. This criteria will act to satisfy internal noise levels established in **Table 2**.

Table 3 Revised Acoustic Quality Objectives

Sensitive Receptor	Acoustic Quality Objectives dBA[1]		
	Day $L_{Aeq, adj,1hr}$	Evening $L_{Aeq, adj,1hr}$	Night $L_{Aeq, adj,1hr}$
Residence (external)	42	42	37

Note 1: Measured/predicted at receptor.

Note: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods

5 Modelling Methodology

A computer model using DGMR (iNoise, Version 2023) noise modelling software was used to quantify noise emissions from the project. iNoise is an intuitive and quality assured software for industrial noise calculations in the environment. 3D noise modelling is considered industry best practice for assessing noise emissions from projects.

The model incorporated a three-dimensional digital terrain map giving all relevant topographic information used in the modelling process. Additionally, the model uses relevant noise source data, ground type, attenuation from barrier or buildings and atmospheric information to predict noise levels at the nearest potentially affected receivers.

The model calculation method used to predict noise levels was in accordance with ISO 9613-1 'Acoustics - Attenuation of sound during propagation outdoors. Part 1: Calculation of the absorption of sound by the atmosphere' and ISO 9613-2 'Acoustics - Attenuation of sound during propagation outdoors. Part 2: General method of calculation' including corrections for meteorological conditions using CONCAWE[1]. The ISO 9613 standard from 1996 is the most used noise prediction method worldwide. Many countries refer to ISO 9613 in their noise legislation. However, the ISO 9613 standard does not contain guidelines for quality assured software implementation, which leads to differences between applications in calculated results. In 2015 this changed with the release of ISO/TR 17534-3. This quality standard gives clear recommendations for interpreting the ISO 9613 method. iNoise fully supports these recommendations. The models and results for the 19 test cases are included in the software.

5.1 Construction Assessment Methodology

The assessment of construction noise for the project will involve a single scenario. This scenario primarily involves minor earthworks utilising small-scale construction equipment and concreting plant to establish a pad for the infrastructure. Additionally, the scenario involves the use of cranes on-site for the assembly of the battery energy storage systems and associated infrastructure. As part of the construction activities, heavy vehicles will access the site to deliver materials required for the project. The assessment will focus on evaluating the potential noise impacts generated by these activities, taking into account the specific characteristics of the construction equipment, machinery, and vehicles involved.

[1] Report no. 4/18, "the propagation of noise from petroleum and petrochemical complexes to neighbouring communities", Prepared by C.J. Manning, M.Sc., M.I.O.A. Acoustic Technology Limited (Ref.AT 931), CONCAWE, Den Haag May 1981

Noise emission data and assumptions used in this assessment are summarised in **Table 4.** All significant noise generating construction activities will be limited to daytime hours (6.30am to 6.30pm Monday to Saturdays). Where low intensity construction activities are required to be undertaken outside standard construction hours, such as cabling, minor assembly, use of hand tools etc, they will be managed such that they are not audible at any residential receivers.

Table 4 Construction Equipment Sound Power Levels, Lw dBA (re 10^{-12} Watts)

Noise Source/Item	Utilisation %	Quantity	Lw/Item	Total Lw
Trenching & Earthworks				
Backhoe	80	1	104	103
Small bulldozer	80	1	108	107
Roller	80	1	106	105
Grader	80	1	106	105
Light vehicle	25	2	76	73
Concrete Pump	50	1	109	106
Total – Trenching & Earthworks				**112**
Assembly				
Mobile Crane/HIAB	75	1	104	103
Tele-handler	75	1	106	105
Light vehicle	25	2	76	73
Hand tools/Power tools	50	1	102	99
Welder	50	1	105	102
Total – Assembly				**109**
Transport (on site)				
Heavy vehicle	40	1	104	101
Tele-handler	50	1	106	103
Total – Transport				**105**

5.2 Operational Assessment Methodology

For this assessment, noise predictions were modelled for a typical worst-case operational scenario over a 1-hour assessment period based on the assumptions and sound power levels in **Table 5.** Plant noise emission data used in modelling for this assessment were obtained from manufacturers data or the MAC database. Where relevant, modifying factors for annoying characteristics have been applied to calculations in accordance with the Queensland Department of Environment and Science NMM 2020.

