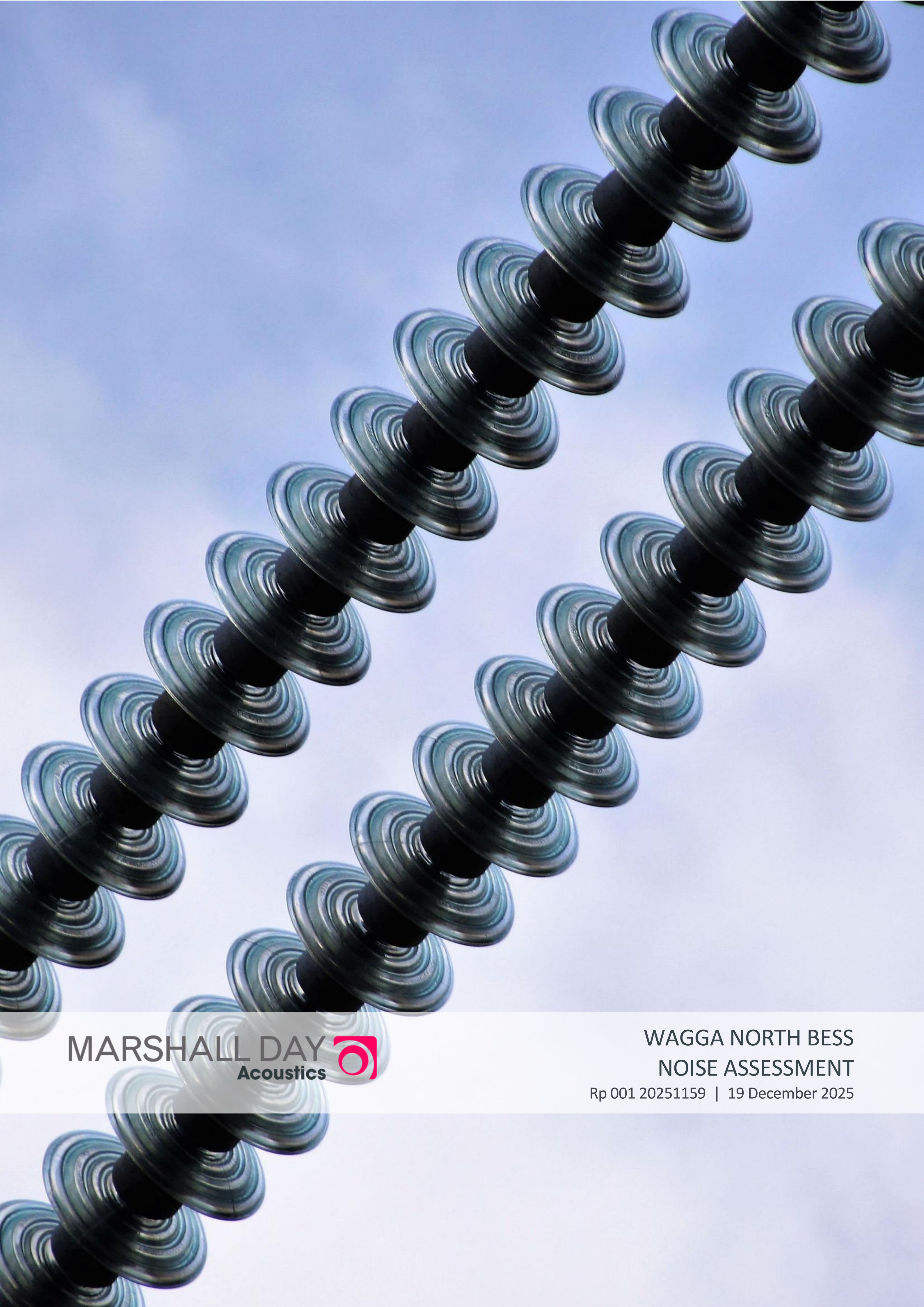


MARSHALL DAY Acoustics

WAGGA NORTH BESS NOISE ASSESSMENT

Rp 001 20251159 | 19 December 2025

Marshall Day Acoustics Pty Ltd
ATF Marshall Day Unit Trust
ABN: 53 470 077 191
Gadigal Eora Country
C 14, 372 Wattle Street
Ultimo NSW 2007
T: +612 9282 9422
www.marshallday.com

Project:	**WAGGA NORTH BESS**
Prepared for:	**Fyfe Pty Ltd** **35 Kincaid Street** **Wagga Wagga** **NSW 2650**
Attention:	**Sarah Hillis**
Report No.:	**Rp 001 20251159**

Document Control

Status:	Rev:	Comments	Date:	Author:	Reviewer:
Complete	--	For client information	19 Dec 2025	H Sah A Stoker	A Stoker O Wesley-Smith

EXECUTIVE SUMMARY

Ib Vogt Development Australia Pty Ltd (proponent) are proposing to develop a new battery energy storage system (BESS) known as the Wagga North BESS (project) approximately 5 km northeast of the city of Wagga Wagga. The project has a proposed capacity of up to 120 MW/480 MWh.

Marshall Day Acoustics (Australia) Pty Ltd (MDA) have been commissioned by Fyfe Pty Ltd (Fyfe) on behalf of the proponent, to undertake an assessment of potential noise impacts associated with the project.

The project is located within the Wagga Wagga Special Activation Precinct (Wagga Wagga SAP) and is subject to the performance criteria outlined in Section 6.3.3.3 of the Wagga Wagga Special Activation Precinct Delivery Plan (SAP Delivery Plan) dated July 2022.[1]

Section 6.3.3.3 of the SAP Delivery Plan requires a noise impact assessment to be prepared in accordance with the NSW EPA NPfI.[2] An assessment under the NPfI would consider operational noise only.

In addition to the requirements of the SAP Delivery Plan, NSW Government Department of Planning, Housing and Infrastructure (DPHI) has indicated that construction noise and traffic noise must be assessed in accordance with the ICNG and the RNP.[3]

Operational noise

The operational noise assessment is intended to provide an assessment of noise associated with the proposed project, based on the current project design, and is limited to the equipment selection provided by the proponent at this stage.

The assessment has considered:

- Sound power levels for representative equipment such as inverters, battery packs and transformers taken from original equipment manufacturer (OEM) noise datasheets.
- Project noise trigger levels derived in accordance with the procedures set out in the NPfI (as referred to in the SAP Delivery Plan).
- Noise modelling of the project layout in the context of surrounding environment, implementing the method described in ISO 9613-2:2024.[4]

The assessment indicates that predicted noise levels associated with the project are below the project noise trigger levels for all assessment time periods at all relevant noise sensitive receivers considered for assessment. The predictions are based on the manufacturer provided silencer kit being applied to all inverters in the project.

The project noise trigger levels that apply to the project, derived in accordance with the NPfI, are intended to indicate the noise level at which feasible and reasonable noise management measures should be considered.

Given the noise assessment indicates that project noise trigger levels will not be exceeded, no further feasible and reasonable noise management measures are indicated to be required.

---

[1] https://www.nsw.gov.au/sites/default/files/2023-01/Wagga-S1-Final-Delivery-Plan-Full-accessible.pdf (SAP Delivery Plan)

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

[3] NSW Department of Environment and Climate Change, *Interim Construction Noise Guideline*, July 2009 (ICNG); NSW Department of Environment, Climate Change and Water, *Road Noise Policy,* March 2011 (RNP)

[4] ISO 9613-2:2024 *Acoustics — Attenuation of sound during propagation outdoors Part 2: Engineering method for the prediction of sound pressure levels outdoors* (ISO 9613-2:2024)

The derived project noise trigger levels include modifications that inherently allow for cumulative noise from multiple, other nearby industrial noise sources. For the project this would include Transgrid Wagga North Substation. Given the indicated compliance with the project noise trigger levels, no additional consideration of cumulative industrial noise is required under the NPfI.

Predicted noise levels are also below the sleep disturbance detailed assessment trigger level, with no further assessment therefore required.

The noise assessment therefore indicates that the project is capable of being designed and operated in accordance with the noise requirements of the NPfI and Section 6.3.3.3 of the SAP Delivery Plan.

A suitably qualified acoustic consultant should be engaged during detailed design to ensure that compliance with relevant criteria is achieved at nearby noise sensitive receptors.

This is particularly pertinent during tender and procurement when alternative equipment may be preferred for matters other than acoustics. The suitably qualified acoustic consultant should review all alternative selections to determine ongoing acoustic compliance. This may also require the specification of commensurate noise control strategies.

Construction noise

A construction noise and vibration assessment has been conducted considering the ICNG and AVTG.

The assessment indicates that noise from construction has the potential to be above the noise affected management levels at some residential receivers, for some construction stages. Predicted noise levels are below the highly affected management levels in all instances.

For public road upgrade works, Receiver 3 is within the minimum working distances for some large vibration intensive equipment such as large capacity vibratory rollers.

Per the guidance of the ICNG, a construction noise and vibration management plan (CNVMP) is provided to assist the proponent in mitigating the indicated potential noise impacts. The CNVMP sets out appropriate work practices, equipment substitutions, mitigation measures, scheduling considerations and community engagement recommendations.

The assessment conducted herein indicates that with reasonable and feasible work practices implemented per the CNVMP, noise and vibration associated with the construction of the project can be acceptably managed.

Traffic noise

An assessment of traffic noise associated with construction traffic movements on nearby roads has been conducted in accordance with the RNP.

The assessment established setback distances for the local road nearest to the project – Bavin Road – within which applicable traffic noise criteria may be exceeded. Up to 2 receivers were identified to be within the defined setback distances. An assessment for sleep disturbance considering over-size, over-mass (OSOM) vehicles was also included which predicted up to 2 receivers that could potentially be affected. These receivers should be consulted prior to and during construction activities to manage impacts and minimise risk of adverse noise impacts. Reduced construction traffic speed limits should also be considered.

TABLE OF CONTENTS

APPENDIX J CONSTRUCTION EQUIPMENT, WORK STAGES AND ACOUSTIC DATA

APPENDIX K PREDICTED CONSTRUCTION NOISE LEVELS

1.0 INTRODUCTION

Ib Vogt Development Australia Pty Ltd (proponent) are proposing to develop a battery energy storage system (BESS) known as the Wagga North BESS (project) approximately 5 km northeast of the city of Wagga Wagga.

The project is proposed to comprise a BESS with an estimated capacity of up to 120 MW/480 MWh and associated infrastructure, including connection to existing transmission infrastructure.

Marshall Day Acoustics (Australia) Pty Ltd (MDA) have been commissioned by Fyfe Pty Ltd (Fyfe) on behalf of the proponent, to undertake an assessment of potential noise impacts associated with the project.

The project is located within the Wagga Wagga Special Activation Precinct (Wagga Wagga SAP) and is subject to the performance criteria outlined in Section 6.3.3.3 of the Wagga Wagga Special Activation Precinct Delivery Plan (SAP Delivery Plan) dated July 2022.[5]

Section 6.3.3.3 of the SAP Delivery Plan requires a noise impact assessment to be prepared in accordance with the NSW EPA NPfI.[6] An assessment under the NPfI would consider operational noise only.

In addition to the requirements of the SAP Delivery Plan, NSW Government Department of Planning, Housing and Infrastructure (DPHI) has indicated that construction noise and traffic noise must be assessed in accordance with the ICNG and the RNP respectively.[7]

The proponent has provided a detailed preliminary project design comprising a defined grid layout of inverters and battery units, with a supporting substation containing a high-voltage (HV) transformer.

This report documents a noise assessment to support the development application for the project, satisfying the performance criteria set out in the SAP Delivery Plan, and addressing DPHI's additional noise assessment requirements.

It contains details of the proposed project infrastructure, current project layout, candidate equipment selections and associated noise data, relevant environmental noise limits and an assessment of operational noise to establish feasibility of the project from an acoustic perspective. An assessment of potential noise impacts associated with construction and construction traffic is also included.

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

---

5 https://www.nsw.gov.au/sites/default/files/2023-01/Wagga-S1-Final-Delivery-Plan-Full-accessible.pdf (SAP Delivery Plan)

6 NSW Environment Protection Authority, *Noise Policy for Industry*, October 2017 (NPfI)

7 NSW Department of Environment and Climate Change, *Interim Construction Noise Guideline*, July 2009 (ICNG); NSW Department of Environment, Climate Change and Water, *Road Noise Policy,* March 2011 (RNP)

2.0 PROJECT OVERVIEW

2.1 Description

The project is located in the southwest region of New South Wales, approximately 5 km northeast of the city of Wagga Wagga, situated in the suburb Bomen.

The project is positioned directly south of the Transgrid Wagga North Substation and lies within the Wagga Wagga SAP, which is a targeted area where NSW State Government has established a strategic planning framework to stimulate further development.

Based on information provided by the proponent, the project is proposed to comprise:

- a BESS including battery enclosures and inverters, with a capacity of up to 120 MW/480 MWh
- a high-voltage (HV) collector substation
- ancillary elements including but not limited to internal access roads and parking, control room and staff amenities, infrastructure, amenities, fencing, security systems and landscaping.

A preliminary project design has been supplied by the proponent and is described as:

- 42 inverters
- 126 battery units
- one HV transformer to be located in a substation.

The assessment in this report is based on equipment layouts and candidate equipment selections confirmed by the proponent to be representative of the project intent. Noise data issued by the relevant original equipment manufacturer (OEM) has been adopted for assessment.

The project layout used for noise modelling purposes is shown in Appendix B.

2.2 Noise sensitive receivers

Noise sensitive receivers up to 3 km from the project have been identified by the proponent. The identified receivers have been categorised to align with the receiver types identified in the NPfI.

The geographic coordinates of the identified receivers are tabulated in Appendix C, with their geographic location in relation to the project presented graphically in Figure 1.

The nearest receiver of each type is detailed in Table 1 alongside their distance to the Project.

Compliance demonstrated at the nearest receivers would also mean compliance at receivers further away.

Table 1: Nearest receivers to the Project

Receiver ID	Approximate distance to Project, m
Residential	
2	600
Commercial	
71	2,100
Industrial	
1	100

Figure 1: Site and receiver layout

3.0 NOISE ASSESSMENT REQUIREMENTS AND POLICY

Noise assessment requirements applicable to the project have been determined based on the project's location within the Wagga Wagga SAP, as well as subsequent requests for further assessment issued by DPHI.

