APPENDIX E

Lachlan River Bridge Modification Project

Noise and Vibration Impact Assessment

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ARTC INLAND RAIL

STOCKINBINGAL TO PARKES (S2P) – LACHLAN RIVER BRIDGE

NOISE AND VIBRATION IMPACT ASSESSMENT

wsp

TABLE OF CONTENTS

CONTENTS (Continued)

LIST OF TABLES

LIST OF TABLES (CONTINUED)

LIST OF FIGURES

LIST OF APPENDICES

GLOSSARY

TERM	DESCRIPTION
Noise terms	
Acoustic barrier	Solid walls or partitions, solid fences, earth mounds, earth berms, buildings, etc used to reduce noise, without eliminating it.
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment period	The period in a day over which assessments are made.
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise environment, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is typically represented as the L_{90} noise level (see below).
Decibels (dB)	The human ear responds to minute pressure variations in the air. These pressure variations can be likened to the ripples on the surface of water but of course cannot be seen. The pressure variations in the air cause the eardrum to vibrate and this is heard as sound in the brain. The stronger the pressure variations, the louder the sound is heard. The range of pressure variations associated with everyday living may span over a range of a million to one. On the top range may be the sound of a jet engine and on the bottom of the range may be the sound of a pin dropping. Instead of expressing pressure in units ranging from a million to one, it is found convenient to condense this range to a scale 0 to 120 and give it the units of decibels. The following are examples of the decibel readings of every day steady or quasi-steady sounds. *0dB the faintest sound we can hear under perfect conditions* *20dB quiet bedroom at night or recording studio* *30dB quiet library or quiet location in the country* *40dB living room* *50dB typical office space or ambience in the city at night* *60dB normal conversational speech* *70dB a car passing by* *80dB kerbside of a busy road* *90dB truck passing by* *100dB nightclub* *110dB rock band or 2m from a jackhammer* *120dB 70m from a jet aircraft* *130dB threshold of pain* *140dB 25m from a jet aircraft*

TERM	DESCRIPTION
dB(A); A-weighted decibels	The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same sound pressure level are not heard as loud as high frequency sounds. The sound level meter attempts to replicate the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched in is denoted as dB(A). Most environmental noise is measured using the A filter.
Diffraction	The bending of sound waves around solid obstacles.
Frequency	Of a periodic quantity: the time rate of repetition. The reciprocal of the period. Frequency is measured in hertz (Hz).
Loudness	A 3dB increase represents a doubling of the sound pressure, however an increase of about 10dB is required before the sound will subjectively appear to be twice as loud. That is, a sound of 85dB is twice as loud as a sound of 75dB which is twice as loud as a sound of 65dB and so on. That is, the sound of 85dB is four times as loud as a sound of 65dB. The smallest change which can be readily heard is approximately 2dB. An increase beyond 5dB is considered to represent the level at which a change in loudness begins to be clearly perceived.
L_{90}	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
L_{eq}	Equivalent sound pressure level – the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring. The sound weighting of the noise measurement is commonly added, for example L_{Aeq} or L_{Ceq}.
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of one second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain L_{eq} sound levels over any period of time and can be used for predicting noise at various locations.
Sound level meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound pressure level	The level of sound pressure, expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound power level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Structure-borne noise	Vibration propagating through solid structures in the form of compression or bending waves, heard as sound.

TERM	DESCRIPTION
Vibration terms	
Acceleration	A vector quantity that specifies the time derivative of velocity.
Accelerometer	A piezoelectric sensor that converts an input acceleration to an output (usually electrical) that is proportional to the input acceleration.
Ambient vibration	The all-encompassing vibration associated with a given environment, usually a composite of vibration from many sources, far and near.
Amplitude	The maximum value of a sinusoidal quantity.
Crest factor	The ratio of the peak value to the r.m.s. value.
Cycle	The complete range of states or values through which a periodic phenomenon or function passes before repeating itself identically.
Displacement	A vector quantity that specifies the change of position of a body or particle with respect to a reference frame.
Frequency	The reciprocal of the period when the independent variable is time.
Hertz (Hz)	Units in which frequency is expressed. Synonymous with cycles per second.
Peak value	The maximum value of a quantity during a given interval.
Peak-to-peak value	Of an oscillating quantity. The algebraic difference between the extreme values of the quantity.
Periodic vibration	A periodic quantity whose values recur for certain equal increments of the independent variable.
Resonance	Of a system in forced oscillation. The condition of the system when any change in the frequency of excitation, however small the change, causes a degrease in a response of the system.
Resonance frequency	A frequency at which resonance occurs.
RMS	Root Mean Square of the acceleration value of the vibration source. This measure allows for the magnitude of the vibration, regardless of its direction.
Spectrum	A description of a quantity as a function of frequency or wavelength.
Transducer	A device that receives energy from one system and supplies energy, of either the same or a different kind, to another system in such a manner that the desired characteristics of the input energy appear at the output.
Velocity	A vector quantity that specifies the time derivative of displacement.
Wavelength	Of a periodic wave. The distance, measured perpendicular to the wave front in the direction of propagation, between two successive points on the wave that are separated by one period.

1 INTRODUCTION

The Australian Government has committed to delivering a significant piece of national transport infrastructure that will provide a safe, sustainable solution to the freight challenge that exist on Australia's east coast. The Inland Rail Program is a 1,700-kilometre interstate freight rail corridor that will connect Melbourne and Brisbane, via central-west New South Wales (NSW) and Toowoomba in Queensland (QLD).

Inland Rail would enhance Australia's existing national rail network and serve the interstate freight market. Key components of the proposal include:

- using the existing interstate rail line though Victoria and southern NSW
- upgrading about 400 kilometres (kms) of existing track, mainly in western NSW
- providing about 600kms of new track in northern NSW and south-east QLD.

The objectives of Inland Rail are to:

- provide a rail link between Melbourne and Brisbane that is interoperable with train operations to Perth, Adelaide, and other locations on the standard gauge rail network, to serve future rail freight demand, and stimulate growth for inter-capital and regional/bull rail freight
- provide an increase in productivity that would benefit consumers though lower freight transport costs
- provide a step-change improvement in rail service quality in the Melbourne to Brisbane corridor and deliver a freight rail service that is competitive with road
- improve road safety, ease congestion, and reduce environmental impacts by moving freight from road to rail
- bypass bottlenecks within the existing metropolitan rail networks, and free up train paths for other services along the coastal route; and
- act as an enabler for regional economic development along the Inland Rail corridor.

The Inland Rail Project is divided into 13 individual projects, with seven located in NSW.

1.1 THE PROPONENT

Australian Rail Track Corporation (ARTC) is the proponent for the proposal and has a ten-year program to deliver Inland Rail. ARTC is an Australian Government owned statutory corporation that manages more than 8,500 kilometres of rail track in NSW, QLD, South Australia, Victoria and Western Australia. ARTC is responsible for:

- selling access to the rail network to train operators
- capital investment in the network
- managing train operational across the network
- maintaining the network
- developing new business.

Further information on ARTC and Inland Rail can be found at www.artc.com.au and www.inlandrail.artc.com.au.

1.2 THE PROPOSAL

The Stockinbingal to Parkes (S2P) section forms a key component of the Inland Rail. It is a 173-kilometre (km) section of existing rail corridor located in regional NSW between the towns of Stockinbingal and Parkes.

A number of enhancement works (which do not constitute a complete upgrade of the track alignment) are required to be undertaken in this section, including modifications to, construction or removal of various structural and track assets along the alignment. Due to the number of enhancement works required along the S2P corridor, the environmental approvals have been split into four Review of Environmental Factors (REF) packages:

- Horizontal Clearances: Milvale (clearance works), Bribbaree (track realignment), Quandialla (clearance works), Caragabal (track slew), Wirrinya (track realignment) and Forbes Station (clearance works and track realignment)
- Lachlan River Bridge (clearance works)
- Wyndham Avenue bridge (track lowering)
- Daroobalgie (new crossing loop).

This REF has been prepared for the Lachlan River Bridge package of works (hereafter referred to as "the proposal").

1.2.1 PROPOSAL OBJECTIVES

The objectives of the proposal are to:

- enhance existing rail infrastructure to achieve the clearances required for Inland Rail, to enable trains using the corridor to travel between Stockinbingal and Parkes, connecting with other sections of Inland Rail to the north and south
- improve reliability and travel times.

1.3 PURPOSE OF THIS REPORT

This report has been prepared as part of the REF for the proposal to:

- identify the noise and vibration assessment study area and associated sensitive receivers
- describe the existing noise environment
- define the assessment criteria adopted to assess the proposal's noise and vibration impacts
- predict and assess construction noise and vibration levels associated with the proposal
- predict and assess operational noise and vibration levels associated with the proposal
- present the feasible and reasonable mitigation measures that should be considered for noise and vibration impacts.