Table 5 Operational Equipment Sound Power Levels, Lw dBA (re 10^{-12} Watts)

Noise Source/Item	Utilisation/Capacity	Quantity	Lw/Item	Total Lw
SMA SCS-3600-UP-XT Inverter Station[1]	Constant (100%)	38	93	114
MVPS 4200-S2 Transformer Unit[1]	Constant (100%)	38	70	91
BESS Module[1,2]	Constant (100%)	82	83	102

Note 1: Modifying factor penalty of +5dB added for low frequency at 50Hz.

Note 2: Mitigation factor of -5dB for shielding effect of container units.

5.3 Meteorological Analysis

Noise emissions can be influenced by prevailing weather conditions. Light stable winds (<3m/s) and temperature inversions have the potential to increase noise at a receiver. Noise enhancing meteorological conditions have been applied to the noise modelling assessment are presented in **Table 6.**

Table 6 Modelled Meteorological Parameters

Assessment Condition[1]	Temperature	Wind Speed[2]/ Direction	Relative Humidity	Stability Class[2]
Day	20°C	3m/s all directions	50%	D
Evening	10°C	3m/s all directions	50%	D
Night	10°C	2m/s all directions	50%	F

Note 1: Day – the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening – the period from 6pm to 10pm; Night – the remaining periods.

Note 2: Implemented using CONCAWE meteorological corrections.

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6 Noise Assessment Results

6.1 Construction Noise Assessment

Noise levels were predicted to all identified receivers at 1.5m above ground level for typical construction activities for standard construction hours. **Table 7** summarises the predicted noise level range and maximum predicted noise level for each of the construction scenarios (trenching, piling and assembly) at identified receivers.

Table 7 Predicted Construction Noise Levels

Receiver	Description/Address	Predicted Noise Level Range dB $L_{Aeq(1hr)}$[1]	Highest Predicted Noise Level dB $L_{Aeq(1hr)}$	Day Period Criteria $L_{Aeq\ (1hr)}$	Compliance Achieved
R01	LOT 80 PLAN RP839408	37 – 41	41	42	✓
R02	LOT 183 PLAN AG2280	34 – 39	39	42	✓
R03	LOT 2 PLAN RP186841	28 – 32	32	42	✓
R04	LOT 1 PLAN RP186841	28 – 32	32	42	✓
R05	LOT 1 PLAN RP186841	27 – 31	31	42	✓
R06	LOT 2 PLAN RP218392	27 – 31	31	42	✓
R07	LOT 62 PLAN RP839408	26 – 30	<30	42	✓
R08	LOT 62 PLAN RP839408	27 – 31	31	42	✓
R09	LOT 23 PLAN RP24652	19 – 22	<30	42	✓
R10	LOT 2251 PLAN A341012	22 – 25	<30	42	✓
R11	LOT 3 PLAN RP36518	23 – 26	<30	42	✓
R12	LOT 1 PLAN RP36521	20 – 23	<30	42	✓
R13	LOT 34 PLAN RP24652	21 – 25	<30	42	✓
R14	LOT 1 PLAN AG3779	23 – 26	<30	42	✓
R15	LOT 1 PLAN AG3779	22 – 26	<30	42	✓
PR01	Project Related Receiver	41 – 42	42	42	✓
PR02	Project Related Receiver	39 – 40	40	42	✓

Note 1: Noise levels from construction activities vary due to their position across the project site with respect to surrounding receivers.

The results of the Noise Assessment demonstrate that construction noise emissions from the project would satisfy relevant noise criteria at all receiver locations. Notwithstanding, noise control recommendations during construction are provided in **Section 7.1** for consideration. Noise contours for this assessment are provided in **Appendix B.**

6.2 Operational Noise Assessment

Noise levels were predicted all identified receivers at 1.5m above ground level for all operational sources and are presented in **Table 8.** The operational noise assessment has been conducted assuming noise enhancing meteorological conditions with all equipment operating at full capacity. Noise contours for this assessment are provided in **Appendix B.**

Table 8 Predicted Operational Noise Levels - Noise Enhancing Meteorological Conditions