This are described in the following sections.

3.1 Wagga Wagga Special Activation Precinct

The project is located within the Wagga Wagga SAP and is subject to the approval process outlined under the newly developed State Environmental Planning Policy (Activation Precincts) 2020.

Appendix D provides a graphical representation of the project in the context of the SAP. Graphics for the SAP have been taken from the Wagga Wagga Special Activation Precinct Master Plan, dated May 2021.[8]

Noise performance criteria applicable to the project are detailed in the SAP Delivery Plan, specifically Section 6.3.3.3 and performance criteria PC62 and PC63.

The criteria requirements differ slightly, depending on whether the subject project requires an environmental protection license under the POEO Act, however the differences are primarily related to post construction compliance requirements.[9]

For the purposes of pre-construction development applications, the requirements are the same, regardless of whether the project is subject to an environmental protection license – specifically:

> *a noise impact assessment prepared by a suitability qualified person in accordance with the NSW EPA Noise Policy for Industry (2017) (NPfI) (or as updated) to be submitted with the application for an Activation Precinct certificate. The noise impact assessment will need to demonstrate that the proposed development will not create an adverse impact at the nearest existing noise-sensitive receiver including details of any on-site noise mitigation measures to be incorporated as part of the development* [10]

On this basis a noise impact assessment conducted in accordance with the NPfI is required to satisfy the SAP Delivery Plan.

3.1.1 Noise Policy for Industry

The NPfI is the applicable guideline for assessing operational noise associated with the project, in line with the requirements of the SAP Delivery Plan.

The NPfI provides a method for determining project noise trigger levels that are used for assessing the potential impact of operational noise from industry at existing receivers.

Specifically, the project noise trigger levels provide a benchmark or objective for assessing a proposal or site. The NPfI states that the project noise trigger levels are not intended for use as mandatory requirements, but represent the levels that, if exceeded, would indicate a potential noise impact on the community, and so 'trigger' a management response; for example, further investigation of mitigation measures.

---

[8] https://shared-drupal-s3fs.s3-ap-southeast-2.amazonaws.com/master-test/fapub_pdf/000-Wagga/Final/Wagga_FinalMasterplan_WEB.pdf

[9] NSW Government Protection of the Environment Operations Act 1997 No 156

[10] This wording is specifically for PC63 (applying to projects not subject to an environment protection license), however the requirements for PC62 are essentially identical for the purposes of this assessment

The project noise trigger levels are derived from an analysis of the background noise environment and zoning information, accounting for acoustic amenity (described as project amenity noise levels) and, in the case of residential receivers, accounting for intrusiveness (described as project intrusiveness noise levels). The project noise trigger levels are defined as the minimum of the project amenity noise level and the project intrusiveness noise level (where applicable). Assessment is conducted in terms of $L_{Aeq\ 15\ min}$.

Additional trigger levels are defined for the assessment of maximum noise level events. This is typically associated with sleep disturbance arising from noise sources that are characterised by transient events i.e. brief periods of increased noise levels and applies during the night-time period only.

The following subsections describe the amenity and intrusiveness noise levels used to determine the project noise trigger levels. Further details on the derivation of project noise trigger levels for the assessment of operational noise levels from the project are provided in Section 6.1 and Appendix E.

Project amenity noise levels

Project amenity noise levels are designed to prevent industrial noise continually increasing above an acceptable level over time with the expansion of infrastructure and development. The NPfI provides recommended amenity noise levels based on receiver categories and typical planning zones, from which the project amenity noise levels are derived.

The recommended amenity noise levels outlined in the NPfI have been determined on the basis of studies that relate industrial noise to annoyance in communities and have been subjectively scaled to reflect the perceived differential expectations and ambient noise environments of rural, suburban, and urban communities for residential receivers. They are based on protecting the majority of the community (90%) from being highly annoyed by industrial noise.

The recommended amenity levels defined in the NPfI relate to total industry noise levels. The project amenity noise levels for an individual industry, i.e. the project, are set at a level 5 dB below the recommended amenity levels to provide a margin for cumulative industry noise.

A further modification is made to standardise the amenity assessment time period to align with the intrusiveness assessment.

Project intrusiveness noise levels

The intrusiveness noise assessment is applicable to residential receivers and is based on knowledge of the background noise level at the receiver. The background noise levels are referred to as the rating background noise level (RBL) in the NPfI.

The intrusiveness noise level is the RBL at the nearest noise sensitive location plus 5 dB. Therefore, the noise emissions from the subject industry, i.e. the Project, are considered to be intrusive if the source noise level ($L_{Aeq,\ 15\ min}$) is greater than the RBL (L_{A90}) plus 5 dB.

Sleep disturbance

The NPfI states that a detailed maximum noise level assessment should be undertaken where the subject development night-time noise levels at a residential location exceed:

- 40 dB $L_{Aeq,\ 15min}$ or the prevailing RBL plus 5 dB, whichever is the greater, and / or
- 52 dB L_{AFmax} or the prevailing RBL plus 15 dB, whichever is the greater.

The NPfI does not currently provide details on how to assess sleep disturbance but refers to the RNP.

3.2 Department of Planning, Housing and Infrastructure

Assessment of noise under the SAP Delivery Plan is limited to the assessment of operational noise under the NPfI.

DPHI has requested that additional assessment of construction noise and traffic noise be conducted, considering the ICNG and RNP respectively.

In addition, it is common practice for the AVTG to be referred to for the assessment of construction vibration.[11]

3.2.1 Interim Construction Noise Guideline

The ICNG aims to provide a clear understanding of ways to identify and minimise noise from construction works through applying all '*feasible*' and '*reasonable*' work practices to control noise impacts. The guideline identifies sensitive land uses and recommends construction hours, provides quantitative and qualitative assessment methods, and subsequently advises on appropriate work practices.

Standard construction hours

The ICNG recommended standard construction hours are detailed in Table 2.

Table 2: ICNG recommended standard hours of work

Work type	Recommended standard hours of work	
Normal construction	Monday to Friday Saturday No work on Sundays or public holidays	07:00 to 18:00 08:00 to 13:00

Noise management levels

Based on the recommended standard hours, the ICNG provides two management levels for consideration in the assessment of construction noise at residential receivers:

- The noise affected management level ($L_{Aeq\ 15\ min}$) is the RBL (per the NPfI) plus 10 dB.
- The highly noise affected management level is prescriptively set at 75 dB $L_{Aeq,\ 15\ min}$.

Where noise from construction works is above the noise affected management level, all feasible and reasonable work practices should be applied.

Where the noise from construction works is above highly noise affected management level, there may be a strong community reaction to noise, and restrictions to the hours of construction may be required, with respite periods afforded to those affected.

For commercial and industrial receivers, the ICNG provides a single noise management level for each:

- Industrial premises: 75 dB $L_{Aeq,\ 15\ min}$
- Offices, retail outlets: external 70 dB $L_{Aeq,\ 15\ min}$.

Background noise levels in the vicinity of the project have not been measured. The minimum allowable day RBL (35 dB $L_{Aeq\ 15\ min}$), as provided in the NPfI, has therefore been adopted.

[11] NSW Department of Environment and Conservation, *Assessing Vibration: A Technical Guideline*, February 2006 (AVTG)

The construction noise management levels applicable to the project are set out in Table 3 and apply to airborne construction noise during the recommended standard hours only.

Table 3: ICNG – Construction noise management levels, dB $L_{Aeq\ 15\ min}$

Receivers	Management Level	
	Noise Affected	Highly Noise Affected
Residential	45	75
Commercial	70	-
Industrial	75	-

It should be noted that for the purposes of the construction noise assessment, the adjacent Transgrid Wagga North Substation has not been considered. It is not a permanently manned facility and would therefore not be classed as a sensitive land use under the ICNG. The next nearest manned and operational industrial receiver has been considered.

Out of hours works

The ICNG also defines the following 5 categories of works that might be undertaken outside the recommended standard hours:

- the delivery of oversized plant or structures that police or other authorities determine require special arrangements to transport along public roads
- emergency work to avoid the loss of life or damage to property, or to prevent environmental harm
- maintenance and repair of public infrastructure where disruption to essential services and/or considerations of worker safety do not allow work within standard hours
- public infrastructure works that shorten the length of the project and are supported by the affected community
- works where a proponent demonstrates and justifies a need to operate outside the recommended standard hours.

The ICNG defines additional assessment and reporting requirements that apply if out of hours work is proposed, including justification of the need to work during these periods, including additional management levels for ground borne noise from construction vibration.

General construction works associated with the project are only expected to occur during standard working hours. On this basis a detailed assessment of out of hours construction activity is not included in this report.

While not currently planned or scheduled, unavoidable works outside of standard hours could conceptually comprise the delivery of over-size/over-mass (OSOM) components at times selected to minimise traffic disruption associated with intersection closures and unloading or installation of oversize equipment, such as power transformers.

The potential for traffic noise impacts associated with OSOM vehicle movements is considered as part of the traffic noise assessment, to provide an early evaluation of risks at later stages of project development.

3.2.2 Assessing Vibration: A Technical Guideline

It is common for an assessment of vibration related to the construction of a project in NSW to consider the AVTG.

The AVTG presents preferred and maximum vibration values for use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques. Preferred and maximum vibration values outlined in the AVTG are taken from BS 6472:1992.[12]

The AVTG identifies three vibration categories:

- *Continuous vibration* – examples: Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery)
- *Impulsive vibration* – examples: Infrequent activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading
- *Intermittent vibration* – examples: Trains, nearby intermittent construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer this would be assessed against impulsive vibration criteria.

Similar to other policy and guideline documentation, the AVTG allows for assessment at various receiver types.

Intermittent vibration

The vibration characteristics of most construction activities, e.g. excavation and pilling, are considered to be intermittent. Intermittent vibration can be defined as interrupted periods of continuous vibration, e.g. heavy truck pass-bys or rock breaking, or continuous periods of impulsive vibration, e.g. impact pile driving.

Higher vibration levels are allowed for intermittent vibration compared with continuous vibration on the basis that the higher levels occur over a shorter time period. Hence, for intermittent vibration, human disturbance vibration levels are assessed on the basis of the vibration dose value (VDV), based on the level and the duration of the vibration events. Vibration criteria applicable to all receivers for intermittent vibration sources are summarised in Table 4.

Table 4: Preferred and maximum vibration levels for human disturbance limits, VDV [a]

Location	Daytime[b]		Night-time[b]	
	Preferred value	Maximum value	Preferred value	Maximum value
Residences	0.20	0.40	0.13	0.26

a These values are only indicative, and there may be a need to assess to other sensitive areas against the relevant criteria.

b Daytime is 07:00 to 22:00 and night-time is 22:00 to 07:00

Continuous and impulsive vibration

Vibration criteria applicable to all receivers in the vicinity of the Project for continuous and impulsive vibration sources, are summarised in Table 5.

Vibration criteria applicable to the residential receivers in the vicinity of the Project for continuous and impulsive vibration sources, are summarised in Table 5.

[12] British Standard 6472:1992 *Evaluation of human exposure to vibration in buildings (1-80 Hz)* (BS 6472:1992)

Table 5: Preferred and maximum vibration levels for human disturbance limits, m/s^2 [1]

Vibration type	Assessment period [2]	Preferred values		Maximum values	
		Z axis	X and Y axes	Z axis	X and Y axes
Continuous vibration	Daytime	0.0100	0.0071	0.020	0.014
	Night-time	0.0070	0.0050	0.014	0.010
Impulsive vibration	Daytime	0.3000	0.2100	0.600	0.420
	Night-time	0.1000	0.0710	0.200	0.140

1 The preferred and maximum values are weighted root mean square (RMS) acceleration values. These values are only indicative, and there may be a need to assess to other sensitive areas against the relevant criteria.

2 Daytime is 07:00 to 22:00 and night-time is 22:00 to 07:00

3.2.3 Road Noise Policy (RNP)

As requested by DPHI, additional traffic on public roads due to construction and operation of the project has been assessed against the requirements of the RNP and relevant application notes.

The RNP provides noise level criteria for increased traffic flow as a result of a land-use development with the potential to create additional traffic, as detailed in Table 6.

Table 6: Road traffic noise assessment criteria for residential land uses

Type of development	Day (07:00-22:00)	Night (22:00-07:00)
Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	60 dB $L_{Aeq, 15 hr}$ (external)	55 dB $L_{Aeq, 9 hr}$ (external)
Existing residences affected by additional traffic on existing local roads generated by land use developments	55 dB $L_{Aeq, 1 hr}$ (external)	50 dB $L_{Aeq, 1 hr}$ (external)

Additionally, the RNP requires that the relative increase in noise levels at residential receivers not exceed 12 dB for land use developments with the potential to generate additional traffic on existing freeways, arterial or sub-arterial roads. The relative increase criterion does not apply for local roads.

The RNP notes that in assessing feasible and reasonable mitigation measures, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person.

Where night-time construction traffic is likely to occur, such as OSOM deliveries, an assessment of sleep disturbance is appropriate. The RNP provides guidance on this matter:

- Maximum internal noise levels below 50–55 dB L_{Amax} are unlikely to awaken people from sleep
- One or two noise events per night, with maximum internal noise levels of 65–70 dB L_{Amax}, are not likely to affect health and wellbeing significantly.

Based on the assumption that an open window provides 10 dB attenuation (which would be typical of a facade with partially open windows), noise levels below 60 - 65 dB L_{Amax} outside an open bedroom window would be unlikely to cause awakening reactions.

Furthermore, one or two events with a noise level of 75 - 80 dB L_{Amax} outside an open bedroom window would be unlikely to affect health and well-being significantly.

4.0 NOISE PREDICTION METHOD

4.1 Operational noise

Operational noise levels associated with the project are predicted using:

- noise emission data for the battery units, inverters, and transformers
- a 3D digital model of the project and the surrounding environment, using proprietary noise modelling software SoundPLANnoise v9.0
- international standards used for the calculation of environmental sound propagation

Calculations have been conducted in general accordance with ISO 9613-2.[13]

The implementation of ISO 9613-2 within proprietary noise modelling software enables multiple sound transmission paths, including reflected and screened paths, to be accounted for in the calculated noise levels.