This report has been prepared with reference to the previous noise and vibration assessment for the proposal [*Inland Rail – Stockinbingal to Parkes, Lachlan River Bridge, Review of Environmental Factors, Report no. 2-0002-230-EAP-02-RP-2000, Version C, Lycopodium* (December 2018)] (the 2018 REF).

1.4 STRUCTURE OF THIS REPORT

The structure of the report is as follows:

- Chapter 1 – Introduction – Introduces the report, the proposal and the relevant legislation and guidelines
- Chapter 2 – Existing environment – Describes the existing noise environment of the assessment area and identifies sensitive receivers
- Chapter 3 – Noise and vibration assessment criteria – Describes the assessment according to relevant guidelines
- Chapter 4 – Construction noise assessment – Describes the methodology and predicted noise impacts generated by construction of the proposal
- Chapter 5 – Construction vibration assessment – Describes the methodology and predicted vibration impacts generated by the construction of the proposal
- Chapter 6 – Operational rail noise and vibration assessment
- Chapter 7 – Mitigation and management measures – Details recommended mitigation measures to minimise noise and vibration impacts
- Chapter 8 – Conclusion – Overview of the key findings of the report.

1.5 RELEVANT GUIDELINES AND LEGISLATION

This report has been written in accordance with ARTC's Noise and Vibration Management Strategy (01-9000-PE-P11-SAT-003_5) and *Inland Rail Technical Specification for noise and vibration assessments* (0-9000-ENV-00-SP-0001_0) as the assessment framework.

The assessment has been prepared with reference to the documents presented in Table 1.1.

Table 1.1 Assessment guidelines

ACOUSTIC ASPECT	DESCRIPTION	ASSESSMENT GUIDELINES
Airborne noise	Operational noise	*Rail Infrastructure Noise Guideline* (NSW Environmental Protection Authority, 2013) (RING)
	Construction noise	*Interim Construction Noise Guideline* (DECCW, 2009) (ICNG) *Construction Noise and Vibration Strategy* 2019 (TfNSW, 2019) (CNVS)
	Construction traffic noise	*NSW Road Noise Policy* (DECCW, 2011) (RNP) *Construction Noise and Vibration Guideline* (CNVG) (Roads and Maritime, 2016)
	Sleep disturbance from construction noise (for work lasting more than 2 consecutive nights)	*Interim Construction Noise Guideline* (DECCW, 2009) *NSW Road Noise Policy* (DECCW, 2011)
	Existing ambient and background noise levels	*Interim Construction Noise Guideline* (DECCW, 2009) *Noise Policy for Industry* (EPA, 2017) *Australian Standard AS 1055 Description and measurement of environmental noise (AS1055)*

ACOUSTIC ASPECT	DESCRIPTION	ASSESSMENT GUIDELINES
Ground-borne noise	Construction noise transmitted through the ground into a structure	*Interim Construction Noise Guideline* (DECCW, 2009)
Vibration	Construction vibration amenity impacts	*Assessing Vibration: a Technical Guideline* (DEC, 2006) (AVaTG)
	Construction vibration effect on structures (structural or cosmetic damage)	*British Standard BS 7358-2: Evaluation and measurement for vibration in buildings guide to damage levels from ground-borne vibration* (BS7358-2) *Construction Noise and Vibration Strategy* 2019 (TfNSW, 2019)
Management	Mitigation and management of noise and vibration issues	*Interim Construction Noise Guideline* (DECCW, 2009) *Construction Noise and Vibration Management Framework 2017* (ARTC, 2017)

1.6 PROPOSAL OVERVIEW

The proponent is seeking to modify the Lachlan River Bridge in Forbes, NSW (the proposal) to provide the clearance required for double stack freight trains. The proposal site, shown in Figure 1.1, is located in the township of Forbes, approximately two kms to the south-east of Forbes Railway Station.

The existing bridge at the proposal site is a multi-span bridge that comprises a single steel span truss crossing the Lachlan River. The bridge was originally constructed in 1912, with the approach spans replaced in 1996. The height of the braces in the truss structure do not provide sufficient vertical clearance and sections of handrail encroach on the horizontal clearance.

The proposal involves modifying the truss structure of the Lachlan River Bridge by removing metal sections from along the top of the structure and installing new angled frames to maintain structural integrity. Ancillary works include utilities on the bridge and establishing construction compounds, laydown areas, a crane pad and environmental controls. Patch painting would also be required where lead-based paint has been disturbed by the works.

1.6.1 BRIDGE WORKS

The modification works to the bridge structure include:

- removing diagonal and horizontal sections from along the top of the truss structure including the diagonal bracing at each end
- installing replacement sections along the top of the truss structure
- installing six angled frames along the truss structure
- strengthening of the underside of the bridge
- making adjustments to short sections of existing handrail adjacent to the truss structure.

Installation of frames and strengthening the bridge is required to ensure the structural integrity of the bridge is not compromised due to removal of existing sections of the truss structure. All cutting and welds to the metalwork would be treated to protect them from corrosion. Patch painting would be completed on the bridge structure where lead-based paint is disturbed by the proposed work. No work is proposed to the track or existing bridge piers.

1.6.2 UTILITIES

A water main and telecommunications cable are attached to the bridge. The supports on the existing water main attached to the bridge would be modified if required. Any works proposed to the water main would be undertaken in consultation with the utility owner, Forbes Shire Council. No permanent changes to the telecommunications cable are proposed.

Stockinbingal to Parkes Lachlan River Bridge Figure 1.1 Proposal Site

0 10 20 m

Coordinate System: GDA 1994 MGA Zone 55

Date: 4/08/2021 Paper: A3
Author: WSP Scale: 1:500
Data Sources: ARTC, NSWSS

- Existing railway
- Local road
- Track
- Watercourse
- Cadastre
- Proposal site

INLAND RAIL ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

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2 EXISTING ENVIRONMENT

2.1 EXISTING NOISE ENVIRONMENT

The proposal is located in the southern outskirts of Forbes. Land uses directly surrounding the site are predominately rural in nature, however suburban areas are located to the west. The existing noise environment is generally influenced by road traffic noise from Lachlan Valley Way and Bathurst Street, in addition to rural sources and train noise at the time of a passby. Natural noise sources such as insects, birds and dogs are commonly audible.

2.2 EXISTING VIBRATION ENVIRONMENT

The most significant existing sources of vibration at nearby receivers includes those generated by traffic on the local road network and existing rail operations.

Vibration due to existing road and rail sources would be well below the structural damage and human comfort criteria for all vibration sensitive receivers in the study area (refer Figure 2.1) and direct measurement is not considered necessary.

2.3 NOISE SENSITIVE RECEIVERS

The nearest noise-sensitive receivers to the proposal are outlined in Table 2.1 and shown in in Figure 2.1.

Table 2.1 Identified noise sensitive receivers

ADDRESS	RECEIVER TYPE	DIRECTION FROM PROPOSAL	DISTANCE FROM PROPOSAL (m)
289 Bathurst St, Forbes	Residential	East	30[1]
113 Bathurst St, Forbes	Residential	West	130
26-28 Bathurst St, Forbes	Residential	West	300
106 Ferry St, Forbes	Residential	West	365
84 Ferry St, Forbes	Residential	West	470
Breakway, 31 Riflerange Rd, Forbes	Residential	North	490
12 Reisling St, Forbes	Residential	South	350
Apex Caravan Park, 88 Reymond St, Forbes	Hotel	South	490

(1) 30m indicates the separation distance to the garage/shed of this property. Living spaces for this residence are located at a distance of approximately 45m.

2.4 NOISE CATCHMENT AREAS

Noise catchment areas (NCA) have been defined to classify groups of sensitive receivers that are likely to have a similar existing noise environment and experience similar impacts from the proposal.

The noise environments at the proposal site can be generally broken into two areas, being the suburban areas of south-east Forbes and the semi-rural areas in the remainder of the proposal study area.

Table 2.2 summarises the general noise environment of each NCA.

Table 2.2 Noise Catchment Areas (NCAs)

NCA ID	REPRESENTATION BACKGROUND MONITORING LOCATION	APPROXIMATE NUMBER OF RECEIVERS IN NCA	DESCRIPTION
NCA01	9-5	816	Generally standalone, medium density residential properties to the north-west of the proposal. Ambient noise conditions are dominated by insects, local wildlife and faint distant road and rail traffic noise from the existing Newell Highway and S2P corridor. Includes the Lachlan River Health Services facility.
NCA02	2018 REF	161	Semi-rural residential properties immediately adjacent to the project site with some farming activity. The ambient noise is dominated by vehicle movements including trucks, motorcycles, light vehicles and S2P corridor.