Receiver	Predicted Noise Level dB LAeq(1hr)	Noise Criteria dB LAeq(1hr)			Compliance Achieved
		Day	Evening	Night	
R01	37	42	42	37	✓
R02	35	42	42	37	✓
R03	32	42	42	37	✓
R04	32	42	42	37	✓
R05	31	42	42	37	✓
R06	31	42	42	37	✓
R07	31	42	42	37	✓
R08	31	42	42	37	✓
R09	<30	42	42	37	✓
R10	<30	42	42	37	✓
R11	<30	42	42	37	✓
R12	<30	42	42	37	✓
R13	<30	42	42	37	✓
R14	<30	42	42	37	✓
R15	<30	42	42	37	✓
PR01	39	n/a	n/a	n/a	n/a
PR02	41	n/a	n/a	n/a	n/a

Note: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

Noise levels are expected to satisfy the noise criteria at all no project related receivers. Noise levels are expected to exceed the criteria by 2dB and 4dB at project related receivers PR01 and PR02. Such an exceedance would be considered minor in nature and the absolute level is not of concern in terms of nuisance or acoustic amenity for the receiver environment. Furthermore, as the receivers are involved with the project and if noise were of concern, the owner and tenant are able to deal directly with the proponent to ameliorate any noise issues.

7 Recommendations

7.1 Construction Noise Recommendations

Whilst construction noise emissions are anticipated to satisfy the relevant NMLs, the following noise mitigation measures may be considered during the construction phase to minimise noise emissions to the surrounding community:

- a construction noise management protocol to minimise noise emissions, manage out of hours (minor) works to be inaudible, and to respond to potential concerns from the community;
- where possible use localised mobile screens or construction hoarding around piling rig/plant to act as barriers between construction works and receivers, particularly where equipment is near the site boundary and/or a residential receiver including areas in constant or regular use (eg unloading and laydown areas);
- operating plant in a conservative manner (no over-revving), shutdown when not in use, and be parked/started at farthest point from relevant assessment locations;
- selection of the quietest suitable machinery available for each activity;
- minimise noisy plant/machinery working simultaneously where practicable;
- minimise impact noise wherever possible;
- utilise a broadband reverse alarm in lieu of the traditional high frequency type reverse alarm;
- provide toolbox meetings, training and education to drivers and contractors visiting the site during construction so they are aware of the location of noise sensitive receivers and to be cognisant of any noise generating activities;
- signage is to be placed at the front entrance advising truck drivers of their requirement to minimise noise both on and off-site; and
- utilise project related community consultation forums to notify residences within proximity of the site with project progress, proposed/upcoming potentially noise generating works, its duration and nature and complaint procedure.

The reduction achieved from the mitigation measures will depend on the specific measures implemented. Monitoring with and without the measures in place will provide an indication of the reduction achieved.

7.2 Operational Noise Recommendations

Operational noise predictions identify that relevant noise criteria would be satisfied at all receivers. Notwithstanding, it is recommended that the proponent actively minimise potential noise emissions from the project. To assist in noise management for the project it is recommended that a one-off noise validation monitoring assessment be completed to quantify operational noise emissions from site and to confirm emissions meet relevant criteria. The monitoring assessment would consist of operator attended noise measurements during normal operation to determine the noise contribution from the project.

8 Discussion and Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed a Noise Assessment for a proposed Battery Energy Storage System near Oakey, QLD.

The results of the Noise Assessment demonstrate that construction noise emissions from the project would satisfy relevant noise criteria at all receiver locations. Recommendations have been provided to minimise the potential noise impacts from construction.

The results of the Noise Assessment demonstrate that emissions from the project would satisfy the operational noise criteria at all identified (non-project related) receivers.

In summary, based on the Noise Assessment results, the project satisfies the relevant requirements of the QLD Environmental Protection (Noise) Policy 2019 and supports the Environmental Assessment.

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Appendix A – Glossary of Terms

A number of technical terms have been used in this report and are explained in **Table A1**.