ISO 9613-2 was designed to assume conditions that favour the propagation of noise from meteorological effects, described as a slight wind (1 to 5 m/s) blowing from source to receiver, or a well-developed moderate ground-based temperature inversion, such as commonly occurs on clear calm nights. This aligns with Pasquil-Gifford stability class F.

In lieu of a detailed evaluation of meteorological conditions for the area, noise enhancing meteorological conditions have been assumed for all assessment periods. This aligns with the conservative option set out in Fact Sheet D of the NPfI.

A digital terrain map with a cell size of 1 m for the project site and surrounds has been sourced from ELVIS and is considered appropriate for noise modelling purposes at this stage.[14]

The ground factor, G, representing the ground attenuation as a result of sound reflected by the ground surface interfering with the sound propagating directly from source to receiver is variable throughout the model being:

- G = 0.1 within BESS and substation areas representing hard ground
- G = 0.5 to all other areas representing mixed hard/soft ground.

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

4.1 Construction noise

Predicted noise levels have been calculated in general accordance with the method detailed in AS 2436-2010.[15] This method enables the prediction of noise levels for sound propagation over hard or soft ground but does not provide the ability to calculate predicted noise levels for mixed ground cover with varied soil conditions.

The standard also notes that caution must be applied when considering predicted noise levels at distances beyond 100 m. For these reasons, predicted noise levels have been conservatively determined as the arithmetic average of the hard and soft ground prediction methods.

---

13 International Organisation for Standardisation 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)

14 https://elevation.fsdf.org.au/

15 Standards Australia, AS 2436-2010 *Guide to noise and vibration control on construction, demolition and maintenance sites*, May 2010 (AS 2436-2010)

This approach is broadly consistent with the equivalent prediction procedure in BS 5228-1:2009, as referenced in AS 2436-2010.[16]

5.0 EXISTING NOISE ENVIRONMENT

5.1 Policy

Project noise trigger levels (per the NPfI) and noise management levels (per the ICNG) applicable to operational noise and construction noise assessment are in some cases dependent on background noise levels at a subject receiver, or in the vicinity of a subject site or project.

Background noise levels are referred to as the RBL in the NPfI and ICNG, and are defined interms of $L_{A90,\ 15\ min}$.

Measurement procedures for determining RBLs are set out in Fact Sheet B of the NPfI. Background noise data developed for an NPfI assessment are also suitable for use in an assessment under the ICNG.

5.2 Background noise levels

Background noise levels in rural environments in NSW are typically very low, particularly in the evening and night period.

The NPfI recognises that very low RBLs can present challenges with the derivation of reasonable noise levels for assessment. Table 2.1 of the NPfI therefore provides minimum assumed RBLs. Where background noise levels are below the minimum RBLs (as is typically the case), the minimum RBLs must be adopted as a matter of course.

The measurement of background noise levels in rural environments is therefore typically not necessary unless the rural receiver/s may be subject to elevated background noise levels e.g. located close to a highway or other noise source. Even in such a case higher background noise levels would result in higher project noise trigger levels. On this basis adopting the minimum RBLs represents a more conservative approach to assessment.

In lieu of a site-specific noise survey the minimum RBLs summarised in Table 7 have been adopted for assessment.

Table 7: Minimum assumed RBLs for NPfI and ICNG, dB L_{A90}

Time of day	Minimum assumed RBL
Day	35
Evening	30
Night	30

Time of day is defined as:

Day	07:00 – 18:00 Monday to Saturday and 08:00 – 18:00 Sundays and public holidays
Evening	18:00 – 22:00 Monday to Sunday and public holidays
Night	the remaining periods

[16] BSI, BS 5228 1:2009 *Code of practice for noise and vibration control on construction and open sites: Noise*, January 2009 (BS 5228-1:2009)

6.0 OPERATIONAL NOISE ASSESSMENT

6.1 Project noise trigger levels

The project noise trigger levels shown in Table 8 have been derived and are applicable to the project.

They are the most stringent project noise trigger levels that can practically be applied to the respective receiver type under the NPfI.

Full derivations are provided in Appendix E.

Table 8: Project trigger levels, dB $L_{Aeq\ 15\ min}$

Receiver	Period	Project noise trigger level
Rural Residential	Day	40
	Evening	35
	Night	35
Commercial premises	When in use	63
Industrial premises	When in use	68

6.2 Operational noise sources

At this stage of the project, equipment selections have not been conclusively determined and final selections will be determined following detailed design and tender. The project design and equipment selections detailed in this report have been used for the purpose of noise assessment and have been reviewed by the proponent and approved as being representative.

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

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 by a suitably qualified acoustic consultant to verify continued compliance of the project.

Sound power levels for individual project equipment items, as used in the noise model, are detailed in Table 9. Data is provided as un-weighted (linear) octave band spectra and A-weighted overall sound power level.

Noise data adopted for the inverter and battery unit represents the lower end of the range of noise levels exhibited on the market, based on MDA's knowledge and research.

Table 9: Sound power levels for Project equipment items, dB L_W

Item	Octave band centre frequency, Hz							
	63	125	250	500	1000	2000	4000	dBA
Inverter[a]	88	85	82	75	70	77	85	87
Battery unit	93	90	79	75	76	70	65	81
HV transformer	99	101	96	96	90	85	80	96

a Includes manufacturer provided silencer kit

Additional information with respect to the source of the data is provided in Table 10.

Table 10: Noise data descriptions

Item	Description
Inverter	Manufacturer third octave band sound power levels measured in accordance with ISO 9614-2:2016 have been provided by the proponent.[17] Extensive specific operating conditions for the equipment were described in the supplied data sheet, including charge/discharge with/without a silencer kit. For the purposes of this assessment noise data associated with worse case operation i.e. 100% fan speed, with the manufacturer provided silencer kit has been adopted. Due to commercial sensitivities the specific inverter manufacturer and model is not detailed in this report but has been confirmed by the proponent to be representative of the specification required for the project.
Battery unit	Noise related to the battery unit is typically limited to that associated with the cooling systems. Manufacturer third octave band sound power levels measured in accordance with ISO 3744:2010 have been sourced from MDA's library. [18] The worst case data set indicated in the manufacturer data sheet have been adopted for assessment. Due to commercial sensitivities the specific battery manufacturer and model is not detailed in this report but has been confirmed by the proponent to be representative of the specification required for the project.
HV transformer	At this stage of the project, specific details of the transformer makes and models are yet to be finalised. The proponent has advised that the HV transformers would have a capacity of up to 150 MVA. In the absence of measured sound power level data for a specific transformer model, reference has been made to the method for estimating overall transformer sound power levels for a given power rating described in AS 60076-10:2009.[19] The '*standard maximum*' sound power level indicated in the standard has been adopted for assessment. Spectral data for each transformer was then estimated by applying Bies & Hansen corrections from Table 11.27, (Location 1a for outdoor transformer noise) to the determined overall sound power level.[20]

[17] ISO 9614-2:1996 *Acoustics — Determination of sound power levels of noise sources using sound intensity Part 2: Measurement by scanning*

[18] 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*

[19] AS 60076-10:2009 *Power transformers – Part 10: Determination of sound levels;*
Bies, D. H. & Hansen, C. H. (2009). Engineering noise control: theory and practice (Fourth edition.). p. 601

6.3 Tonality

Noise associated with inverters and transformers is often tonal in nature, typically evidenced in associated third octave spectral noise data.

Fact Sheet C of the NPfI provides a mechanism by which the characteristics of a noise source, such as tonality, may attract the application of a modifying factor correction if deemed to meet the prescribed criteria. The NPfI states that:

> *Where a noise source contains certain characteristics, such as tonality, intermittency, irregularity or dominant low-frequency content, there is evidence to suggest that it can cause greater annoyance than other noise at the same noise level.*

With regards to tonality, the NPfI references the ISO 1996-2 – 2007 objective method for assessing the audibility of tones, with the application of a modifying factor correction of 5 dB to the measured or predicted noise level for the subject source where tonality is present.[21]

To provide a conservative assessment, a modifying factor correction of +5 dB (as per the NPfI) has been applied to the predicted noise levels to account for the potential tonal characteristics of the noise from both the substation transformers and BESS equipment.

It should be noted that, in practice, the +5 dB correction is not applicable based on the source noise characteristics but would only be applied if the tonality was measurable at the subject receiver. As tonality at a receiver cannot readily be predicted, this correction has been included to provide a conservative assessment.

6.4 Worst case assessment

The assessment provided herein is considered a reasonable worst-case assessment with multiple decisions made to adopt conservative approaches. Based on the totality of these conservative assumptions it is expected that noise levels in practice will be lower than predicted by this assessment, particularly during the night period.

The conservative assumptions are discussed in turn in the following sections.

6.4.1 Concurrent maximum operational conditions

The operation of the cooling systems associated with the transformers, batteries and inverters will typically vary over a 24 hr period due to grid related charge and discharge conditions and varying ambient temperatures. Cooler temperatures in the night-time will generally result in reduced demand on cooling systems, and lower associated noise levels.

In order for such conditions to be modelled directly the OEM noise datasheet must provide variable noise data for corresponding operational conditions and ambient temperatures. This is not currently available.

As a conservative approach it has been assumed that worst-case equipment operation could occur at any time in a 24 hr period. This approach disregards the mitigating factors offered by cooler evening and night-time temperatures, and/or more prolonged charge/discharge rates

The highest relevant noise levels set out in the OEM noise datasheets have been adopted for assessment.

---

[21] ISO 1996-2:2007 *Acoustics — Description, measurement and assessment of environmental noise Part 2: Determination of environmental noise levels*

6.4.2 Exclusion of equipment shielding

Batteries and inverters are large pieces of equipment that can offer valuable shielding effects, particularly when installed in a grid pattern.

In order to provide a conservative assessment such shielding has not been included in the noise model - each noise source therefore has the potential to have direct line of site to a subject receiver provided it is not shielded by topography. This is likely to lead to higher noise levels indicated by the noise model than may occur in practice, when the shielding of equipment bodies is present and line of site is eliminated.

6.4.3 Simplified tonality assumptions

Per Section 0, a + 5 dB modifying factor correction for tonality has been applied as a matter of course. This provides robust risk management for potential tonality but in many cases can be overly punitive.

Review of the 1/3 octave band noise data for the battery indicates that the equipment is not tonal at source, per the ISO 1996-2 – 2007 objective method. Inverter noise data indicates potential tonality at the 3.15 kHz band however such noise energy would be readily absorbed through atmospheric propagation. It is unlikely that tonality at 3.15 kHz would translate to receivers several hundred metres away.

On this basis noise levels at receivers would be lower than indicated by this assessment.

6.5 Directivity

Noise data for the inverter and batteries has been measured by the respective OEMs in accordance with ISO 9614-2:2016 and ISO 3744:2010 respectively. These standards are aimed at evaluating the total sound energy of the tested noise source and do not provide robust methods for determining directivity to the extent that may be useful for complete noise modelling. Further the respective noise datasheets provide incomplete reporting to support directional noise modelling. Complete datasets to accurately support directional noise modelling of the candidate equipment may require further measurement by the OEM.

It is acknowledged that there may be instances where highly directional noise sources are underpredicted by an omni-directional noise modelling method, however this would predominantly happen under specific conditions e.g. all directional noise sources pointing directly at a subject noise sensitive receiver. This would not be the case for the project where, due to airflow requirements, 50% of the equipment will be pointing generally north (away from residential receivers) and 50% of the equipment will be pointing generally south (towards residential receivers). On this basis omni-directional noise modelling is expected to be a reasonable representation of noise emissions from the project, in the absence of detailed directivity information for the equipment.

Notwithstanding the above, directivity will be a key consideration during tender and procurement and will inform ongoing project design development and layout determination. Due to the absence of residential receivers to the north, preferentially rotating directional equipment so that noise is pointed away from residential receivers will be a fundamental noise control concept. This would result in noise levels at receivers lower than indicated in this assessment.

In addition, the totality of the conservatism set out in Section 6.4 would be expected to be larger than any potential variation due to directivity.

6.6 Predicted noise levels

Operational noise levels at the nearest noise sensitive receivers have been predicted based on the project design described in Section 2.1, the method detailed in Section 4.1, and the noise data shown in Section 6.2.

Per the NPfI:

The development is considered to cause a noise impact if the predicted noise level at the receiver exceeds the corresponding project noise trigger level.

Where the project noise trigger level is achieved, impacts are not indicated. Further where impacts are not indicated at the nearest receivers, impacts would also not be indicated at receivers further away.

The results of these predictions at the nearest receivers are provided in Table 11.

Table 11: Predicted operational noise levels at nearest receivers, dB $L_{Aeq, 15\ min}$

Receiver	Predicted noise level[a]			Project noise trigger level[b]			Compliance?
	Day	Evening	Night	Day	Evening	Night	
Residential							
2	33	33	33	40	35	35	✓/✓/✓
Commercial							
71	22	22	22	63	63	63	✓/✓/✓
Industrial							
1	50	50	50	68	68	68	✓/✓/✓

a Includes a + 5 dB modifying factor correction for tonality per Section 0

b Commercial and Industrial project noise trigger levels apply only when the subject premises is in use

Predictions at all receivers within 3 km are provided in Appendix G.

Predicted noise level contours are shown in Appendix H.

6.7 Cumulative noise

Transgrid Wagga North Substation is an existing, operational facility located approximately 35 m to the north of the Project boundary. Existing environmental noise levels associated with this facility have not been measured or quantified.

The NPfI project amenity noise level is designed *'to protect against cumulative noise impacts from industry'* with modifications made to the recommended amenity noise level to account for noise contributions for existing industry, as described in Section 3.1.1 and Appendix E.

Further, the NPfI states:

Where the project amenity noise level applies and it can be met, no additional consideration of cumulative industrial noise is required.

Given the compliance with NPfI project trigger noise levels indicated in Table 11, no further consideration is given to noise from Transgrid Wagga North Substation or other approved or proposed developments. Assessment of cumulative industrial noise under the NPfI is therefore considered satisfied.