2.5 BACKGROUND NOISE MONITORING

Several noise monitoring locations were used to characterise the existing noise environment in the areas surrounding the proposal site and sensitive receivers potentially impacted by the works. Monitoring at location 8-3 formed part of this assessment and this location was identified and approved by ARTC. The logger locations selected for the assessment were considered to be representative of the existing background and ambient noise environment in the proposal study area.

The weather conditions at the time of monitoring were correlated with the nearest Bureau of Meteorology stations and periods of affected data were removed in accordance with methodology outlined in the Noise Policy for Industry (NPfI). The locations of the deployed monitoring equipment are presented in Table 2.3 and shown in Figure 2.1.

The second monitoring site was undertaken as part of the 2018 REF. Further details of that testing are contained within that report.

Table 2.3 Noise monitoring locations

NOISE MONITORING LOCATION	SURVEY METHOD[1]	LOT AND DP	DESCRIPTION
9-5	LOG / AT	Lot 1335 DP750158	1 Union Street, Forbes
2018 REF	LOG	Lot 639 DP750158	289 Bathurst Street, Forbes, NSW 2871

(1) LOG = unattended noise logging; AT = operator attended noise survey

2.6 UNATTENDED NOISE SURVEY

Unattended noise monitoring of background noise levels was completed between 3 and 17 March 2021. The results are summarised in Table 2.4 and detailed daily plots of data are presented in Appendix A.

Where required, background noise levels (RBL) have been adjusted for evening and night periods in accordance with methodologies outlined in the NPFI. Noise monitoring parameters are discussed further in Section 3.1.2. Monitoring conducted as part of the 2018 NVIA has been adopted for semi-rural receivers in the vicinity of the bridge.

Table 2.4 Summary of unattended noise monitoring results

LOCATION	RATING BACKGROUND LEVEL (RBL) dBA			AMBIENT NOISE LEVEL dBA $L_{EQ(15\ MIN)}$		
	Day[1]	Evening[1]	Night[1]	Day[1]	Evening[1]	Night[1]
9-5	39	39	36	55	54	42
2018 REF	31	31[2] (42)	31[2] (33)	61	-	60

(1) Time periods defined as – Day: 7am to 6pm Monday to Saturday, 8am to 6pm Sunday; Evening, 6pm to 10pm; Night 10pm to 7am Monday to Saturday, 10pm to 8am Sunday

(2) RBL data has been adjusted for Evening and Night periods as per NPfI methodology (bracketed figure indicates measured value)

The 2018 NVIA contains the following summary of rail noise at 10m from the main line:

Table 2.5 Summary of measured train noise levels (10m from main line)

TRAIN TYPE	MAXIMUM NOISE LEVEL dB(A)			
	Range	50^{TH} percentile	95^{TH} percentile	Log average Sound Exposure Level (SEL)
Freight	87–111	92	102	102.6

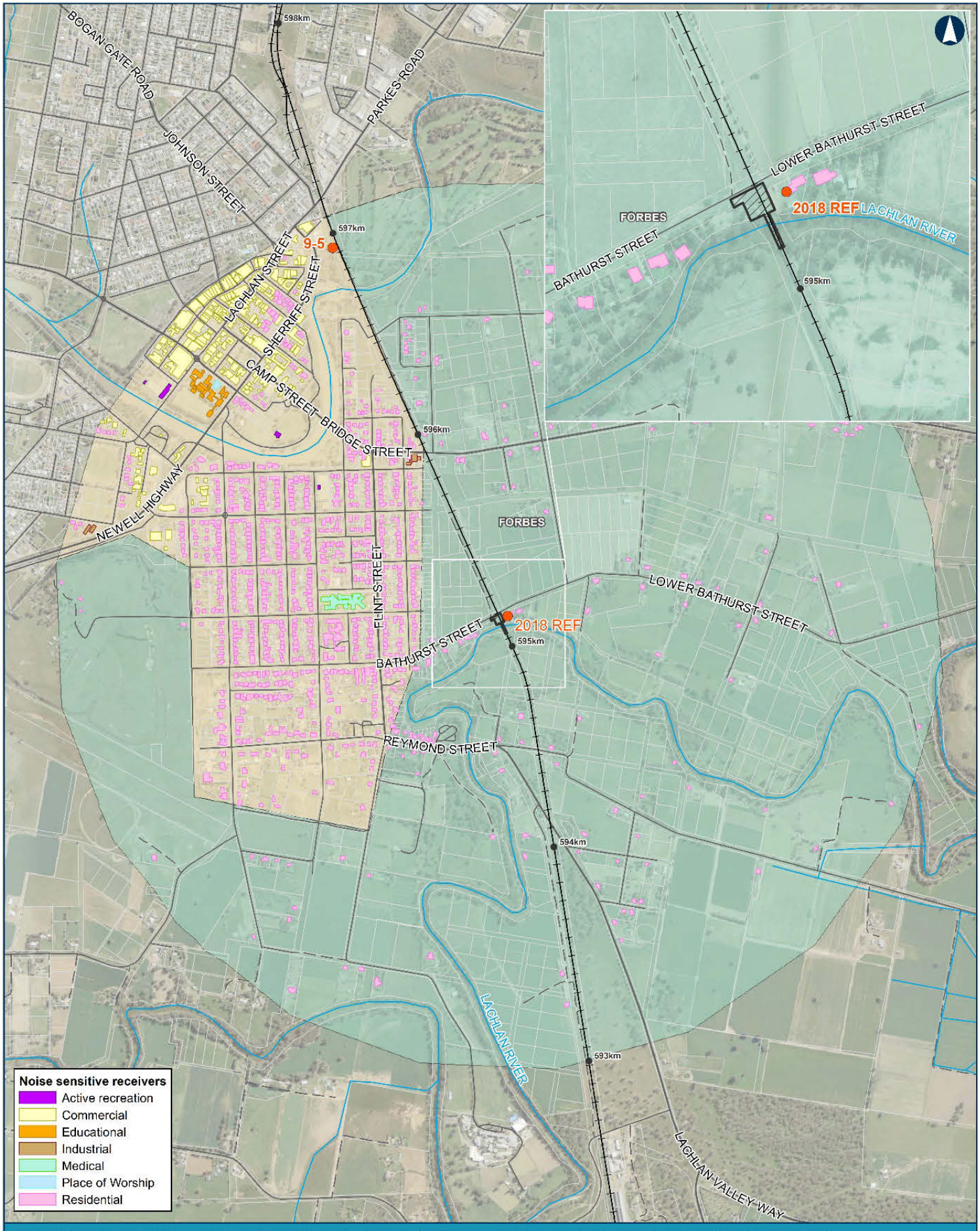
2.7 OPERATOR ATTENDED NOISE SURVEY

Operator attended noise surveys were carried out to characterise the noise environment and identify the contributors to the acoustic environment. The results of the attended noise surveys conducted at Location 8-3 shows good agreement with the unattended monitoring and observations are presented in Table 2.6.

Based on the attended and unattended monitoring results, the background noise environments at that monitoring locations can be categorised as a mix of urban and rural environments, with intermittent noise from vehicle pass-bys and noise from local wildlife.

Table 2.6 Summary of attended noise measurement results

LOCATION	DATE	TIME	dBA $L_{eq(15min)}$	dBA $L_{90(15min)}$	OBSERVATIONS
9-5	03/03/2021	4:51 PM	51	47	Background noise environment characterized by insects, faint distant traffic and local wildlife. Car passing with an L_{eq} of approximately 55dBA as a maximum.



Stockinbingal to Parkes Lachlan River Bridge Figure 2.1 Noise sensitive receivers, NCAs and monitoring locations

0 250 500 m

Coordinate System: GDA 1994 MGA Zone 55

Date: 30/09/2021 Paper: A3
Author: WSP Scale: 1:16,000
Data Sources: ARTC, NSWSS

- KM post
- Existing railway
- Main road
- Local road
- Track
- Watercourse
- Cadastre
- Proposal site
- Noise monitoring location

Noise catchment area

- NCA01
- NCA02

INLAND RAIL ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

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3 NOISE AND VIBRATION ASSESSMENT CRITERIA

3.1 CONSTRUCTION NOISE CRITERIA

3.1.1 ENVIRONMENTAL PROTECTION LICENCE (EPL 3142)

ARTC operates its rail network in accordance with ARTC's Environmental Protection License (EPL) 3142, administered by the Environment Protection Authority under the *Protection of the Environment Operations Act 1997*. The proposal is considered maintenance of existing railway infrastructure under Clause 33A(2(c)), Schedule 1 of the *Protection of the Environment Operations Act 1997.*

Given the minor nature of this project, it is understood that this work will be carried out as a maintenance activity under this EPL.