Table A1 Glossary of Acoustical Terms

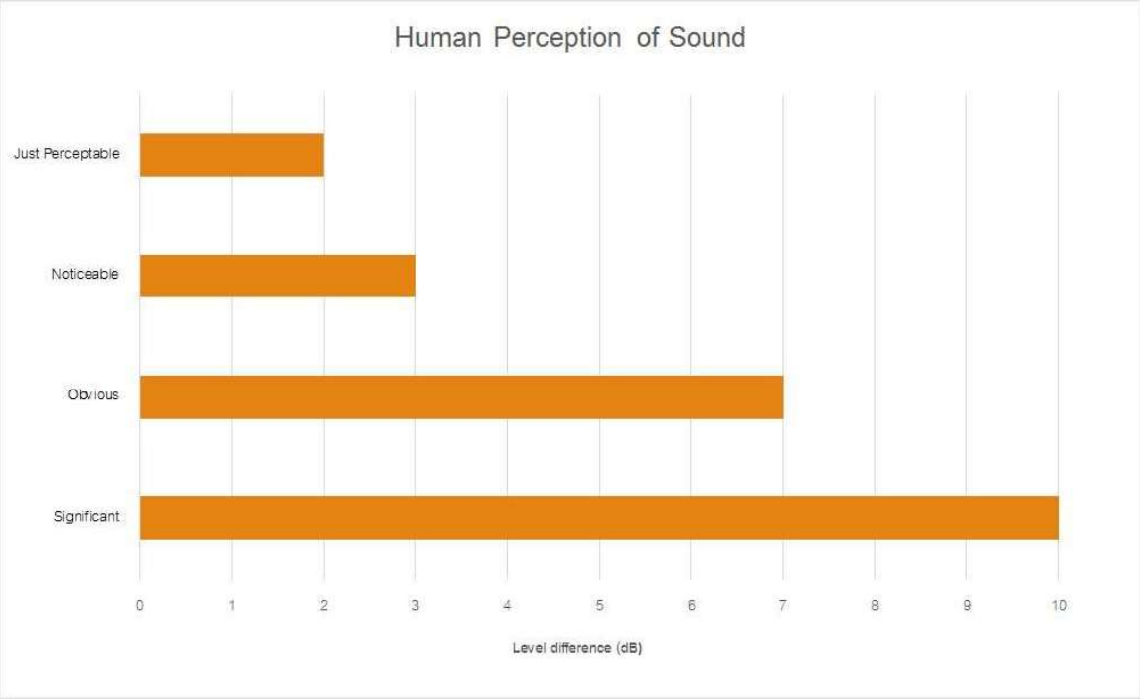
Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the NPI as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured L90 statistical noise levels.
Ambient Noise	The total noise associated with a given environment. Typically, a composite of sounds from all sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to sound.
Background Noise	The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed. This is usually represented by the LA90 descriptor
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dB(Z), dB(L)	Decibels Z-weighted or decibels Linear (unweighted).
Extraneous Noise	Sound resulting from activities that are not typical of the area.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
LA10	A sound level which is exceeded 10% of the time.
LA90	Commonly referred to as the background noise, this is the level exceeded 90% of the time.
LAeq	Represents the average noise energy or equivalent sound pressure level over a given period.
LAmax	The maximum sound pressure level received at the microphone during a measuring interval.
Masking	The phenomenon of one sound interfering with the perception of another sound. For example, the interference of traffic noise with use of a public telephone on a busy street.
RBL	The Rating Background Level (RBL) as defined in the NPI, is an overall single figure representing the background level for each assessment period over the whole monitoring period. The RBL, as defined is the median of ABL values over the whole monitoring period.
Sound power level (Lw or SWL)	This is a measure of the total power radiated by a source in the form of sound and is given by 10.log10 (W/Wo). Where W is the sound power in watts to the reference level of 10^{-12} watts.
Sound pressure level (Lp or SPL)	the level of sound pressure; as measured at a distance by a standard sound level meter. This differs from Lw in that it is the sound level at a receiver position as opposed to the sound 'intensity' of the source.

Table A2 provides a list of common noise sources and their typical sound level.