6.8 Sleep disturbance

Predicted noise levels at residential receivers are comfortably below the 40 dB $L_{Aeq, 15min}$ screening criteria set out in the NPfI and summarised in Section 3.1.1.

On this basis a detailed maximum noise level assessment is not warranted and sleep disturbance is not indicated to be a risk.

6.9 Mitigation measures

Noise data for the inverters is based on OEM noise control kits being installed on the units. This would be an inherent control that would need to be applied to the project, should the candidate inverter model be carried through the design development process.

No specific controls are indicated to be required for the batteries or HV transformer.

Based on these factors, the project noise trigger levels that apply to the project, derived in accordance with the NPfI, are intended to indicate the noise level at which feasible and reasonable noise management measures should be considered.

Given the noise assessment indicates that project noise trigger levels will not be exceeded, no further feasible and reasonable noise management measures are indicated to be required.

Nonetheless the proponent must continue to develop the project in a manner which will ensure that the project is capable of complying with the requirements of the NPfI once constructed.

The primary recommendation made by this assessment is for a suitably qualified acoustic consultant to be engaged during detailed design to ensure that compliance with relevant criteria is achieved at nearby noise sensitive receptors.

This is particularly pertinent during tender and procurement when alternative equipment may be preferred for matters other than acoustics. The suitably qualified acoustic consultant should review all alternative selections to determine ongoing acoustic compliance. This may also require the specification of commensurate noise control strategies.

The above approach sets out a robust due diligence approach such that the proponent can maintain confidence in acoustic compliance prior to construction. Post-construction noise monitoring can be employed to verify compliance, as is typically consented by DPHI.

6.10 Conclusion

The results shown in Table 11 demonstrate that the predicted noise levels associated with the proposed project are below the NPfI project noise trigger levels at the nearest, and therefore all, noise sensitive receivers.

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

The predictions are based on the manufacturer provided silencer kit being applied to all inverters in the project and are demonstrated for the specific equipment selections and associated noise levels detailed in this report.

Noise data adopted for the inverter and battery unit represents the lower end of the range of noise levels exhibited on the market, based on MDA's knowledge and research. On this basis the specific selection of equipment items, and the manufacturer's noise data associated the specific selections, are controlling factors for compliance of the project.

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 by a suitably qualified acoustic consultant to verify continued compliance of the project.

Based on this assessment it has been established that the project is capable of being designed and operated such that noise from operation is below the project trigger noise levels outlined in the NPfI. It is expected that this satisfies the requirements of Section 6.3.3.3 of the SAP Delivery Plan.

7.0 CONSTRUCTION NOISE AND VIBRATION ASSESSMENT

7.1 Overview

The construction of the project will generate noise and vibration as a result of activities occurring within the project area.

In NSW, construction noise is generally to be assessed in accordance with the ICNG and considering the AVTG (see Section 3.2).

On-site works will include a range of activities such as construction of access tracks, transmission infrastructure, cable trenching, battery installation, and other tasks.

Off-site noise generating activities considered by the assessment are limited to public road upgrades.

General construction works associated with the project are only expected to occur during standard working hours. On this basis a detailed assessment of out of hours construction activity is not included in this report.

7.2 Construction activities

Based on information provided by Fyfe, construction of the project is likely to involve the following key stages:

- Public road upgrades
- Access road construction
- BESS installation
- Cable trench digging
- Gravel laydown
- Site compound construction
- Site rehabilitation
- Substation & O&M facility construction
- Vegetation clearing.

Specific details of the construction program and the number, type, and duty of the construction plant to be used would be determined during the detailed design phase of the project when a construction contractor has been selected. The assessment provided herein is generally representative of the equipment and work processes expected to be carried out.

The types of equipment associated with different stages of construction typically include excavation plant, pneumatic equipment, different piling processes and lifting equipment.

Appendix I provides a construction site layout denoting key work areas.

Appendix J details typical major equipment items associated with the above construction stages, alongside noise levels developed on the basis of reference data from AS 2436-2010 and previous MDA project experience. Also provided is a breakdown of relevant equipment items per stage, the number of items per stage, and the 'on' duration in a typical 15 minute period.

In determining aggregate sound power levels per stage, it is not expected that all equipment will be operating simultaneously. A conservative assumption that the 5 noisiest equipment items could be operating simultaneously has been adopted.

7.3 Construction noise assessment

Noise levels associated with each of the main construction tasks have been predicted at all noise sensitive receivers identified by Fyfe. These are presented in Appendix K.

Results indicate that a number of residential receivers may be subject to construction noise levels above the noise affected management level.

No residential receivers are indicated to be subject to construction noise levels above the highly noise affected management level.

No commercial or industrial receivers are indicated to be subject to construction noise levels above the respective noise affected management levels.

Due to the nature of construction works, equipment would only be in a single area for a short period of the overall construction schedule. Where adverse impact is indicated this is likely to only occur for a limited portion of the overall construction timeline.

7.3.1 Affected residential receivers

Notwithstanding the above, receivers at which noise levels are indicated to be above the ICNG noise affected management level are summarised in Table 12.

Table 12: Summary of receivers and constructions stages where noise may be above the noise affected management level

Construction stage	Affected receivers
Public road upgrade	2, 3, 8, 9, 14, 17, 27, 32, 36, 38, 46, 47, 52
Access road construction	2, 3, 8, 9
BESS installation	2, 3, 8, 9, 14, 17, 27, 32, 36, 38, 39, 59, 60, 62
Cable trench digging	2, 3, 9
Gravel laydown	2
Site compound construction	2, 3, 8, 9, 14, 17, 27, 32, 38, 39, 59
Site rehabilitation	N/A
Substation & O&M facility construction	2, 3, 8, 9, 14, 17, 27, 32, 36, 38, 39, 59, 60, 62
Vegetation clearing	N/A

The ICNG states that for residential receivers:

The noise affected level represents the point above which there may be some community reaction to noise.

- *Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level.*
- *The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.*

Based on the above noise reduction work practices and mitigation measures should be applied, where reasonable and feasible.

Further information on noise reduction work practices and mitigation measures is provided in Section 8.0. As predicted noise levels are not above the highly noise affected management level, the specification of additional noise controls is not warranted.

It is noted that construction noise levels above the noise affected management level are not unique to the project and are characteristic of many construction noise assessments due to the high 'at source' noise levels of construction equipment. Predicted noise levels are typical of the range expected for a medium size infrastructure project in a semi-rural setting.

7.4 Construction vibration assessment

The prediction of vibration propagation through the ground is convoluted and complex, and depends on several factors including damping, reflection, and in-ground impedance conditions. A detailed vibration propagation assessment is considered to be a site-specific assessment and requires a combination of baseline vibration assessment, empirical measurement of equipment and analytical methods. Assessment of this nature is typically associated with major infrastructure projects in an urban context, where vibration risks are significantly elevated. For the purposes of this project, given the reasonable distance between work areas and receivers, a risk assessment is appropriate.

The AVTG provides guidance with respect to the assessment of human comfort due to vibration from construction works. This guideline distinguishes intermittent, impulsive, and continuous vibration sources, which can be generated by construction activities.

7.4.1 Intermittent vibration

The AVTG indicates that intermittent vibration should be assessed in terms of the vibration dose value (VDV). Representative VDV values for construction works are calculated considering the magnitude and duration of vibration events and are highly specific to site conditions, equipment selections and operational durations. As such, calculation of VDV levels is not typical or practical at the planning stage or where source receiver distances are large - as is the case for a majority of construction stages for the project.

Works associated with public road upgrades to Bavin Rd are indicated to occur at distances less than 50 m to Receiver 3. This means that care must be taken to ensure equipment selection and operational periods do not lead to adverse impact. While calculation of specific VDV levels is not feasible at this stage, the proposed road upgrade works are similar to those carried out regularly on public roads and management practices are well known.

The types of construction likely to cause intermittent vibration i.e. impact pile driving and jack hammers, are not proposed for the project. Appropriate management of equipment selection, as described in Section 7.4.2 will assist in managing any potential impacts.

7.4.2 Continuous vibration

Vibration due to some construction operations can be considered continuous depending on the duration and nature of the works. Since the guide values for continuous vibration are independent of exposure duration, indicative safe working distances can be developed. Appendix D of the CNVG sets out minimum working distances from sensitive receivers for typical items of vibration intensive plant.[22] The minimum distances, reproduced in Table 13 are quoted for effects relating to human comfort.

---

[22] NSW RMS *Construction Noise & Vibration Guideline* (CNVG), Sep 2023

Table 13: Recommended minimum working distances for human response limits for vibration intensive plant

Plant item	Rating/description	Minimum working distance, m
Vibratory roller	< 50 kN (typically 1-2 tonnes)	15 to 20
	< 100 kN (typically 2-4 tonnes)	20
	< 200 kN (typically 4-6 tonnes)	40
	< 300 kN (typically 7-13 tonnes)	100
	> 300 kN (typically 13-18 tonnes)	100
Small hydraulic hammer	300 kg – 5 to 12 t excavator	7
Medium hydraulic hammer	900 kg – 12 to 18 t excavator	23
Large hydraulic hammer	1600 kg – 18 to 34 t excavator	73
Vibratory pile driver	Sheet piles	20
Piling rig – bored	≤ 800 mm	N/A
Piling rig – hammer	12 t down force	50
Jackhammer	Handheld	Avoid contact with structure

Note: Reproduced from Table 20 Appendix D of the CNVG Sep 2023.

The CNVG notes that the minimum working distances for human comfort relate to continuous vibration and are indicative. In practice, appropriate minimum working distances will vary depending on the particular item of plant and local geotechnical conditions. The CNVG further notes that for most construction activities, vibration emissions are intermittent in nature and for this reason, higher vibration levels, occurring over shorter periods are allowed, likely equating to greater minimum working distances.

It can be seen that the minimum working distances are significantly less than the minimum distances between proposed construction stage work areas at the project area and residential receivers (refer Section 2.2, Figure 1).

For public road upgrades on Bavin Rd, that may occur within 50 m of Receiver 3, use of the larger vibratory rollers (greater than 6 tonnes) may give rise to adverse impact. No other vibration intensive equipment is proposed to be operated for the public road upgrade construction stage.

Mitigation measures that may be employed include the use appropriately sized vibratory rollers or providing respite periods. Contextually, it is anticipated that works may occur within a respective impact setback distance for very short periods (likely a matter of days or fractions of days) with a majority of public road upgrade works being conducted at distances greater than the working distances indicated in Table 13.

8.0 CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN

Based on the construction staging and equipment information provided by Fyfe, a suitable construction noise and vibration management plan (CNVMP) has been developed. The CNVMP aims to assist the construction team in managing and mitigating noise impacts (where expected) as well as communicating effectively with impacted stakeholders.

The CNVMP provides a mix of construction best practices that should be adopted, where feasible, regardless of expected impact. Other items are specifically identified as noise control measures to reduce impact, during the noisiest periods of construction. These would only be required and applied when the worst-case construction scenario each stage occurs i.e. the totality of construction equipment for that stage operating continuously and concurrently at the closest point to a subject receiver.

8.1 Training

All staff are to participate in an induction training session before starting work, with attention given to the following matters:

- Activities with the potential to generate high levels of noise and/or vibration (identified as the equipment items set out in Appendix J with sound power levels 110 dB L_{WA} and above).
- Mitigation and management measures (as set out in the remainder of this section).
- Sensitive receivers and any agreements made through engagement (if any).
- Monitoring requirements (if any).

As the construction progresses, any updates of noise and vibration matters should be addressed during regular site meetings and/or 'toolbox' training sessions.

8.2 Equipment selection

The following should be considered when selecting construction equipment:

- Use of quieter construction methodologies where practicable.
- Use of electric motors rather than diesel engines where practicable.
- Use of rubber-tracked equipment rather than steel tracked equipment where practicable.
- Use of equipment that is suitably sized for the task.
- Maintenance of equipment to minimise rattles, squeaks etc.
- Use of exhaust silencers and engine covers for engines where practicable.
- Avoidance of tonal reversing or warning alarms (beepers). Alternatives include broadband alarms (squawkers/quackers), flashing lights, proximity sensors, reversing cameras and spotters.

8.3 Scheduling of activities and providing respite periods

While none of the construction stages are predicted to be above the highly noise affected management level at any receivers, there is a potential for the noise from public road upgrades to be close to the management level when works occur close to Receiver 3.

While respite periods are required when the highly noise affected management level is exceeded (which is not indicated for the project), respite periods can be a useful noise mitigation measure for any noise impact. On this basis, the proponent should consider the provision of respite periods during extended periods of high noise work (particularly when the scraper and front-end loader is used) close to Receiver 3.

Such works should also be concentrated to the middle of the working day, with early morning (hours 0700 – 0900), and late afternoon (1700 – 1800 hrs) expected to be more sensitive to noise.

For construction activities that have the potential to generate special audible characteristics (which are not currently indicated) and/or vibratory impacts on dwellings (such as limited public road upgrade activities close to Receiver 3), it is recommended to conduct the works in continuous blocks of up to 3 hours with a minimum one-hour respite period in between each block. Continuous here refers to any respite periods of duration less than one-hour between ceasing and recommencing any work.

Per recommendations from the ICNG, in considering respite periods and scheduling of works, the proponent should account for:

- Times identified by the community when they are less sensitive to noise, such as mid-morning or mid-afternoon for works near dwellings.
- Whether the community is prepared to accept a longer period of construction in exchange for restrictions on construction times (this preference should be identified during consultation).