ARTC EPL3142 Section O4 outlines conditions relating to noise and vibration management. This NVIA has been prepared to address the requirements for noise assessment. Management measures are included which address the following aspects concerning noise and vibration:

- railway maintenance activities
- standard railway maintenance hours
- exception to standard railway maintenance hours
- exception to standard railway maintenance hours for low noise impact generating works
- management of noise impacts from maintenance.

3.1.2 INTERIM CONSTRUCTION NOISE GUIDELINE

The Interim Construction Noise Guideline (ICNG) is to be used for assessment and management of construction noise for the proposal. The ICNG is the primary instrument for the assessment of construction noise impacts within NSW.

It is noted that the ICNG is soon scheduled to be superseded by the Draft Construction Noise Guideline, however at the time of writing of this report, this had not been released and the ICNG is currently the valid assessment methodology.

3.1.2.1 RECOMMENDED STANDARD CONSTRUCTION HOURS

The ICNG sets Noise Management Levels (NMLs) for land use types based upon the day of week and time of day at which construction noise occurs. For residential land uses, the ICNG defines Recommended Standard Hours which represent the times of the day when receivers are likely to be less sensitive to noise impacts. Where work is proposed outside of Recommended Standard Hours, would be undertaken in accordance with assessment and management requirements of the ICNG and any conditions attached to the ARTC EPL 3142 (conditions O9.1 to O9.6) (refer Section 3.1.1).

Construction noise is considered to adversely impact a receiver if the predicted noise level exceeds the NML, which is determined based on the measured RBLs. RBLs are the Rating Background noise Level, as defined in the NPfI, and RBLs for the proposal are sourced from measurement data in Section 2.6.

Table 3.1 summarises the ICNG NML approach for the residential receiver types which are relevant to the proposal.

Table 3.1 Application of the ICNG noise management levels

SETTING AND APPLYING NMLS AT RESIDENCES		
Time of day	**NML, $L_{eq,15min}$ dBA**	**How to apply**
Recommended standard hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm Excludes on Sundays or public holidays	Noise affected RBL + 10dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{eq\ (15\ min)}$ 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.
	Highly noise affected 75dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: — times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences) — if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5dBA above the noise affected level, the proponent should negotiate with the community.

For construction of the proposal it is understood that most works will be conducted during rail possession periods. As such, works will be conducted outside of the ICNG defined standards hours at times. Any works required to be completed outsides of standard working hours would be carried out in accordance with the REF and ARTC's EPL3142 (condition O.4).

3.1.2.2 CONSTRUCTION NOISE MANAGEMENT LEVELS

The resultant NMLs for residential receivers adjacent the proposal are presented in Table 3.2.

Table 3.2 Noise Management levels at residential receivers

ASSESSMENT PERIOD[1]	RBL dBA	NOISE MANAGEMENT LEVEL dBA $L_{eq(15min)}$	HIGHLY NOISE AFFECTED LEVEL dBA $L_{eq(15min)}$
NCA01			
Standard hours	39	49	75
Out of hours – Day	39	44	–
Out of hours – Evening	39	44	–
Out of hours – Night	36	41	–
NCA02			
Standard hours	31	41	75
Out of hours – Day	31	36	–
Out of hours – Evening	31	36	–
Out of hours – Night	31	36	–

(1) Standard hours: Monday to Friday 7am to 6pm, Saturday 8am to 1pm, Excludes on Sundays or public holidays
Out of hours – Day Monday to Friday 6am to 7am, Saturday 6am to 8am and 1pm to 6pm, Sunday 6am to 6pm
Out of hours – Evening All days 7am to 6pm
Out of hours – Night 10pm to 6am all days

Where NMLs are exceeded either during or outside of recommended standard hours for construction work, all feasible and reasonable noise mitigation and management measures should be implemented.

Noise management levels at non-residential receivers located within the study areas are presented in Table 3.3.

Table 3.3 Noise management levels for non-residential sensitive receivers

LAND USE	NOISE MANAGEMENT LEVEL (EXTERNAL) dBA $L_{eq(15min)}$
Educational	55[1, 2]
Commercial (offices, retail outlets)	70[2]
Commercial (industrial)	75[2]
Hospital wards and operating theatres	55[1, 2]
Active Recreation	65[2]
Passive Recreation	60[2]
Place of Worship	55[1, 2]

(1) An internal to external correction of +10dB has been applied as per the ICNG.

(2) When in use

3.1.3 SLEEP DISTURBANCE

Construction noise during the night (10pm to 7am Monday to Saturday, 10pm to 8am Sunday) has the potential to awaken residents from sleep. The *Construction Noise and Vibration Strategy* (CNVS) refers to the Road Traffic Authority's (RTA) *Environmental Noise Management Manual* (ENMM) (RTA, 2001) and DECCW's *Environmental Criteria for Road Traffic Noise* (ECRTN) (RTA,1999) for guidance relevant to the assessment of sleep disturbance and awakening. These guidelines have been superseded by the *Road Noise Policy* (RNP) (DECCW, 2011).

The RNP adopts the ECTRN's guidance level of $L_{AF1,1min}$ to limit sleep disturbance from environmental noise, which should not exceed the ambient L_{A90} + 15dB. Section 5.4 of the RNP then states that:

> *Maximum internal noise levels below 50 to 55dBA L_{max} would be unlikely to awaken people from sleep; and*
>
> *One or two noise events per night, with maximum internal noise levels of 65-70dBA, are not likely to affect health and wellbeing significantly.*

The RNP indicates that internal noise levels of 50 to 55dBA L_{max} are unlikely to cause sleep awakenings. It follows that at levels above 55dBA L_{max}, sleep awakening would be considered likely. Assuming receivers may have windows partially open for ventilation, a +10dB inside to outside correction has been adopted as outlined in the ICNG.

The NPfI also contains guidance on sleep disturbance and awakening, outlining that further investigation of sleep disturbance and awakening should be undertaken where the following external screening levels are exceeded:

- $L_{eq,15min}$ 40dBA or the prevailing RBL plus 5dB, whichever is the greater, and/or
- L_{Fmax} 52dBA or the prevailing RBL plus 15dB, whichever is the greater.

The assessment of $L_{eq,15\ min}$ against the prevailing RBL plus 5 aligns with construction noise management levels, and would be considered in the assessment against construction noise management levels. The assessment L_{max} against the prevailing RBL plus 15dB aligns with the ECRTN guidance.

Therefore, assessment of sleep disturbance and awakening has been conducted for residential receivers in each NCA by adopting the most conservative (lowest) of the external noise level screening levels of RBL+15dB and L_{max} 65dBA.

3.1.4 ROAD TRAFFIC NOISE IMPACTS

The proposal requires vehicle movements on adjacent roads to facilitate the delivery and removal of materials to site, as well as the delivery of equipment and construction staff.

As the RNP provides guidance with relation to operational noise impacts, and noise from construction traffic is non-permanent, further guidance has been taken from the Construction Noise and Vibration Guideline (CNVG) (Roads and Maritime, 2016).

The CNVG states that 'an initial screening test should first be applied by evaluating whether noise levels will increase by more than 2dBA due to construction traffic or a temporary reroute due to a road closure. Where increases are 2dBA or less then no further assessment is required'. Where road traffic noise levels are anticipated to increase by more than 2dB, the noise assessment criteria outlined in Table 3.4 will be considered.

Table 3.4 Road Noise Policy assessment criteria

ROAD CATEGORY	TYPE OF PROJECT/ LAND USE	TRAFFIC NOISE ASSESSMENT CRITERIA	
		Day (7am to 10pm)	Night (10pm to 7am)
Collector/sub-arterial/ arterial/freeway	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{eq,15hr}$ 60dBA	$L_{eq,9hr}$ 55dBA
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{eq,1hr}$ 55dBA	$L_{eq,1hr}$ 50dBA

3.2 CONSTRUCTION VIBRATION CRITERIA

Vibration associated with construction activities may result in adverse impacts on human comfort or the damage of physical structures such as dwellings. These two impacts are assessed against different criteria, with the effects of vibration on human comfort having a lower threshold.

3.2.1 COSMETIC BUILDING DAMAGE AND STRUCTURAL INTEGRITY

There are no vibration limits for buildings and structures in *Assessing Vibration: A Technical Guideline* (AVaTG). Therefore, limits have been adopted from the *British Standard BS 7358-2: Evaluation and measurement for vibration in buildings guide to damage levels from ground-borne vibration*.

Importantly, cosmetic damage is regarded as minor in nature; it is readily repairable and does not affect a building's structural integrity. If there is no significant risk of cosmetic damage, then structural damage is not considered a risk.