Table A2 Common Noise Sources and Their Typical Sound Pressure Levels (SPL), dBA

Source	Typical Sound Pressure Level
Threshold of pain	140
Jet engine	130
Hydraulic hammer	120
Chainsaw	110
Industrial workshop	100
Lawnmower (operator position)	90
Heavy traffic (footpath)	80
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
Bedroom (night with windows closed)	20
Threshold of hearing	0

Figure A1 – Human Perception of Sound



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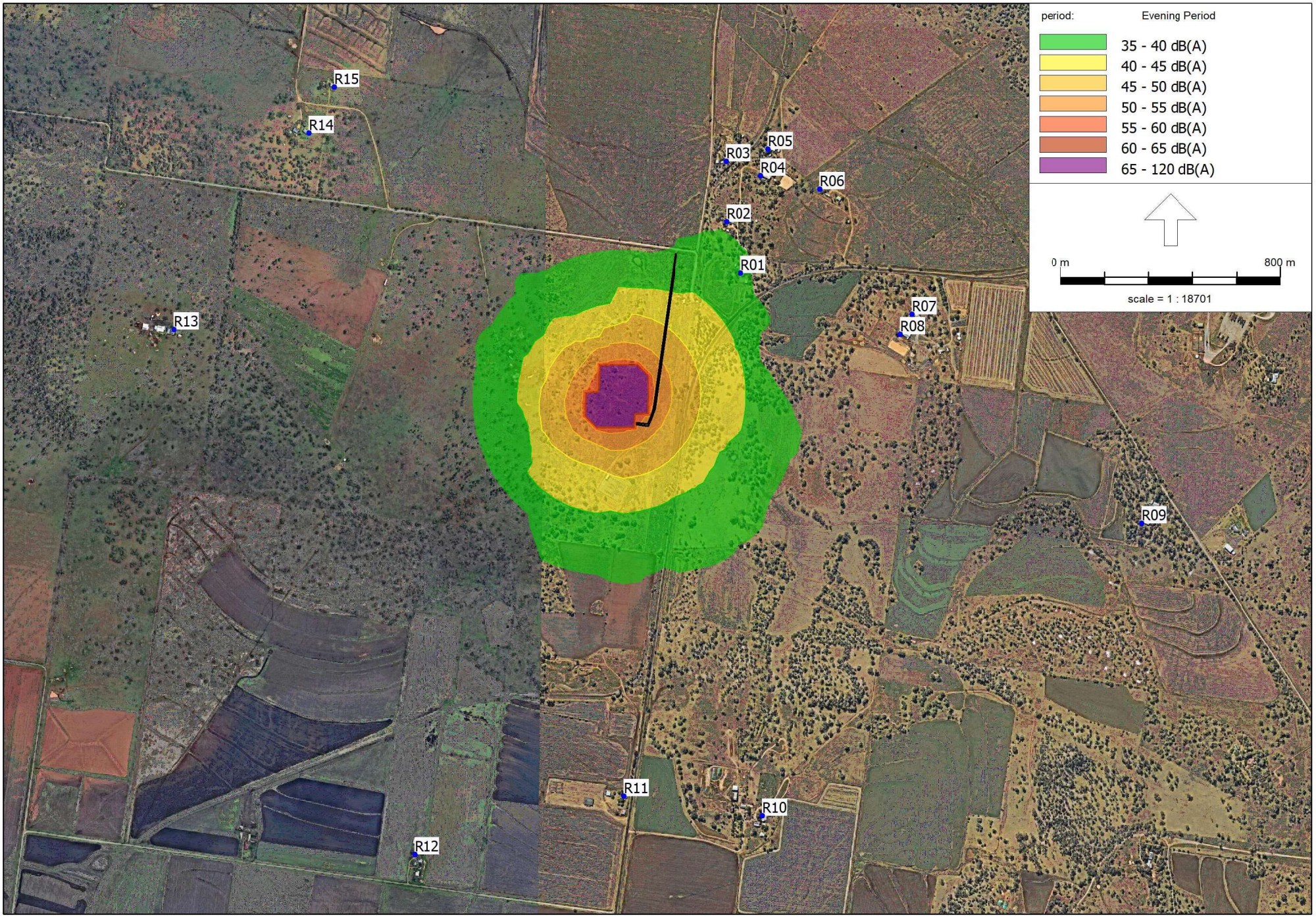
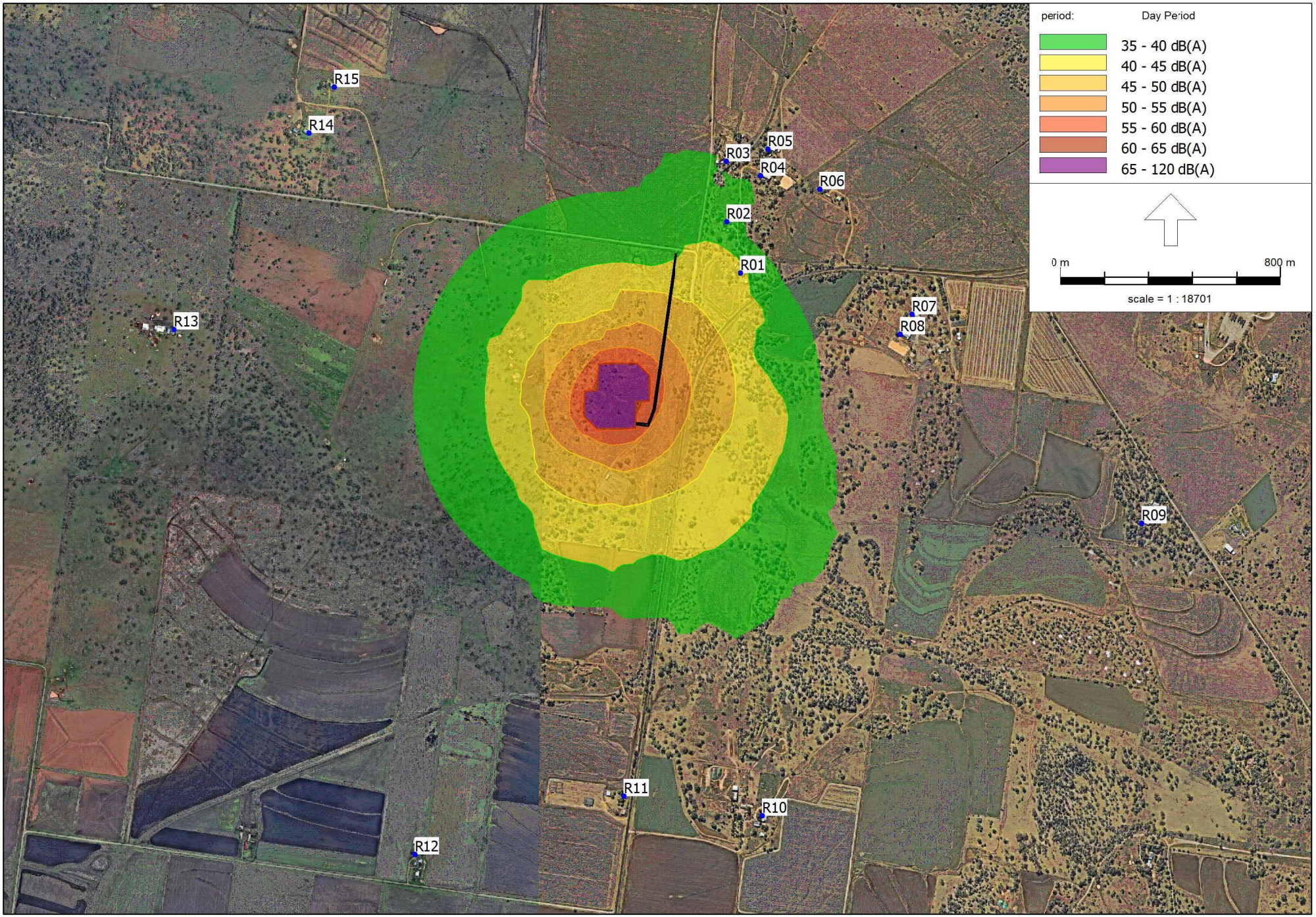
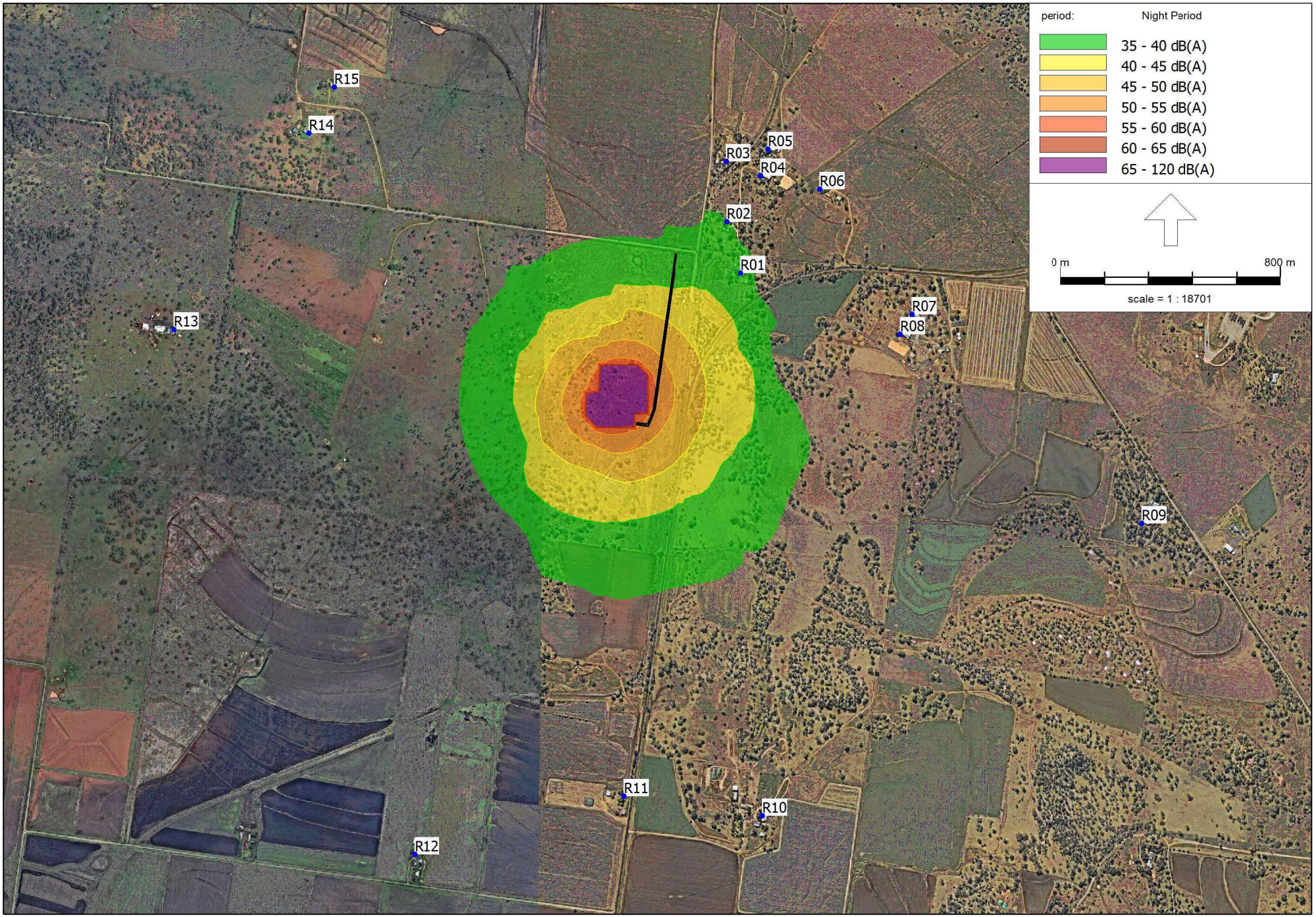
Appendix B – Noise Contours


period:
Evening Period
35 - 40 dB(A)
40 - 45 dB(A)
45 - 50 dB(A)
50 - 55 dB(A)
55 - 60 dB(A)
60 - 65 dB(A)
65 - 120 dB(A)
0 m
800 m
scale = 1 : 18701
R15
R14
R13
R12
R11
R10
R09
R08
R07
R06
R05
R04
R03
R02
R01



ISO 9613, [For Noise Contours - Construction] , iNoise V2023 rev 1 Enterprise Licensed to Muller Acoustic Consulting Pty Ltd - Australia


period:
Night Period
35 - 40 dB(A)
40 - 45 dB(A)
45 - 50 dB(A)
50 - 55 dB(A)
55 - 60 dB(A)
60 - 65 dB(A)
65 - 120 dB(A)
0 m
800 m
scale = 1 : 18701
R15
R14
R13
R12
R11
R10
R09
R08
R07
R06
R05
R04
R03
R02
R01

Muller Acoustic Consulting Pty Ltd
PO Box 678, Kotara NSW 2289
ABN: 36 602 225 132
Ph: +61 2 4920 1833
www.mulleracoustic.com

MAC
Muller Acoustic Consulting