8.4 General measures

Complaints associated with construction noise can arise even if noise levels are below the noise management levels. To minimise complaints, the following common mitigation measures are recommended:

- Avoid unnecessary noise by managing the site to ensure:
  - No shouting.
  - No unnecessary use of horns.
  - No loud site radios.
  - No rough handling of material and equipment.
  - No banging or shaking excavator buckets.
  - No unnecessary steel on steel contact (e.g. during the loading/unloading of equipment on trucks).
  - No high engine revs. This includes choosing the right sized equipment and turning engines off when idle.
  - Vehicle deliveries are scheduled so that there are no trucks waiting in queue and ensuring that all delivery vehicles are switched off during loading and unloading activities.
  - Minimal usage of engine braking near dwellings.
- Avoid unnecessary vibration by managing the site to ensure:
  - No unnecessary dropping of heavy objects.
  - No potholes, bumps or corrugations in site accessways.
  - Equipment operators are skilled and use their machines considerately.
- Select low noise equipment at each stage of construction works to reduce impacts on dwellings where feasible.
- Mitigate track squeal from tracked equipment, such as excavators. This may include tensioning and watering or lubricating the tracks regularly.
- Locate stationary equipment (e.g. generators) away from noise sensitive receivers and/or screen them behind site buildings and material stores.

- Orient mobile machinery to maximise the distance between the engine exhaust and the nearest noise sensitive receiver (e.g. excavators).
- Utilise specific measures for the following activities:
  - Excavators (specifically with pneumatic breaker)
  - Impact piling rigs
  - Rock crushers
  - Dump trucks
  - Hand tools (pneumatic)
  - Scrapers
  - Concrete vibratory screeds
  - Compactors
  - Front end loaders

8.4.1 Other noise generating equipment

Following are some noise and vibration mitigation measures for other identified noise generating equipment from the list of equipment indicated for use by the Proponent during construction works:

- Replace large rock breakers/crushers with smaller ones or rock saws where feasible.
- Use quieter alternative equipment and/or methods where feasible such as hydraulic rock splitters, jaw crushers and chemical rock splitting.
- Maximise on-site storage capacity to reduce the need for truck movements during sensitive times.
- Organise the site so that construction vehicles (such as dump trucks, front-end loaders etc.) only drive forward to avoid the use of reversing alarms. Where reversing alarms are used, use less annoying alternatives such as broadband quacker alarms instead of beeper alarms, or smart alarms that adjust their emission level depending on the ambient level of noise.
- Use hydraulic or electrically controlled equipment instead of pneumatic equipment where feasible. Where pneumatic equipment is to be used, ensure the air lines on the equipment do not leak.

8.5 Community Engagement

It is valuable for the proponent to engage with the community and residential receivers to facilitate constructive dialogue about noise and any feasible management options where noise may be an issue. The following sections provide guidance with respect to community engagement, complaints handling and responsible and accountable representation.

8.5.1 Communication

Before construction

The proponent should consult with the occupants of the nearby dwellings prior to lodging an application where required.

Written communication (e.g. newsletter) should be provided to residents identified in this report prior to starting construction. The following should be addressed:

- All potentially impacted receivers should be informed, reasonably ahead of time, of the nature of works to be carried out, the expected noise levels from noisier activities and their duration, and the measures being taken to minimise noise from the construction.
- Effective channels of communication must be established between the contractor/developer, Local Authority and affected receivers.
- A site representative responsible for all matters relating to noise should be appointed and contact details of this representative be readily available. A site information board should be installed in front of the construction site with the name and contact details for the site representative.
- Acknowledge that some activities (listed in this report) are predicted to generate high noise and/or vibration levels and may result in disturbance for short/extended periods.

During construction

Once construction has begun, ongoing communication is important. Regular communication during the works would include:

- Public site signage that includes contact details.
- Details of upcoming activities that may result in disturbance.
- Any changes to scheduled timing and duration of activities.
- Dwellings identified in this report to be advised at least three days prior to any construction works commencing.

8.5.2 Complaint response

All construction noise and/or vibration complaints should be recorded in a complaints file that is available to affected parties and relevant authorities on request.

When a noise complaint or enquiry is received, either electronically or via telephone, acknowledgement should be provided as soon as possible. Where possible, a subsequent response should be provided the same day. Where the inquiry demands a more detailed response, an appropriate period may be within two working days or an alternative timeframe where this is communicated to the complainant.

All noise complaints should be recorded in a complaints file. For each complaint, an investigation is recommended to be undertaken involving the following steps as soon as practicable:

- Acknowledge receipt of the concern or complaint:
  - Time and date the complaint was received and who received it
  - Time and date of the activity subject to the complaint (estimated where not known)
  - The name, address, and contact details of the complainant (unless they elect not to provide)
  - The complainant's description of the activity and its resulting effects, including notes about the character of the noise (e.g., one-off bang, continuous hum, low or high frequency)
  - The complainant's description of the location or relative direction of the source.

- Identify the relevant activity and the nature of the works at the time of the complaint and then forward the complaint to the appropriate construction area.
- Review the noise, and the mitigation and management measures to ensure that good practices are being conducted. Review the relief sought by the complainant. Consider whether any attended noise monitoring is required. Adopt further mitigation and management measures if appropriate.
- Document the findings, implement changes and review whether the process has triggered improvements to a noise management plan
- If requested, report the outcomes of the investigation to the complainant, identifying where the relief sought by the complainant has been adopted or the reason(s) otherwise.
- Report the findings and recommendations to the project manager, implement changes and update this CNVMP as appropriate.

The proponent is advised to maintain a register of noise complaints along with any action taken to investigate and resolve the complaints.

8.6 Monitoring

Based on the outcomes of the construction noise assessment, adverse noise impacts are not considered to be a significant risk, however there may be brief periods during the construction stages when noise levels above the noise affected management levels may occur. This CNVMP sets out various best practices and noise mitigation options that can reduce adverse impact. Generally, the implementation of such controls is expected to be sufficient to manage impacts, and noise monitoring is not considered to be inherently necessary.

Notwithstanding the above, guidance and recommendations are provided below in relation to noise monitoring.

8.6.1 Attended monitoring

Where required (e.g. in the event of repeat noise complaints or reports of significant adverse impact), a suitably qualified acoustic engineer should visit the site and measures noise and/or vibration levels in real time. The following should be performed:

- Review of the implementation of this CNVMP, including the mitigation and management measures in this report.
- Verification of the predicted levels as representative, and the response protocols as appropriate for the resulting effects.
- Determination of ‘in practice’ noise levels in the context of the project noise management levels set out in Section 3.2.1.

Attended noise monitoring would be used to determine next steps or additional noise controls or best practices as set out in Section 8.5.

Where required, construction noise should be monitored:

- In response to a reasonable noise complaint. Noise monitoring is recommended on an as-required basis in response to receipt of any complaints. Typically, investigations and monitoring should occur following receipt of 2 or more complaints.
- At 1 m from any building facade facing the construction site, or a proxy position adjusted for distance.
- By a suitably qualified and experienced specialist (e.g. Member of the Australian Acoustical Society).
- For an appropriate duration, reported with the measured level (e.g. 65 dB $L_{Aeq\,(15min)}$).

8.6.2 Long-term monitoring

Long-term noise monitoring is not expected to be necessary for the project. The requirement (or otherwise) for long-term noise monitoring should be reviewed only in the event of extensive noise complaints or where construction works occur at distances much closer to receivers than set out in this report.

9.0 TRAFFIC NOISE ASSESSMENT

Noise criteria for the assessment of traffic associated with the construction and operation of the project are detailed in Section 3.2.3.

Traffic generation during the operation of the project is expected to be limited, with construction stage traffic likely to comprise the significant majority of associated traffic movements. Operational traffic on public roads is therefore not considered further in this report as it is likely to be very low and have negligible noise impacts.

Based on information provided by Fyfe and the engaged traffic consultant Impact Traffic Engineering Pty Ltd (Impact), noise associated with construction traffic have been assessed along Bavin Road and Byrnes Road.

In relation to the road definitions in the RNP, Byrnes Road is considered to be a freeway/arterial/sub-arterial road, while Bavin Road is a local road.

It is understood that the project will target the use of existing major roads and designated heavy vehicle routes, with existing traffic flows expected to be greater than any increase arising from project construction. Traffic noise along the broader transport route is therefore not considered further in this report - increases in traffic noise levels experienced by receivers near these major roads are likely to be negligible.

The base traffic flows and estimated construction traffic flows along the roads considered within this assessment have been sourced from the Traffic Impact Assessment as prepared by Impact.[23]

The existing traffic flows for Byrnes Road included in the Traffic Impact Assessment are shown in Table 14 and are based on publicly available vehicle movement data accessed through Wagga Wagga City Council. The data is provided in terms of total weekday average daily movements and weekday average heavy vehicles, with no hourly breakdown provided.

Table 14: Byrnes Road existing traffic volumes (sourced from the Traffic Impact Assessment)

Road	Weekday average daily movements	
	Total	Heavy vehicles (%)
Byrnes Road (north of Bavin Road)	3,175	1,140 (36%)
Byrnes Road (south of Bavin Road)	3,260	944 (29%)

No existing traffic flows for Bavin Road are included in the Traffic Impact Assessment, however observations regarding traffic conditions made by Impact align with a local road with negligible existing traffic flows. On this basis the existing flows have been conservatively assumed to be zero for the purposes of the noise assessment.

The future traffic volumes associated with the peak construction period of the project have been provided by Impact in terms of total two-way light and heavy vehicle movements per day. This is understood to correspond with an AM and PM peak during which workers are arriving at or departing from the project site. The predicted future traffic volumes have been reproduced in Table 15.

[23] Impact, *Wagga North Battery Energy Storage System – Traffic Impact Assessment* (Traffic Impact Assessment) dated 5 August 2025

Table 15: Peak construction period traffic flows (sourced from the Traffic Impact Assessment)

Road	Two-way vehicle movements	
	Total	Heavy vehicle (%)
All	160	40 (25%)

Per the above, additional traffic on public roads associated with the peak construction period is low in absolute terms, particularly in the context of the high existing volumes on Byrnes Road. The construction traffic represents an increase of approximately 5% or less of the existing daily traffic flows, even under conservative assumptions.

Although hourly or diurnal distribution data for existing traffic flows along Byrnes Road is not available, it is not expected that any reasonable assumption regarding day/night distribution would materially influence the assessment outcome, given that:

- Existing traffic volumes on Byrnes Road are already relatively high and the resulting traffic noise would be a dominant component of the nearby noise environment.
- The construction traffic volumes are low relative to the existing conditions.

On this basis, numerical assessment of project construction traffic noise levels along Byrnes Road has not been undertaken, as any change in traffic noise levels attributable to the project would be negligible and unlikely to be perceptible. Noise impacts associated with construction traffic have therefore only been assessed quantitatively on Bavin Road, being a local road with limited to no existing traffic flows. This approach is considered appropriate and conservative for the purposes of assessing potential noise impacts associated with project construction traffic.

9.1 Construction traffic predictions

Information in the Traffic Impact Assessment regarding existing Bavin Road traffic flows and the peak construction period traffic flows indicates that both the existing traffic volumes and those associated with the construction of the project are generally low in absolute levels, particularly when considering traffic flows on local roads. The CoRTN prediction method, preferred by Transport for NSW (TfNSW) and the EPA, is not typically applied where traffic flows are less than 50 vehicles per hour.[24] A correction factor for low traffic volumes, applicable when considering traffic flows lower than 200 vehicles per hour, has been applied in accordance with CoRTN.

From the traffic data in Table 15, traffic noise levels have been predicted in the vicinity of the assessed roads using the following method and assumptions:

- Traffic speed set to 100 km/h (this is likely conservative and traffic speeds will be lower)
- Roads assessed as a local road as defined in the RNP.
- Predicted noise levels include an additional +2.5 dB correction for facade reflection as required by the RNP.
- $L_{Aeq,\,1h}$ levels are calculated as CoRTN $L_{A10(1hr)}$ - 3 dB, per RMS practice (noting that this research was conducted by the RMS which has now been absorbed into TfNSW).[25]
- Grass or cultivated fields assumed between the road and receivers.

Modifying corrections for Australian conditions or for road surface conditions have not been applied as applicable data for the road surfaces in question is not available.

---

[24] UK Department of Transport, The Calculation of Road Traffic Noise (CoRTN)

[25] NSW Roads and Maritime Services (RMS) now absorbed into NSW Transport for NSW (TfNSW)

Table 16 shows a summary of the minimum setback distances from the assessed roads, beyond which compliance with the RNP criteria is predicted to be achieved during the day and night periods.

Table 16: Minimum setback distance for RNP compliance per traffic flows associated with the project only

	Minimum setback distance, m		Identified receivers within setback zone	
Road	**Day**	**Night**	**Day**	**Night**
Bavin Road	50	110	1	2

As shown in Table 16, there is one receiver located within the predicted day setback zones, and 2 receivers located within the predicted night setback zones. These receivers are shown geographically in Figure 2.

Notwithstanding the prediction results, the increase in traffic noise from the already low existing volumes may result in a noticeable increase in noise during some periods of construction. Noise mitigation options are generally limited for local roads, with community consultation and regular communication being the most effective and practical means of minimising adverse impacts.

It is recommended that residents residing nearby to Bavin Road be included in consultation prior to, and during, construction. This includes a receiver located on the corner of Bavin Road and Byrnes Road that has not previously been identified as part of the receiver dataset – identified as 168 Byrnes Road. The location of this receiver is shown in Figure 2

Alternative practical methods for minimising noise impact may include limiting construction traffic speed for the affected road sections. Reducing construction traffic speeds would reduce the minimum setback distances and the potential for noise impact to these receivers.

9.2 Sleep disturbance due to construction traffic

The majority of construction traffic movements will occur during the day period, as construction works associated with the project are only expected to occur during standard working hours.

Out of hours work is not specifically scheduled in the current conceptual construction works information provided by Fyfe. However, a maximum of 2 oversize/over mass vehicles (OSOM) movements over the project construction period are included in traffic flow data within the Traffic Impact Assessment.

The RNP sleep disturbance criteria established in Section 3.2.3 provides context to external noise levels that may give rise to awakening impacts. Based on this an external noise level screening threshold of 65 dB L_{Amax} has been adopted to assess the potential for sleep disturbance due to construction traffic during the periods of OSOM delivery. Typical OSOM vehicle noise data, taken from MDA's library, indicates that a maximum external noise level of 65 dB L_{Amax} or higher, is feasible within 40 m of an OSOM vehicle movement.