A summary of the relevant limits from BS7358-2 is presented in Table 3.5. These peak vibration limits are set so that the risk of cosmetic damage is minimal. They have been set at the lowest level above which damage has been credibly demonstrated. The limits assume that the equipment causing the vibration is used intermittently.

Table 3.5 BS 7385-2 Guideline vibration limits for cosmetic damage

GROUP	TYPE OF STRUCTURE	PEAK COMPONENT PARTICLE VELOCITY, mm/s[1]		
		4–15Hz	15–40Hz	40Hz and above
2	Un-reinforced or light framed structures Residential or light commercial buildings	15–20[2]	20–50	50

(1) Values referred to are at the base of the building, on the side of the building facing the source of vibration (where feasible)

(2) At frequencies below 4Hz, a maximum displacement of 0.6mm (zero to peak) should not be exceeded.

3.2.2 HUMAN COMFORT (AMENITY)

Table 3.6 presents the limits (vibration dose values) above which there is considered to be a risk to the amenity and comfort of people occupying buildings from intermittent vibration from construction works. These limits are sourced from the AVTG.

Table 3.6 Human comfort (amenity) guideline vibration limits (intermittent work)

LOCATION	ASSESSMENT PERIOD	VIBRATION DOSE VALUE, $m/s^{1.75}$	
		Preferred values	Maximum values
Residences	Daytime	0.20	0.40
	Night time	0.13	0.26

3.2.3 HERITAGE AND VIBRATION SENSITIVE STRUCTURES

The German Standard provides the guideline values for vibration quantified using vibration velocity, which is a measure of the rate of displacement (change of position). It is commonly expressed in millimetres per second using Peak Particle Velocity (PPV) which is the maximum velocity during a time interval.

The structural damage criteria from the German Standard are detailed in Table 3.7. Vibration from construction occurs between 8 Hertz (Hz) to 100Hz, to conservatively manage the risk of cosmetic damage the assessment adopted the lowest level above which damage has been credibly demonstrated:

- 5mm/s assessment criteria for dwellings (residences); and
- 3mm/s for sensitive structures of great intrinsic value, for example sites of heritage significance.

Cosmetic damage is regarded as minor in nature; it is readily repairable and does not affect a building's structural integrity. If there is no significant risk of cosmetic damage, then structural damage is not considered a risk.

Table 3.7 Guideline vibration limits for cosmetic damage

TYPE OF STRUCTURE	PEAK COMPONENT PARTICLE VELOCITY, mm/s (A)		
	1–10Hz	10–50Hz	50-100Hz
Structures that have great intrinsic value and not classified as residential, commercial or industrial buildings.	3	3–8	8–10

Source: *German Standard DIN 4150-3:1999-02, Structural vibration Part 3: Effects of vibration on structures* (1999).

3.3 OPERATIONAL NOISE CRITERIA

3.3.1 RAIL INFRASTRUCTURE NOISE GUIDELINE

The acceptability of rail noise from train operations in NSW is assessed in accordance with the NSW *Rail Infrastructure Noise Guidelines* (RING). This guideline presents noise trigger levels for a project; if these levels are likely to be exceeded as a result of the rail development, noise mitigation measures would need to be considered.

Trigger levels are presented for new rail developments and re-developments of existing rail lines. The redevelopment of existing rail lines generally applies to developments which are intended to increase rail traffic or alter the track alignment through design or engineering changes.

The proposal alignment at all project sites remains within the existing operational rail corridor. As such, the proposal is considered to be a redeveloped rail line project. Table 3.8 presents the airborne noise criteria for a redeveloped rail line.

Table 3.8 Airborne residential noise trigger levels for redevelopment of existing rail line

TYPE OF DEVELOPMENT	NOISE TRIGGER LEVELS (EXTERNAL) dBA	
	Day (7am to 10pm)	Night (10pm to 7am)
Redevelopment of existing train line	Development increases existing $L_{eq(period)}$[1] rail noise levels by 2dB or more, or existing L_{max} rail noise levels by 3dB or more **and** predicted rail noise levels exceed:	
	$65L_{eq\ 15hr}$	$60L_{eq\ 9\ hr}$
	$85L_{max}$[1]	

(1) L_{max} refers to the maximum A-weighted noise level not exceeded for 95 per cent of rail pass-by events

In assessing noise levels emitted by the proposal at residential receiver locations, the external noise level is to be assessed at a location one metre in front of the most affected building facade. Any 'internal noise level' refers to the noise level at the centre of the habitable room most exposed to the noise source, and applies with windows open sufficiently to provide adequate ventilation.

3.3.2 EPL 3142

EPL 3142 does not specify noise limits for operation of the rail corridor outside construction and maintenance activities. Conditions O4 to O6 require ARTC to minimise noise impacts on noise sensitive receivers from trains including breaking and horn use.

3.4 GROUND-BORNE RAIL NOISE TRIGGER LEVELS

The RING defines ground-borne rail noise trigger levels for heavy rail for residential and sensitive land uses as presented in Table 3.9.

Table 3.9 Ground-borne rail noise trigger levels for residential and sensitive land uses

SENSITIVE LAND USE	TIME OF DAY	INTERNAL NOISE TRIGGER LEVELS, dBA
		Development increases existing rail noise levels by 3dBA or more **and** **resulting rail noise levels exceed:**
Residential	Day (7am – 10pm)	$40L_{ASmax}$
	Night (10pm – 7am)	$35L_{ASmax}$
Schools, educational institutions, places of worship	When in use	$40–45L_{ASmax}$

For schools, educational institutions and places of worship, the lower value of the range is most applicable where low internal noise levels are expected, such as in areas assigned to studying, listening and praying. Ground borne noise trigger levels are not applicable to commercial receivers.

Ground-borne noise level values are relevant only where they are audible and higher than the airborne noise from railways and where the ground-borne noise levels are expected to be, or are, audible within habitable rooms. The levels are to be assessed near to, but not at the centre, of the most affected habitable room. It is noted that the most affected room from a ground-borne noise perspective is normally on the opposite facade to the most affected from airborne noise.

3.5 GROUND VIBRATION RAIL CRITERIA

Ground vibration criteria have been determined in accordance with the AVTG, as summarised in Table 3.10. Rail traffic is generally classified as an intermittent vibration source.

Table 3.10 Vibration criteria for rail traffic

RECEIVER TYPE	TIME PERIOD	INTERMITTENT VIBRATION DOSE LEVEL (VDV $MS^{1.75}$)	
Residential	Day (7am to 10pm)	0.2	0.4
	Night (10pm to 7am)	0.13	0.26

4 CONSTRUCTION NOISE ASSESSMENT

4.1 CONSTRUCTION METHODOLOGY

The indicative construction methodology for the proposal is outlined in this section. The proposed timing, methodology, resources and access arrangements would be refined prior to construction. A final construction methodology and program will be developed by the construction contractor based on the mitigation and management measures provided in this document. Should the construction methodology change, ARTC would be consulted and would determine if additional assessment and approvals are required.

The activities required for construction of the proposal are identified below and discussed in the following sections:

- site establishment and access
- bridge works
- demobilisation and rehabilitation.

4.2 SITE ACCESS AND COMPOUNDS

A temporary site compound would be established to the north of the bridge. Access is proposed from Bathurst Street with some light vehicle access from Wandary Lane to the south of the compound.

4.3 DURATION OF WORKS

Construction of the proposal is expected to last around 12 weeks, with commencement in early 2024 (subject to ARTC determination of the REF).

4.4 WORKING HOURS

Working hours would be in accordance with ARTC's EPL 3142 (conditions O9.1 to O9.6). Works would be undertaken where practicable during standard working hours:

- 7am to 6pm Monday to Friday
- 8am to 1pm Saturday
- no work on Sundays or public holidays.

Due to access constraints and the requirement for a safe working site, some works may be undertaken outside standard working hours and during scheduled track possessions. Any works required to be completed outside standard working hours would need ARTC approval and would be in accordance with ARTC's Environmental Protection License (EPL) 3142 (condition O4). The affected community would be advised in accordance with the communication management plan.

Site establishment and demobilisation works will be undertaken during standard ICNG working hours only.

4.4.1 WORKS DURING POSSESSIONS

The majority of bridge works would be completed during 9–16 hour track possessions, which could occur up to five times a week. Timing of possessions is subject to the train timetables at the commencement of the work.

4.4.2 CONSTRUCTION PLANT AND EQUIPMENT

The indicative noisy plant and equipment likely to be required for each construction stage of the proposal is outlined in Table 4.1, with Sound Power Levels (SWLs) adopted for acoustic modelling of noise generating construction plant. This data has been adapted from the Roads and Maritime Services *Construction Noise and Vibration Guideline* (CNVG), and other government databases.

Corrections have been applied for anticipated usage and for the assessment of maximum $L_{1(1min)}$ noise level events. Sound power levels have been presented for Standard Hours and Out of Hours Works (OOHW) as indicated.

Table 4.1 Indicative plant and equipment and Sound Power Levels (SWLs)

ID	CONSTRUCTION ACTIVITY	EQUIPMENT REQUIRED	SWL	CORRECTIONS[1]	
			L_{eq} dBA	Usage dBA	$L_{1(1min)}$ dBA
1	Site establishment	14H Grader[2]	115	–	–
		30T Articulated dump truck (ADT)	107	-3	+3
		30T Excavator	108	-3	+4
		Smooth drum roller[3]	107	–	–
		Padfoot roller[3]	109	–	–
		Water cart	107	-3	+3
		TOTAL SH[4] L_{eq}	**118**		
2	Bridge works	Hand tools (rattle gun, welding, grinder, drills, etc)	105	-6	+3
		Elevated work platform[3]	105	-12	+3
		Crane	98	-6	+3
		Abrasive blaster[2, 3]	108	–	–
		Steel saw[2, 3]	118	-6	–
		TOTAL SH[4] L_{eq}	**114**		
		TOTAL OOHW[4] L_{eq}	**101**		
		TOTAL OOHW[4] $L_{1(1min)}$	**104**		
3	Demobilisation and rehabilitation	5T excavator	105	-3	+4
		14H Grader[2]	115	–	–
		Water Carts	107	-3	+3
		Hydro seed truck	107	-3	+3
		TOTAL SH[4] L_{eq}	**116**		

ID	CONSTRUCTION ACTIVITY	EQUIPMENT REQUIRED	SWL	CORRECTIONS[1]	
			L_{eq} dBA	Usage dBA	$L_{1(1min)}$ dBA
4	Compound operation	Light vehicles	88	-12	+3
		Generator	103	–	–
		Delivery trucks[2, 3]	108	-6	+3
		Franna[2]	98	-6	+3
		TOTAL SH[4] L_{eq}	**106**		
		TOTAL OOHW[4] L_{eq}	**103**		
		TOTAL OOHW[4] $L_{1(1min)}$	**107**		

(1) Estimated, assuming typical working conditions

(2) Noisy plant – assumed to not operate OOH

(3) Total noise level includes 5dB penalty for annoyance in accordance with ICNG methodology

(4) SH – Standard Hours / OOHW – Out of Hours Work

4.5 CONSTRUCTION NOISE MODELLING METHODOLOGY

A construction noise model was developed using SoundPLAN 8.2 noise modelling software in accordance with ARTC's *Inland Rail NSW Construction noise and Vibration Management Framework* (CNVF).

The SoundPLAN implementation of the CONCAWE noise propagation algorithm was utilised to predict environmental noise propagation, determining receiver noise levels for each of the construction stages.

Modelling inputs for each scenario included topography, ground and air absorption, locations of sensitive receivers, noise-generating equipment and buildings surrounding the proposal.

The following assumptions were used in the modelling:

- all noise sources modelled at 1.5m above ground level
- receiver heights were modelled for the most affected floor and facade for each building
- a ground absorption factor of 0.75
- neutral meteorological conditions.

The predictions assume the listed construction equipment in each modelling scenario would be operating simultaneously at the closest point to the receiver. In practice, most plant items are not expected to be operating in this stationary position for the full 15-minute assessment duration. As such the modelling results are a conservative representation of construction noise impacts and demonstrate the potential worst case noise levels that may be experienced.

It should be noted that assessments of construction noise and vibration have been prepared based on the knowledge of the likely construction methodology available at the time of preparation. Potential construction noise impacts will be re-assessed by the construction contractor before construction commences and following the finalisation of the construction methodology.

4.6 PREDICTED CONSTRUCTION NOISE LEVELS

Table 4.2 presents a summary of the predicted noise levels compared against the relevant NMLs for representative receivers for each assessed scenario. Results have been presented in terms of number of properties exceeding the construction NMLs for each work stage.

Detailed results of noise modelling for Standard Hours and Out of- Hours Night, being the most sensitive period over which works occur, are presented as graphics in Appendix B.

Table 4.2 Predicted construction noise exceedances at residential receivers (per NCA)

WORK STAGE	NML $L_{Aeq(15\ min)}$	NUMBER OF PROPERTIES EXCEEDING NML, GROUPED BY MAGNITUDE OF EXCEEDANCE					HIGHLY NOISE AFFECTED
		0–5dB	5–10dB	10– 20dB	20–30dB	>30dB	> 75dB
NCA01 (Total number of receivers 816)							
Standard hours[1]							
Site establishment	49	166	23	0	0	0	0
Bridge works	49	50	0	0	0	0	0
Demobilisation and rehabilitation	49	97	9	0	0	0	0
Compound operation	49	0	0	0	0	0	0
Outside standard hours – Day time/Evening[1]							
Bridge works	44	0	0	0	0	0	0
Compound operation	44	0	0	0	0	0	0
Outside standard hours – Night[1]							
Bridge works	41	0	0	0	0	0	0
Compound operation	41	10	0	0	0	0	0
NCA02 (Total number of receivers 161)							
Standard hours							
Site establishment	41	49	43	37	2	1	0
Bridge works	41	42	41	7	1	0	0
Demobilisation and rehabilitation	41	51	48	15	3	0	0
Compound operation	41	15	0	3	0	0	0
Outside standard hours – Day time/Evening							
Bridge works	36	15	0	3	0	0	0
Compound operation	36	33	3	2	1	0	0

WORK STAGE	NML $L_{Aeq(15\ min)}$	NUMBER OF PROPERTIES EXCEEDING NML, GROUPED BY MAGNITUDE OF EXCEEDANCE					HIGHLY NOISE AFFECTED
		0–5dB	5–10dB	10– 20dB	20–30dB	>30dB	> 75dB
Outside standard hours – Night							
Bridge works	36	15	0	3	0	0	0
Compound operation	36	33	3	2	1	0	0

(1) Refer Table 3.2 for definition of hours

Table 4.3 Maximum predicted noise levels (Sleep disturbance)

WORK STAGE	MAXIMUM NOISE LEVEL		NUMBER OF RECEIVERS EXCEEDING SLEEP DISTURBANCE LEVELS[1]
	RBL + 15 (dBA)	L_{max} (dBA)	
NCA01 (Total number of receivers 816)			
Bridge works	51	65	0
Compound operation			0
NCA02 (Total number of receivers 161)			
Bridge works	50	65	5
Compound operation			7

(1) Sleep disturbance applicable at residential receivers only, during period of 10pm to 7am.

4.7 CONSTRUCTION TRAFFIC ASSESSMENT

During the construction phase of the proposal, heavy vehicles would be required for materials and equipment delivery while light vehicles will transport workers to and from the site. This additional road traffic may impact receivers along the proposed transport routes.

Access to the site would predominantly be via Bathurst Street to the east and west of the level crossing. Light vehicles may access the rail corridor via Wandary Lane to the south to reach the southern side of the Lachlan River Bridge. B-double-suitable routes including Flint Road, Reymond Street, Lachlan Valley Way and The Escort Way would be used to access Bathurst Street. A qualitative assessment of likely traffic noise impacts has been conducted.

At its peak, the proposal is expected to generate an additional 16 vehicle movements a day consisting of 5 light vehicles and 3 heavy vehicles per direction per day. It is therefore anticipated that hourly vehicle traffic from construction would consist of up to two heavy vehicle movements per hour during typical works, however during the morning and afternoon peak, an additional 5 light vehicles may pass along the route.

Section 3.1.4 outlines that an increase in road traffic noise during construction of less than 2dB would generally be considered acceptable. This corresponds to an approximate increase in traffic of 60 per cent increase.

Given existing traffic volumes and their designation as an approved B double route (refer NSW combined Higher Mass Limits and Restricted Access Vehicle Map), an increase of 2dB in not predicted on the Newell Highway, Camp / Bridge Street and Flint Street routes, and as such adverse road traffic noise impacts are not anticipated during daytime periods as a result of construction of the proposal. However, it is anticipated that heavy vehicles may generate impacts where they operate during night-time periods.

Existing traffic numbers on Bathurst Street are in the order of 98 vehicles per direction per day. Based on these numbers, no exceedance of the RNP criteria is predicted, however it is anticipated that minor road traffic noise impacts may occur along Bathurst Street during night and peak periods. Although it is noted that on Bathurst Street, construction activities are expected to be the dominant noise source during work periods.

Noise management measures have been recommended in Section 7.1 to assist in minimising the potential for noise disturbance, particularly along Bathurst Street.