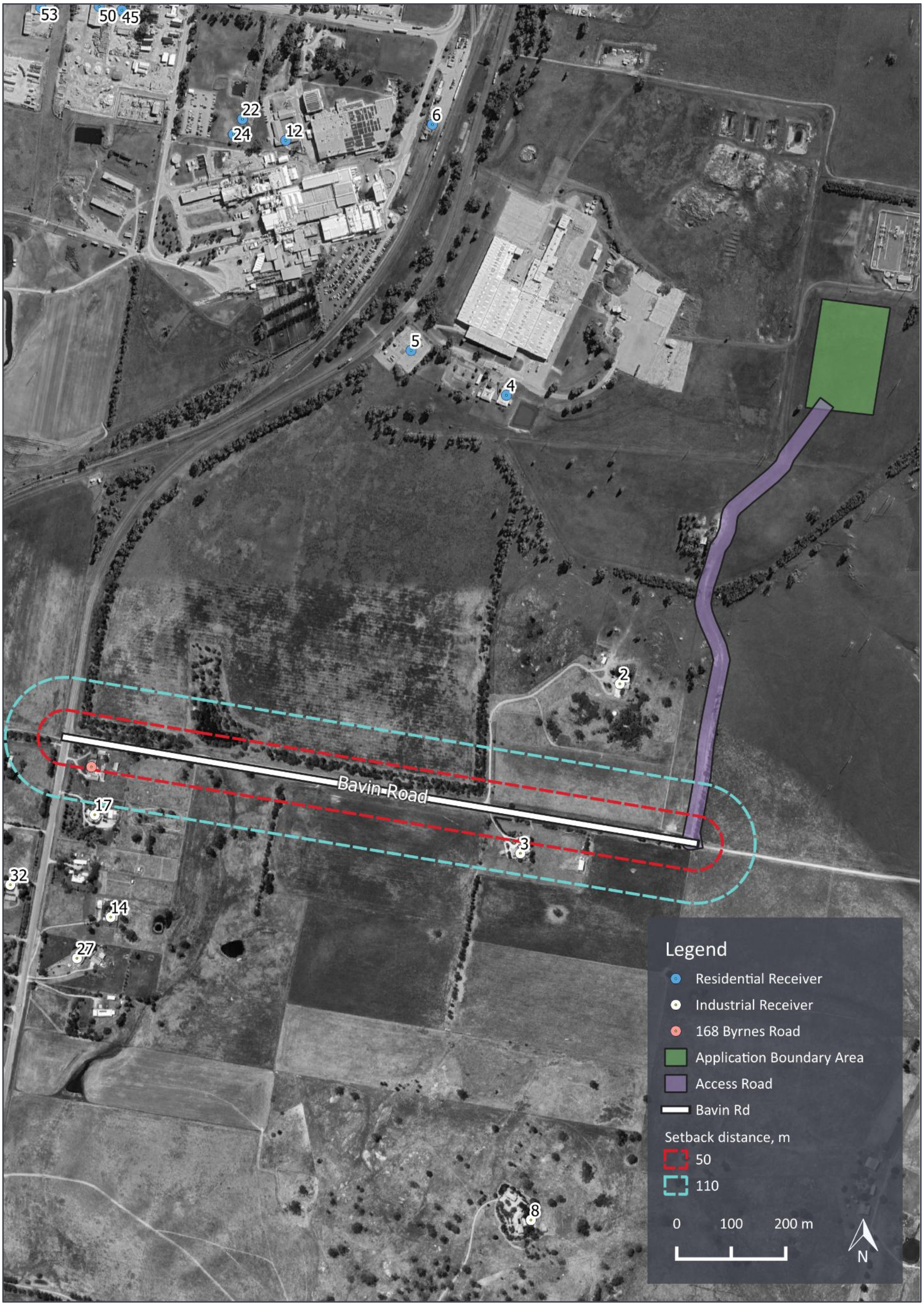
Based on the receiver dataset provided by Fyfe, Receiver 3 and 168 Byrnes Road are the only receivers located nearby to the 40 m buffer.

It is recommended that these receivers be included in community consultation and communications regarding the scheduling of OSOM deliveries, given the potential for noise impacts associated with both OSOM vehicle movements and general construction traffic associated with the project.

Where OSOM deliveries must be carried out during night periods, reasonable and feasible noise mitigations should be considered. Potential mitigation could include:

- Reducing the maximum number of movements to once each night.
- Scheduling for times when adverse impact is less likely, e.g. the very start of the night period and the very end of the night period, to reduce the potential for sleep disturbance.

Figure 2: Receivers within minimum setback distances adjacent to assessed roads



APPENDIX A GLOSSARY OF TERMINOLOGY

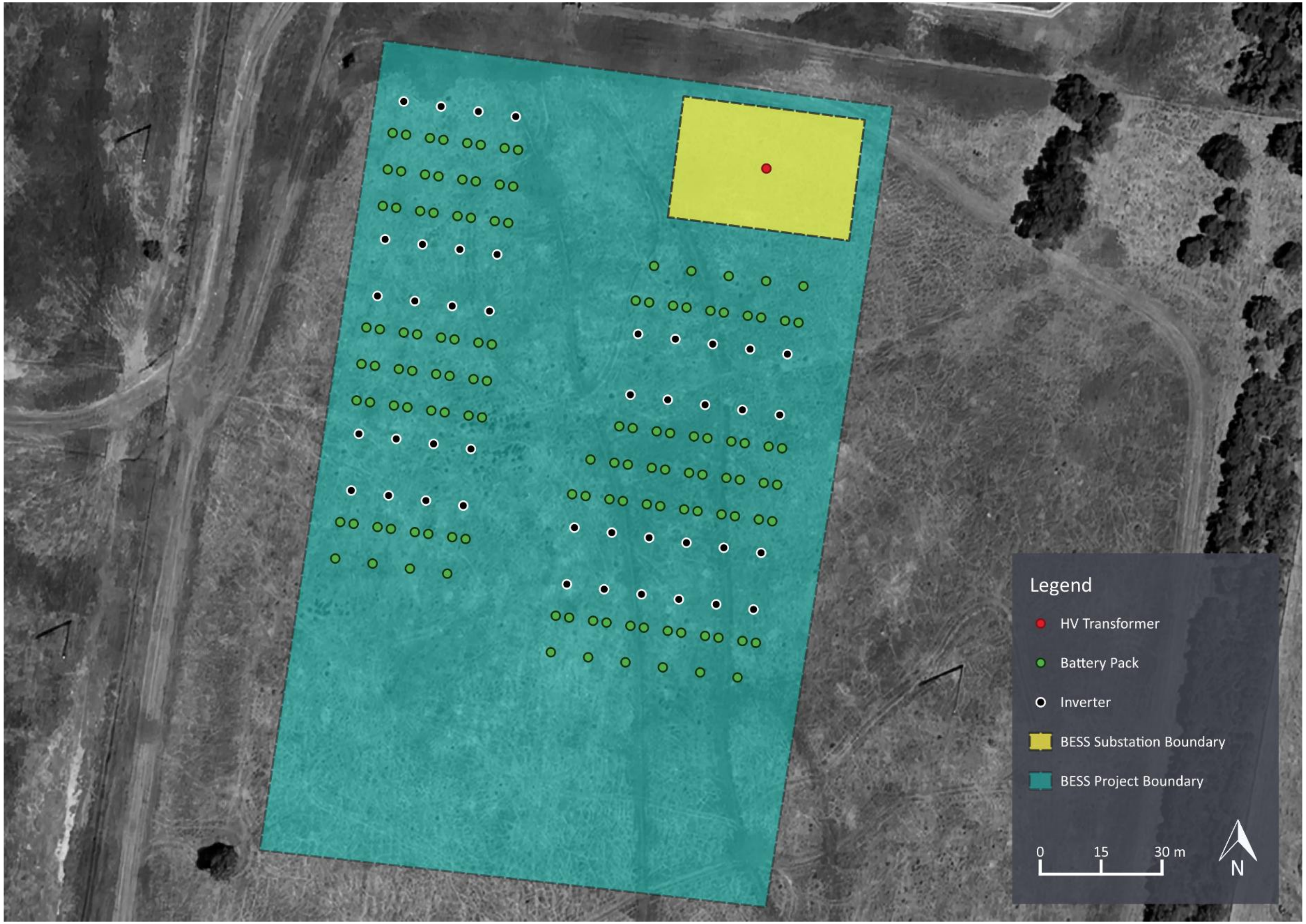
Term	Definition
A-weighting	A set of frequency-dependent sound level adjustments that are used to better represent how humans hear sounds. Humans are less sensitive to low and very high frequency sounds. Sound levels using an "A" frequency weighting are expressed as dB L_A. Alternative ways of expressing A-weighted decibels are dBA or dB(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_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 1995-1:2016 *Acoustics - Description measurement and assessment of environmental noise – Basic quantities and assessment procedures* (ISO 1995-1:2016)

APPENDIX B PROJECT LAYOUT



APPENDIX C RECEIVER COORDINATES

Table 17 sets out the 74 receivers identified by the proponent within 3 km of the project, together with the respective distance to project.

Data has been supplied by the proponent via email dated 19 March 2024.

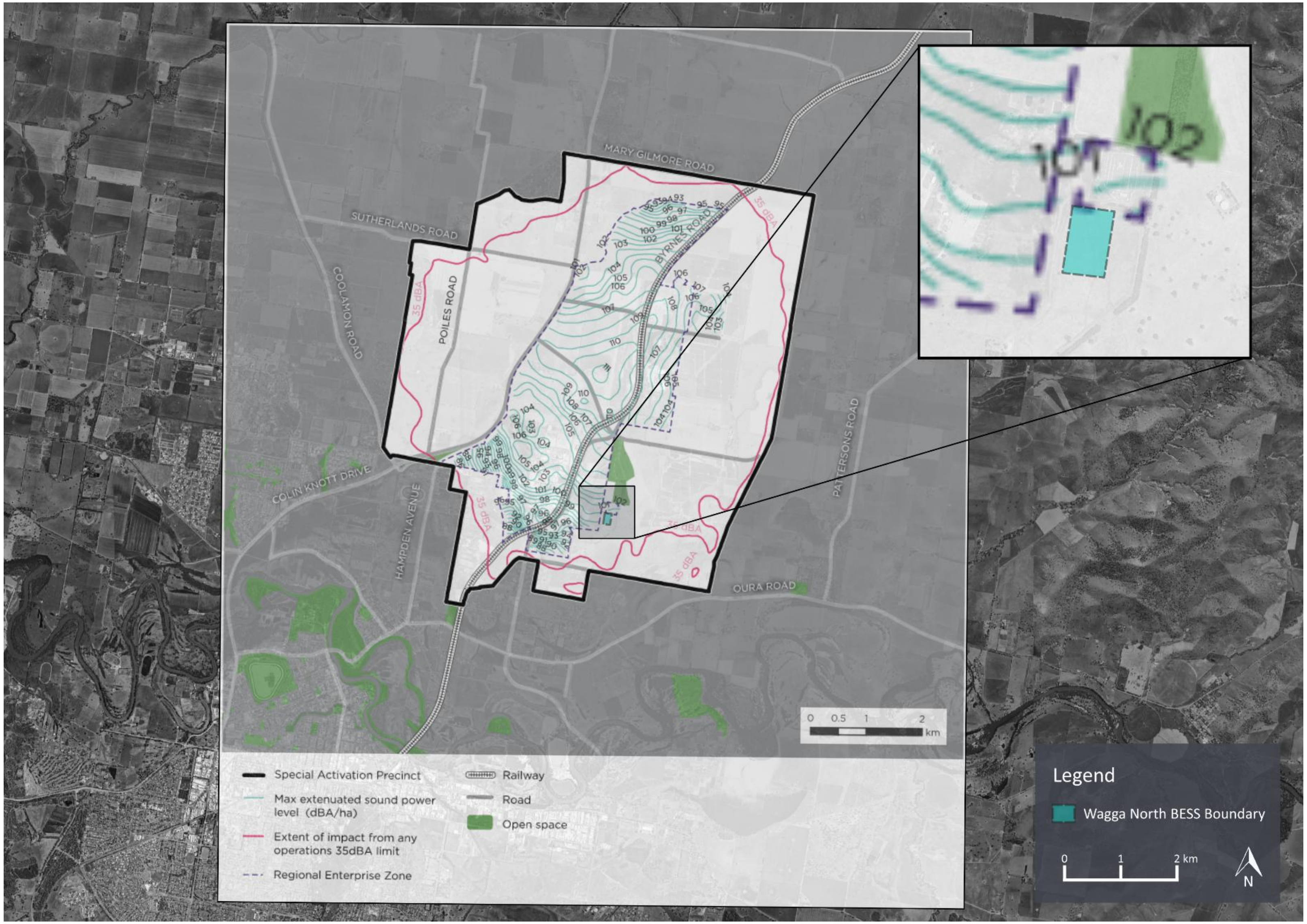
Table 17: Receivers within 3 km of the Project - GDA2020 MGA Zone 55

Receiver ID	Easting, m	Northing, m	Approximate distance to Project, m
Residential			
2	538,018	6,117,591	600
3	537,836	6,117,281	950
8	537,855	6,116,609	1,550
9	538,982	6,117,260	950
14	537,085	6,117,164	1,600
17	537,056	6,117,351	1,500
27	537,023	6,117,089	1,650
29	537,637	6,116,279	1,950
32	536,901	6,117,223	1,700
36	536,863	6,117,107	1,800
38	536,831	6,117,422	1,650
39	539,108	6,116,445	1,750
41	537,806	6,116,058	2,100
43	537,425	6,116,196	2,100
46	536,817	6,116,941	1,950
47	536,790	6,117,013	1,900
52	536,699	6,116,891	2,050
54	536,659	6,116,817	2,150
58	536,581	6,116,662	2,300
59	540,270	6,118,133	1,750
60	540,020	6,117,178	1,800
61	536,464	6,116,772	2,300
62	536,705	6,118,875	1,800
63	540,363	6,118,611	1,900
64	537,099	6,115,876	2,550
65	536,476	6,116,633	2,400
66	537,629	6,120,111	1,950

Receiver ID	Easting, m	Northing, m	Approximate distance to Project, m
67	536,611	6,118,912	1,900
68	537,688	6,115,577	2,600
69	538,867	6,115,642	2,450
70	536,301	6,116,891	2,400
72	539,948	6,116,673	2,050
73	537,473	6,115,502	2,750
74	539,073	6,115,606	2,550
Commercial			
71	539,108	6,120,272	2,100
Industrial			
1	538,551	6,118,389	100
4	537,810	6,118,120	550
5	537,636	6,118,202	750
6	537,675	6,118,616	800
7	537,805	6,118,963	900
10	537,633	6,118,930	1,000
11	537,844	6,119,289	1,150
12	537,406	6,118,587	1,050
13	537,576	6,119,118	1,150
15	537,492	6,119,005	1,150
16	537,720	6,119,295	1,200
18	537,458	6,118,991	1,150
19	537,460	6,119,004	1,150
20	537,745	6,119,342	1,250
21	537,587	6,119,198	1,200
22	537,326	6,118,626	1,100
23	537,586	6,119,214	1,200
24	537,310	6,118,598	1,100
25	537,426	6,118,990	1,200
26	537,664	6,119,307	1,250
28	537,329	6,118,885	1,200
30	537,580	6,119,321	1,300
31	537,267	6,118,897	1,250

Receiver ID	Easting, m	Northing, m	Approximate distance to Project, m
33	537,229	6,118,904	1,300
34	537,291	6,119,062	1,350
35	537,499	6,119,372	1,400
37	537,520	6,119,400	1,400
40	537,222	6,119,070	1,400
42	537,330	6,119,270	1,450
44	537,135	6,118,916	1,400
45	537,105	6,118,826	1,400
48	537,366	6,119,384	1,500
49	537,101	6,118,935	1,450
50	537,064	6,118,833	1,450
51	537,037	6,118,838	1,450
53	536,957	6,118,831	1,550
55	536,926	6,116,330	2,250
56	537,364	6,119,678	1,700
57	536,840	6,118,837	1,650

APPENDIX D CONTEXTUALISATION OF THE PROJECT WITH RESPECT TO THE SAP



APPENDIX E NOISE POLICY FOR INDUSTRY ASSESSMENT

In NSW, the Environmental Protection Authority's NPfI is the guideline for assessing noise emissions from industrial facilities and other developments with noise sources that may be considered industrial in nature. The NPfI sets out a procedure where an industrial facility can be assessed against a series of noise levels. Project specific noise levels are derived from an analysis of background noise levels, ambient noise environment and zoning information.

An NPfI assessment requires the derivation of two project noise trigger levels - one from an intrusiveness assessment and another from an amenity assessment.

E1 Project intrusiveness noise level

The intrusiveness noise assessment is applicable to residential receivers and is based on knowledge of the RBL at the receiver location. Per Section 5.2, The minimum assumed RBLs have been adopted. The project intrusiveness noise level is taken to be the RBL plus 5 dB. Therefore, the noise emissions from the noise source are considered to be intrusive if the A-weighted source noise level ($L_{Aeq,\ 15min}$) is greater than the RBL (L_{A90}) plus 5 dB. Assessment time periods are set out in Table 7 of Section 5.2.

The minimum project intrusiveness noise levels set out in Table 2.1 of the NPfI are reproduced in Table 18.

Table 18: Minimum assumed RBLs and minimum project intrusiveness noise levels, dB $L_{Aeq,\ 15\ min}$

Time of day	Minimum assumed RBL	Minimum project intrusiveness noise level
Day	35	40
Evening	30	35
Night	30	35

E2 Project amenity noise levels

Project amenity noise levels are designed to prevent industrial noise continually increasing above an acceptable level over time with the expansion of infrastructure and development.

Receivers close to the project are a mix of residential, commercial and industrial. Table 2.2 of the NPfI sets out recommended amenity noise levels for each receiver category. Residential receivers are further subcategorised based on noise amenity. Guidance provided in Table 2.3 of the NPfI indicates that residential receivers near to the site are '*Rural Residential'*, being residential receivers in a rural noise amenity area.

Section 2.4 of the NPfI requires modification of the recommended amenity noise level (by subtracting 5 dB) to account for the potential additional industrial noise from existing or future developments.

A further modification is made to standardise the amenity assessment time period to align with the intrusiveness assessment. This adjustment assumes that the $L_{Aeq,\ 15\ min}$ will be taken to be equal to the $L_{Aeq,\ period}$ + 3 dB. The resultant project amenity noise levels are shown in Table 19.

Table 19: Project amenity noise level, dB

Receiver	Time of day	Recommended amenity noise level, dB $L_{Aeq,\ period}$	Project amenity noise level, dB $L_{Aeq,\ 15min}$
Rural Residential	Day	50	48
	Evening	45	43
	Night	40	38
Commercial premises	When in use	65	63
Industrial premises	When in use	70	68

E3 Project noise trigger levels

The final process in determining the operational noise limits for the Project is to derive the project noise trigger levels. The project noise trigger levels are levels that, if exceeded, would indicate a potential noise impact on the community, and so '*trigger*' a management response; for example, further investigation of noise mitigation measures.

The project noise trigger levels are derived by selecting the more stringent of either the project intrusiveness noise level or project amenity noise level. The project noise trigger levels applicable to receivers relevant for assessment of the Project are shown in Table 20.

Table 20: Project noise trigger levels, dB $L_{Aeq,\ 15min}$

Receiver	Time of day	Project noise trigger level
Rural Residential	Day	40
	Evening	35
	Night	35
Commercial premises	When in use	63
Industrial premises	When in use	68

E4 Sleep disturbance

The NPfI states that a detailed maximum noise level assessment should be undertaken where the subject development night-time noise levels at a residential location exceed:

- 40 dB $L_{Aeq,\ 15min}$ or the prevailing RBL plus 5 dB, whichever is the greater, and/or
- 52 dB L_{AFmax} or the prevailing RBL plus 15 dB, whichever is the greater.

The NPfI does not currently provide details on how to assess sleep disturbance but refers to the RNP which has compared a number of sleep disturbance criteria and concluded the following:

- Maximum internal noise levels below 50 - 55dB L_{Amax} are unlikely to cause awakening reactions
- One or two noise events per night, with maximum internal noise levels of 65 – 70 dB L_{Amax} are not likely to affect health and wellbeing significantly.

Based on these findings, noise levels below 60 – 65 dB L_{Amax} outside an open bedroom window would be unlikely to cause awakening reactions - assuming that the facade of the residential building provides 10 dB attenuation, which would be typical of a facade with partially open windows.

Furthermore, one or two events with a noise level of 75 – 80 dB L_{Amax} outside an open bedroom window would be unlikely to affect health and well-being significantly.

APPENDIX F NOISE PREDICTION MODEL

F1 Noise prediction method

A computer model was created in the environmental noise modelling program SoundPLANnoise v9.0 to predict noise levels from the project to relevant noise-affected receivers in the vicinity of the project. The noise model has been used to calculate noise levels at the nearest noise-affected premises in general accordance with ISO 9613-2:2024, which 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 receiver within an angle of +/-45 degrees from a line connecting the source to the receiver, at wind speeds between approximately 1 m/s and 5 m/s, measured at a height of 3 m to 11 m above the ground. Equivalently, the method accounts for average propagation under a well-developed moderate ground based thermal inversion. This aligns with Pasquil-Gifford stability class F.

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

In lieu of a detailed evaluation of meteorological conditions for the area, noise enhancing meteorological conditions have been assumed for all assessment periods. This aligns with the conservative option set out in Fact Sheet D of the NPfI.

To calculate far-field noise levels according to the ISO 9613-2:2024, the noise levels of each source are firstly characterised in the form of octave band frequency levels. A series of octave band attenuation factors are then calculated for a range of effects including:

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

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

Geometry data for the model has been sourced from public aerial photography and client provided data. 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.

The following inputs have been referenced in the noise model to predict noise levels from onsite activities.

- Receiver locations positioned according to client provided data and at 1.5 m AGL.
- Topographical data sourced from ELVIS.
- Noise emission data for each noise source at the site as detailed in Section 6.2.

9.3 Noise model configuration

The parameters detailed in Table 21 were utilised to develop the noise model.

Table 21: Noise model configuration

Feature	Description
Terrain data	Digital elevation model with a cell size of 1 m taken from the public national portal, ELVIS
Environmental ground conditions	Ground conditions on the project site were assigned a ground factor (G) of G = 0.1 representing hard ground. The surrounding area has been assigned a ground factor of G = 0.5 to reflect mixed hard/soft ground.
Atmospheric conditions	Temperature 10°C and relative humidity 70%. These represent conditions which result in relatively low levels of atmospheric sound absorption, resulting in slightly higher predicted noise levels.
Site layout	Spatial data provided to MDA by the proponent
Receiver heights	1.5 m above ground.
Noise calculation method	Noise model calculated according to ISO 9613-2.
Noise data for all equipment	As detailed in Section 6.2 Noise data has been derived based on: • candidate manufacturer data provided by the Proponent • empirical standards • noise data from MDA's library.
Operating duration	All equipment has been conservatively modelled considering worst-case operational duty during all time periods.

APPENDIX G PREDICTED OPERATIONAL NOISE LEVELS

Table 22: Predicted operational noise levels at all receivers, dB $L_{Aeq,\ 15\ min}$

Receiver	Predicted noise level [a]			Project noise trigger level [b]			Compliance?
	Day	Evening	Night	Day	Evening	Night	
Residential							
2	33	33	33	40	35	35	✓/✓/✓
3	29	29	29	40	35	35	✓/✓/✓
8	29	29	29	40	35	35	✓/✓/✓
9	18	18	18	40	35	35	✓/✓/✓
14	24	24	24	40	35	35	✓/✓/✓
17	31	31	31	40	35	35	✓/✓/✓
27	24	24	24	40	35	35	✓/✓/✓
29	22	22	22	40	35	35	✓/✓/✓
32	24	24	24	40	35	35	✓/✓/✓
36	23	23	23	40	35	35	✓/✓/✓
38	30	30	30	40	35	35	✓/✓/✓
39	23	23	23	40	35	35	✓/✓/✓
41	21	21	21	40	35	35	✓/✓/✓
43	21	21	21	40	35	35	✓/✓/✓
46	22	22	22	40	35	35	✓/✓/✓
47	22	22	22	40	35	35	✓/✓/✓
52	22	22	22	40	35	35	✓/✓/✓
54	21	21	21	40	35	35	✓/✓/✓
58	20	20	20	40	35	35	✓/✓/✓
59	23	23	23	40	35	35	✓/✓/✓
60	23	23	23	40	35	35	✓/✓/✓
61	21	21	21	40	35	35	✓/✓/✓
62	30	30	30	40	35	35	✓/✓/✓
63	15	15	15	40	35	35	✓/✓/✓
64	-	-	-	40	35	35	✓/✓/✓
65	20	20	20	40	35	35	✓/✓/✓
66	27	27	27	40	35	35	✓/✓/✓
67	29	29	29	40	35	35	✓/✓/✓
68	-	-	-	40	35	35	✓/✓/✓

Receiver	Predicted noise level [a]			Project noise trigger level [b]			Compliance?
	Day	Evening	Night	Day	Evening	Night	
69	-	-	-	40	35	35	✓/✓/✓
70	26	26	26	40	35	35	✓/✓/✓
72	22	22	22	40	35	35	✓/✓/✓
73	-	-	-	40	35	35	✓/✓/✓
74	-	-	-	40	35	35	✓/✓/✓
Commercial							
71	22	22	22	63	63	63	✓/✓/✓
Industrial							
1	50	50	50	68	68	68	✓/✓/✓
4	41	41	41	68	68	68	✓/✓/✓
5	35	35	35	68	68	68	✓/✓/✓
6	38	38	38	68	68	68	✓/✓/✓
7	31	31	31	68	68	68	✓/✓/✓
10	32	32	32	68	68	68	✓/✓/✓
11	30	30	30	68	68	68	✓/✓/✓
12	36	36	36	68	68	68	✓/✓/✓
13	28	28	28	68	68	68	✓/✓/✓
15	32	32	32	68	68	68	✓/✓/✓
16	28	28	28	68	68	68	✓/✓/✓
18	31	31	31	68	68	68	✓/✓/✓
19	32	32	32	68	68	68	✓/✓/✓
20	29	29	29	68	68	68	✓/✓/✓
21	28	28	28	68	68	68	✓/✓/✓
22	35	35	35	68	68	68	✓/✓/✓
23	27	27	27	68	68	68	✓/✓/✓
24	35	35	35	68	68	68	✓/✓/✓
25	33	33	33	68	68	68	✓/✓/✓
26	27	27	27	68	68	68	✓/✓/✓
28	34	34	34	68	68	68	✓/✓/✓
30	27	27	27	68	68	68	✓/✓/✓
31	33	33	33	68	68	68	✓/✓/✓
33	33	33	33	68	68	68	✓/✓/✓