4.8 DISCUSSION OF CONSTRUCTION NOISE IMPACTS

4.8.1 NCA01 – SUBURBAN PROPERTIES

RECOMMENDED STANDARD HOURS

Minor exceedances for NMLS (<5dB) are predicted at 166 residential properties in NCA01 during Standard (daytime) hours during site establishment and demobilisation work, which will be undertaken for short time periods at the start and end of the works. Up to 23 properties may experience exceedances of up to 10dB during daytime site establishment works.

Noise impacts are expected to be primarily associated with use of the grader during small scale earthwork type activities. Where use of this equipment is avoided, exceedances are not anticipated during either work stage.

No properties are expected to exceed the highly noise affected NML of 75dBA $L_{eq\ 15\ min}$.

OUTSIDE OF STANDARD HOURS

No exceedances are predicted during typical bridge work activities during Out of Hours Works periods, due to the assumption that abrasive blasting and concrete saws will not be used.

Minor exceedances may be experienced at up to 10 properties during activities in the vicinity of the site compound during Out of Hours Works periods. It is expected that these impacts would be easily mitigated through the adoption of standard noise mitigation methods (refer Section 4.10).

No sleep disturbance impacts have been predicted.

Works are predicted to comply with relevant criteria at the remaining receivers for all scenarios.

4.8.2 NCA02 – SEMI RURAL PROPERTIES

RECOMMENDED STANDARD HOURS

Construction noise levels greater than the NMLS are predicted at a 132 receivers in NCA02 during Standard (daytime) hours, primarily during site establishment and demobilisation work, which will be undertaken for short time periods at the start and end of the works. Up to 3 properties may experience exceedances of more than 20dB during Standard (daytime) hours site establishment works.

Noise impacts are expected to be primarily associated with use of the grader during small scale earthwork type activities. Where use of this equipment is avoided, exceedances will be substantially reduced.

No properties are expected to exceed the highly noise affected NML of 75dBA $L_{eq\ 15\ min}$.

OUTSIDE OF STANDARD HOURS

During night-time bridge works, up to 18 properties are predicted to experience noticeable noise impacts, with exceedances of between 10 to 20dB at 3 properties. These lower impacts are due to the assumption that abrasive blasting and concrete saws will not be used and that site establishment and demobilisation are not proposed for out of hours work.

Minor to moderate exceedances may be experienced at up to 39 properties during activities in the vicinity of the site compound during Out of Hours Works periods.

Sleep disturbance impacts have been predicted at up 7 receivers.

4.8.1 SUMMARY

Construction noise levels are primarily predicted to exceed construction NMLs at residential receivers during site establishment and demobilisation activities. As these work stages are expected to be short term and carried out during standard (daytime) hours, predicted impacts during these stages are considered to be minor, and can be managed with appropriate measures outlined in this report.

During bridge works, minor (up to 5dBA) exceedances of daytime NMLs has been predicted at 92 residences, with more noticeable exceedances (up to 10dBA) at the nearest 41 properties. During Out of Hours Night work, these numbers are anticipated to decrease to 15 (up to 5dBA) and 3 properties (up to 20dBA). These predictions are based on the assumption that the use of high noise equipment, such as concrete saws and abrasive blasting can be avoided outside of standard hours. Use of the site compound would generate greater noise impacts during Out of Hours Night work with 43 properties (up to 5dBA) and 6 properties (up to 20dBA) experiencing exceedances.

The majority of bridge works would be completed during 9–16 hour track possessions, which could occur up to five times a week. Timing of possessions is subject to the train timetables at the commencement of the work.

Sleep disturbance impacts have been predicted at 7 receivers.

Noise management and mitigation measures would therefore be required to be implemented during construction of the proposal within the extent that is reasonable and feasible. Details of such noise mitigation are included in Section 7.1.

4.9 CUMULATIVE CONSTRUCTION NOISE ASSESSMENT

Sensitive receivers may be potentially impacted by cumulative noise levels associated with separate construction scenarios occurring simultaneously at adjacent worksites. Table 4.4 outlines project that are in planning stages in the vicinity of the Forbes Station and yard proposal. No other developments have been identified in the vicinity of other sites.

Table 4.4 Projects potentially affecting cumulative noise impacts

PROPOSAL	DESCRIPTION	LOCATION	COMMENTS
Forbes Station and yard	Track and station infrastructure upgrades	2km north west of Lachlan River Bridge	Where track works on southern areas of Forbes Station and Yard coincide with works at Lachlan River Bridge, some cumulative impacts may occur at receivers in the close vicinity of Forbes Station.
Wyndham Avenue	Track lowering	2.7km north east of Lachlan River Bridge	Where works at Lachlan River Bridge coincide with works at Wyndham Avenue, some cumulative impacts may occur for receivers in the north of Forbes.
Daroobalgie Loop	Track works	7.7km north east of Lachlan River Bridge	No cumulative noise impacts are predicted to occur from this project.
Daroobalgie Solar Farm	New 100MW solar farm	9km north east of Lachlan River Bridge	No cumulative noise impacts are predicted to occur from this project.
Edward Street subdivision	New subdivision for 223 residential properties and associated services	4.5km north west of Lachlan River Bridge	No cumulative noise impacts are predicted to occur from this project.

In most cases the cumulative noise impact experienced at these receivers will be equivalent to the highest construction noise level, or in worst case scenarios up to 3dBA higher than the highest noise level. These cumulative impacts would be experienced for limited periods of time when the highest noise generating construction activities in each area are occurring simultaneously.

In order to quantify specific cumulative impacts, it is essential to understand the scheduling for each project and further assessment on cumulative noise impacts should be undertaken during preparation of the Construction Noise and Vibration Management Plan (CNVMP) (refer Section 7.1).

4.10 RESIDUAL CONSTRUCTION NOISE IMPACTS

Specific noise mitigation measures will be determined by the construction contractor during detailed construction planning. Where residual exceedances occur after the implementation of reasonable and feasible site specific mitigation measures, the *ARTC Construction Noise and Vibration Framework (CNVF)* provides guidance on additional mitigation measures to be implemented for each receiver depending on the magnitude of residual exceedance. These are discussed further in Section 7.1.

Table 4.5 presents typical noise reductions from a selection of standard noise management measures.

Table 4.5 Indicative noise reduction from construction controls

REF	ENGINEERING CONTROLS	POSSIBLE NOISE BENEFIT, dBA
1	Portable temporary screens	5–10
2	Screen or enclosure for stationary equipment	10–15
3	Maximising the offset distance between noisy plant items and sensitive receivers	3–6
4	Avoiding using noisy plant simultaneously and/or close together, adjacent to sensitive receivers	2–5
5	Orienting equipment away from sensitive receivers	3–5
6	Carrying out loading and unloading away from sensitive receivers	3–5
7	Using noise source controls, such as the use of residential class mufflers, to reduce noise from all plant and equipment including bulldozers, cranes, graders, excavators and trucks	5–10
8	Selecting site access points and roads as far as possible away from sensitive receivers	3–6

Table 4.6 outlines potential noise reductions during each work stage where relevant standard mitigation measures have been adopted. Where these specific management measures are not implanted, actual noise levels are predicted to be somewhat higher.

Table 4.6 Predicted achievable noise reductions

WORK STAGE	ASSUMED NOISE MANAGEMENT MEASURES[1]	POTENTIAL NOISE REDUCTION dBA
Site establishment	3, 7	11
Bridge works	1, 2	15
Demobilisation	3,7	11
Compound operation	1,6	8

(1) Refer Table 4.6

Where these reductions are applied to the predicted construction noise levels outlined in Table 4.2, the number of properties predicted to experience noise levels in excess of the NMLs is substantially reduced. The updated noise levels are provided below in Table 4.7.

Table 4.7 Predicted construction noise exceedances at residential receivers (per NCA)

WORK STAGE	NML $L_{Aeq(15\ min)}$	NUMBER OF PROPERTIES EXCEEDING NML, GROUPED BY MAGNITUDE OF EXCEEDANCE					HIGHLY NOISE AFFECTED
		0–5dB	5–10dB	10– 20dB	20–30dB	>30dB	>75dB
NCA01 (Total number of receivers 816)							
Standard hours[1]							
Site establishment	49	0	0	0	0	0	0
Bridge works	49	0	0	0	0	0	0
Demobilisation and rehabilitation	49	0	0	0	0	0	0
Compound operation	49	0	0	0	0	0	0
Outside standard hours – Day time/Evening[1]							
Bridge works	44	0	0	0	0	0	0
Compound operation	44	0	0	0	0	0	0
Outside standard hours – Night[1]							
Bridge works	41	0	0	0	0	0	0
Compound operation	41	0	0	0	0	0	0
NCA02 (Total number of receivers 161)							
Standard hours							
Site establishment	41	22	2	3	0	0	0
Bridge works	41	2	0	1	0	0	0
Demobilisation and rehabilitation	41	8	2	1	0	0	0
Compound operation	41	2	0	1	0	0	0
Outside standard hours – Day time/Evening							
Bridge works	36	1	0	0	0	0	0
Compound operation	36	2	0	1	0	0	0
Outside standard hours – Night							
Bridge works	36	1	0	0	0	0	0
Compound operation	36	2	0	1	0	0	0

With the incorporation of standard noise mitigation measures, impacts during night time periods are expected to affect less than 11 properties.