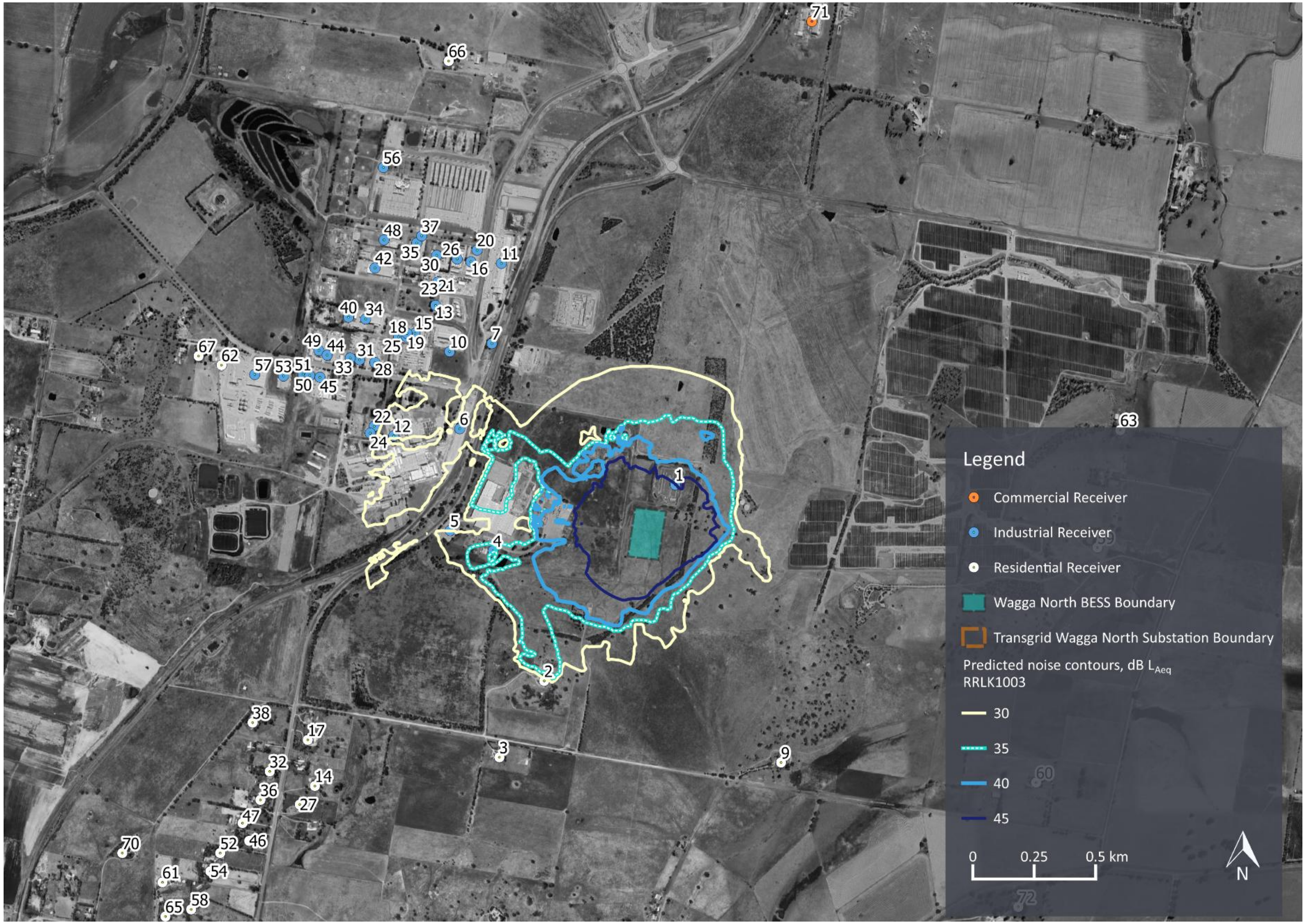
Receiver	Predicted noise level [a]			Project noise trigger level [b]			Compliance?
	Day	Evening	Night	Day	Evening	Night	
34	33	33	33	68	68	68	✓/✓/✓
35	26	26	26	68	68	68	✓/✓/✓
37	26	26	26	68	68	68	✓/✓/✓
40	32	32	32	68	68	68	✓/✓/✓
42	29	29	29	68	68	68	✓/✓/✓
44	32	32	32	68	68	68	✓/✓/✓
45	32	32	32	68	68	68	✓/✓/✓
48	28	28	28	68	68	68	✓/✓/✓
49	32	32	32	68	68	68	✓/✓/✓
50	32	32	32	68	68	68	✓/✓/✓
51	32	32	32	68	68	68	✓/✓/✓
53	31	31	31	68	68	68	✓/✓/✓
55	21	21	21	68	68	68	✓/✓/✓
56	24	24	24	68	68	68	✓/✓/✓
57	31	31	31	68	68	68	✓/✓/✓

a Includes a + 5 dB modifying factor correction for tonality per Section 0

b Commercial and Industrial project noise trigger levels apply only when the subject premises is in use

c Receivers 64, 68, 69, 73 and 74 are more than 2.5 km from project infrastructure and outside of the noise modelling calculation area. Based on the predicted levels at the other nearby receivers (41 and 43) noise levels will be comfortably below the applicable project noise trigger levels.

APPENDIX H PREDICTED NOISE LEVEL CONTOURS



APPENDIX I CONSTRUCTION WORK AREA LAYOUT

APPENDIX J CONSTRUCTION EQUIPMENT, WORK STAGES AND ACOUSTIC DATA

Sound power levels for the types of equipment used to construct the project have been determined from guidance and data sources including AS 2436-2010, and noise level data from previous projects of a similar nature.

Table 23 summarises the noise emissions used to represent key items of plant associated with construction.

Table 23: Construction noise sources sound power level data, dB L_{WA}

Noise source	Sound power level
Backhoe	104
Bulldozer	108
Compactor	113
Concrete truck	108
Crane (200 t)	105
Crane (500 t)	110
Crane (mobile)	104
Delivery truck	107
Dump truck	117
Excavator	107
Excavator (100 to 200 kW)	107
Front end loader	113
Generator	99
Gritblaster (grit & nozzle air noise)	129
Hand tools (electric)	102
Rock crusher	120
Roller (vibratory)	108
Scraper	116
Spreader	95
Truck (water cart)	107
Vehicle (light commercial e.g. 4WD)	106

Overall aggregated total sound power levels for key construction tasks have been determined on the basis of a typical schedule of equipment associated with each task. The actual equipment choices and equipment numbers for each task are not presently defined in detail, and therefore the schedule of equipment listed here does not represent a final or definitive list of plant.

The number of plant and equipment items required per stage, as well as the 'on' time in a representative 15 min period are set out in Table 24. These have been developed based on the assumption that each item of plant associated with a task operates simultaneously for the entire duration of an assessment period.

In determining aggregate sound power levels per stage it is not expected that all equipment will be operating simultaneously. A conservative assumption that the 5 noisiest equipment items could be operating simultaneously has been adopted.

Table 24: Construction stages, equipment counts, and 'on' duration

Plant/Equipment	Number	'On' time, %
Public road upgrades		
Bulldozer	2	40
Compactor	2	40
Dump truck	4	20
Front end loader	2	40
Generator	2	100
Roller (vibratory)	1	30
Scraper	1	30
Spreader	1	30
Truck (water cart)	1	40
Vehicle (light commercial e.g. 4WD)	7	20
Access road construction		
Bulldozer	2	40
Compactor	2	40
Dump truck	4	20
Front end loader	2	40
Generator	2	100
Roller (vibratory)	1	30
Scraper	1	30
Spreader	1	30
Truck (water cart)	1	40
Vehicle (light commercial e.g. 4WD)	7	20
BESS installation		
Concrete truck	1	40
Crane (500 t)	2	50
Delivery truck	4	20
Dump truck	2	30
Excavator	1	40
Front end loader	1	40
Generator	2	100

Plant/Equipment	Number	'On' time, %
Gritblaster (grit & nozzle air noise)	2	20
Hand tools (electric)	10	10
Rock crusher	1	40
Vehicle (light commercial e.g. 4WD)	7	20
Cable trench digging		
Backhoe	1	40
Crane (mobile)	1	50
Dump truck	2	30
Excavator (100 to 200 kW)	1	40
Generator	1	100
Rock crusher	1	40
Vehicle (light commercial e.g. 4WD)	7	20
Gravel laydown		
Dump truck	8	40
Generator	1	100
Spreader	1	40
Site compound construction		
Bulldozer	1	40
Compactor	2	20
Concrete truck	1	30
Crane (200 t)	1	50
Excavator (100 to 200 kW)	1	20
Front end loader,	1	30
Generator	2	100
Gritblaster (grit & nozzle air noise)	2	20
Rock crusher	1	30
Truck (water cart),	1	40
Vehicle (light commercial e.g. 4WD)	7	20
Site rehabilitation		
Bulldozer	2	40
Generator	2	100
Substation & O&M facility construction		
Concrete truck	1	40

Plant/Equipment	Number	'On' time, %
Crane (500 t)	2	50
Delivery truck	4	20
Dump truck	2	30
Excavator	1	40
Front end loader	1	40
Generator	2	100
Gritblaster (grit & nozzle air noise)	2	20
Hand tools (electric)	10	10
Rock crusher	1	40
Vehicle (light commercial e.g. 4WD)	7	20
Vegetation clearing		
Bulldozer	2	40
Generator	2	100

APPENDIX K PREDICTED CONSTRUCTION NOISE LEVELS

Table 25: Construction noise predictions at residential receivers, dB $L_{Aeq\ 15\ min}$

Receiver	Noise affected	Highly noise affected	Public road upgrades	Access road construction	BESS installation	Cable trench digging	Gravel laydown	Site compound construction	Site rehabilitation	Substation and O&M facility construction	Substation construction
2	45	75	**57**	**62**	**56**	**50**	**46**	**55**	38	**56**	38
3	45	75	**70**	**55**	**51**	**46**	41	**51**	33	**51**	33
8	45	75	**47**	**47**	**47**	41	36	**46**	28	**47**	28
9	45	75	45	**46**	**51**	**46**	41	**51**	33	**51**	33
14	45	75	**54**	43	**47**	41	36	**46**	28	**47**	28
17	45	75	**59**	43	**47**	41	37	**47**	29	**47**	29
27	45	75	**52**	42	**46**	40	36	**46**	28	**46**	28
29	45	75	43	42	45	39	34	44	26	45	26
32	45	75	**52**	42	**46**	40	36	45	28	**46**	28
36	45	75	**50**	41	45	40	35	45	27	45	27
38	45	75	**52**	41	**46**	40	36	**46**	28	**46**	28
39	45	75	41	41	**46**	40	35	45	27	**46**	27
41	45	75	41	41	44	38	33	43	25	44	25
43	45	75	42	41	44	38	33	43	25	44	25

Receiver	Noise affected	Highly noise affected	Public road upgrades	Access road construction	BESS installation	Cable trench digging	Gravel laydown	Site compound construction	Site rehabilitation	Substation and O&M facility construction	Substation construction
46	45	75	**48**	41	45	39	34	44	26	45	26
47	45	75	**48**	40	45	39	34	44	26	45	26
52	45	75	**46**	40	44	38	34	44	26	44	26
54	45	75	45	39	44	38	33	43	25	44	25
58	45	75	43	39	43	37	33	42	25	43	25
59	45	75	36	38	**46**	40	35	45	27	**46**	27
60	45	75	37	38	45	40	35	45	27	45	27
61	45	75	43	38	43	37	33	42	25	43	25
62	45	75	40	38	45	40	35	45	27	45	27
63	45	75	34	37	45	39	35	44	27	45	27
64	45	75	39	38	42	36	32	41	24	42	24
65	45	75	42	38	43	37	32	42	24	43	24
66	45	75	34	36	44	39	34	44	26	44	26
67	45	75	39	37	45	39	35	44	27	45	27
68	45	75	38	38	42	36	31	41	23	42	23
69	45	75	38	38	42	36	32	42	24	42	24
70	45	75	43	37	43	37	32	42	24	43	24

Receiver	Noise affected	Highly noise affected	Public road upgrades	Access road construction	BESS installation	Cable trench digging	Gravel laydown	Site compound construction	Site rehabilitation	Substation and O&M facility construction	Substation construction
72	45	75	37	37	44	38	34	44	26	44	26
73	45	75	37	37	41	35	31	41	23	41	23
74	45	75	37	37	42	36	32	41	24	42	24

Note: Predicted noise levels highlighted in bold are greater the residential noise affected management level

Table 26: Construction noise predictions at commercial and industrial receivers, dB $L_{Aeq\ 15\ min}$

Receiver	Noise affected	Public road upgrades	Access road construction	BESS installation	Cable trench digging	Gravel laydown	Site compound construction	Site rehabilitation	Substation and O&M facility construction	Substation construction
Commercial										
71	70	32	36	44	38	34	43	26	44	26
Industrial										
1	75	42	55	72	66	62	72	54	72	54
4	75	46	51	57	51	47	56	39	57	39
5	75	46	48	54	48	44	54	36	54	36
6	75	42	45	53	48	43	53	35	53	35
7	75	39	43	52	46	42	52	34	52	34
10	75	40	43	51	45	41	51	33	51	33
11	75	37	41	50	44	40	49	31	50	31
12	75	42	43	51	45	40	50	32	51	32
13	75	38	41	50	44	39	49	31	50	31
15	75	39	41	50	44	39	49	31	50	31
16	75	37	41	49	43	39	49	31	49	31
18	75	39	41	50	44	39	49	31	50	31
19	75	39	41	50	44	39	49	31	50	31

Receiver	Noise affected	Public road upgrades	Access road construction	BESS installation	Cable trench digging	Gravel laydown	Site compound construction	Site rehabilitation	Substation and O&M facility construction	Substation construction
20	75	37	40	49	43	39	49	31	49	31
21	75	38	41	49	43	39	49	31	49	31
22	75	42	42	50	44	40	49	32	50	32
23	75	38	41	49	43	39	49	31	49	31
24	75	42	42	50	44	40	49	32	50	32
25	75	39	41	49	44	39	49	31	49	31
26	75	37	40	49	43	39	48	31	49	31
28	75	40	41	49	43	39	49	31	49	31
30	75	37	40	48	43	38	48	30	48	30
31	75	40	41	49	43	38	48	30	49	30
33	75	40	40	48	43	38	48	30	48	30
34	75	39	40	48	42	38	48	30	48	30
35	75	37	39	48	42	37	47	29	48	29
37	75	37	39	48	42	37	47	29	48	29
40	75	39	40	48	42	37	47	29	48	29
42	75	38	39	48	42	37	47	29	48	29
44	75	40	40	48	42	37	47	29	48	29

Receiver	Noise affected	Public road upgrades	Access road construction	BESS installation	Cable trench digging	Gravel laydown	Site compound construction	Site rehabilitation	Substation and O&M facility construction	Substation construction
45	75	40	40	48	42	38	47	30	48	30
48	75	37	39	47	41	37	47	29	47	29
49	75	40	40	48	42	37	47	29	48	29
50	75	40	40	48	42	37	47	29	48	29
51	75	40	40	47	42	37	47	29	47	29
53	75	40	39	47	41	37	46	29	47	29
55	75	42	39	43	37	33	43	25	43	25
56	75	36	37	46	40	35	45	27	46	27
57	75	40	39	46	40	36	46	28	46	28