4.10.1 ADDITIONAL CONSTRUCTION NOISE MANAGEMENT FOR RESIDUAL IMPACTS

Where all reasonable and feasible standard mitigation measures have been applied and exceedances are still predicted to occur, Chapter 7 provides guidance on additional mitigation measures to be implemented for each receiver. These will be considered in detail during preparation of the Construction Noise and Vibration Management Plan (CNVMP) for the proposal.

5 CONSTRUCTION VIBRATION ASSESSMENT

Vibration-generating equipment is required for certain construction activities. Vibration from this construction plant has the potential to affect nearby sensitive receivers. The only vibration-generating plant indicated to be required during construction are vibratory rollers.

Table 5.1 presents the indicative minimum working distances for the nominated construction plant to minimise the risk of cosmetic damage to residential buildings and human comfort for sensitive receivers. Vibration levels and minimum safe working distances have been sourced from the Roads and Maritime Construction Noise and Vibration Guideline (CNVG).

The minimum working distances are based on the typical distances between proposed works and sensitive receivers to meet the limits set out in Section 3.2. Note that these distances are indicative only and results may vary depending on the activity, equipment, local ground, and receiver conditions.

Table 5.1 Recommended minimum working distances for vibration intensive plant

PLANT ITEM	MINIMUM WORKING DISTANCE (m)	
	Cosmetic damage	Human response
Vibratory roller (7-13T)	15 m	100 m

Source: RMS CNVG.

The nearest vibration sensitive receivers to the proposal are presented in Table 2.1. These results show that potential impacts to human comfort may occur at the following residence during site establishment works:

- 289 Bathurst Street, Forbes.

No vibration impacts are predicted to occur during bridge works.

Vibration impact for the locally heritage listed Lachlan River Bridge has been considered, however given existing train movement, it is considered to be structurally sound and resilient to the predicted levels of ground vibration during earthworks at the site compound.

No cosmetic damage is predicted to occur at any site. With the exception of the bridge itself, no other vibration sensitive heritage items or infrastructure has been identified within the minimum working distances outlined in Table 5.1. Given the bridge is currently in use and exposed to high levels of vibration from freight train movements, construction activities are not anticipated to impacts the structure of the bridge.

6 OPERATIONAL NOISE AND VIBRATION ASSESSMENT

6.1 TRAIN OPERATION

The proposal would form part of the rail network managed and maintained by ARTC. Train services would be provided by a variety of operators. Inland Rail as a whole would be operational once all 13 sections of the overall project are complete, which is estimated to be in 2027.

Inland Rail would operate 24 hours per day and would initially accommodate double-stacked freight trains of up to 1,800 metres in length and up to 6.5 metres high. Train speeds would vary according to axle loads and range from 80 to 115kms per hour.

It is estimated that Inland Rail would be trafficked by an average of 12 trains per day (each direction) in 2027, increasing to about 18 trains per day (each direction) in 2039. This rail traffic would be in addition to the existing rail traffic using other lines that the proposal interacts with, as described in Section 3.2.3.

The Inland Rail trains would be a mix of grain, bulk freight and other general transport trains. Total annual freight tonnages would be about 10 million tonnes in 2027, increasing to about 17.5 million tonnes in 2040.

The assessment of railway noise and vibration considers the redevelopment of the existing rail infrastructure, as part of the proposal, and the future railway operations forecast to occur once Inland Rail commences operations.

6.2 TRAIN NUMBERS

The noise assessment has considered exiting railway operations based on the year 2020, the future railway operations once Inland Rail commences operations in 2027 and the future capacity of Inland Rail in the year 2040. The daily train movements were adopted from ARTC's *Technical Note - IR Tonnage Profile and Train Plan*[1] and ARTC's noise emission modelling methodology for Inland Rail[2].

The train movements for each year of assessment are detailed in Table 6.1. For the purpose of assessing noise levels, an approximate 60:40 split of the daily train movements was assumed for daytime and night-time periods.

Table 6.1 Typical daily train numbers for noise modelling (both directions)

YEAR	TRAIN TYPE	TOTAL LENGTH (m)	LOCOMOTIVE CLASS	TYPICAL DAYTIME	TYPICAL NIGHT-TIME	DAILY AVERAGE
2020 existing	NSW grain freight	984	82	3	2	5
2027 proposal opening	NSW grain freight	984	NR	1	1	2
	Inland Rail superfreighters	1,750	NR	5	4	9
	Steel freight	1,000	NR	1	0	1
2040 future capacity	NSW grain freight	984	NR	1	2	3
	Inland Rail superfreighters	1,750	NR	8	6	14
	Steel freight	1,000	NR	1	0	1

1 ARTC document 0-00000-900-POP-00-TN-0001_3.

2 ARTC document 01-9000-PE-P00-ME-1005 REV2.

The total daily train movements are summarised in Table 6.2. The train numbers are based on the total daily train movements and rounded to the nearest integer to represent a whole train.

Table 6.2 Summary of total daily train movements (each direction)

YEAR	TYPICAL DAYTIME	TYPICAL NIGHT-TIME	TOTAL 24-HOURS
2020 existing	3	2	5
2027 proposal opening	7	5	12
2039 future capacity	11	7	18

6.3 OPERATIONAL NOISE MODELLING METHODOLOGY

A noise prediction model was developed using SoundPLAN 8.2 noise modelling software. Railway noise levels for daytime and night-time railway operations at the proposal site were calculated utilising the Nordic Rail Prediction Methodology (Kilde 130). In addition to the train movements detailed above, the noise modelling adopted the approach detailed in Table 6.3.

Table 6.3 Noise modelling inputs and parameters

MODELLING ASPECT	APPROACH
Train speeds	80km/h all areas for existing (2020) and future (2027 and 2039) traffic
Ground absorption	0.6
Façade correction	+2.5dBA
Bridge correction	+4dBA for a ballasted, fabricated steel box girder, no side screens
Level crossing	+6dBA to wheel rail emission
Locomotive notch	Medium (flat/level track)
Track curvature	No tight radius curves
Receivers	Digitised from the PSMA Geoscapes database with receivers at 1m from each building façade 2.4m above ground level.

Noise levels were modelled for an area 500m either side of the track alignment.

Buildings were reviewed to identify sensitive receivers consistent with the classification of receivers in the RING. The buildings identified as not being sensitive receivers were retained in the noise model as they will screen railway noise.

At this stage of the design, the specific notch operations of the locomotives as they traverse the alignment was not confirmed. For the purpose of assessment, a medium notch setting was applied at all locations as the track gradient is relatively level and uphill movements (high notch setting) or dynamic braking on downhill sections was not identified.

Local railway infrastructure was identified from aerial imagery, for example as rail bridges over waterways and level crossings where the rail alignment intersects the local road network.

6.4 ASSESSMENT OF RAILWAY NOISE LEVELS

6.4.1 OVERVIEW

Noise levels were calculated for the daytime and night-time railway operations for; existing railway operations (2020), the opening year of railway operations within the proposal (2027) and the future capacity of Inland Rail (2039). The predicted noise levels at the sensitive receivers have been assessed against the noise management levels from the RING.

The railway noise levels at residential receivers are detailed in Appendix C with maps shown in Appendix D. The existing railway noise levels (2020) are not required to be assessed against the noise management triggers and have been referenced only to quantify the potential change in railway noise levels with the proposal.

6.4.2 SUMMARY OF RAILWAY NOISE LEVELS

A summary of the predicted railway noise levels, and residential receivers triggering a review of noise mitigation, is provided in Table 6.4.

The proposed upgrades to the Lachlan River Bridge have been identified to not materially change railway noise levels and, in isolation, do not trigger a review of railway noise mitigation.

The railway noise levels, and predicted change from existing railway noise, are influenced by the proposed railway operations with Inland Rail in 2027 and 2039. This includes more trains per daytime and night-time period, longer trains and the introduction of new types of rollingstock.

Table 6.4 Assessment of railway noise levels 2027 and 2039

YEAR	RAILWAY NOISE ASSESSMENT	NOISE TRIGGERS
2027	At residential receivers, railway noise levels with the proposal are predicted up to: — Daytime 57dBA $L_{Aeq15hr}$ — Night-time 58dBA L_{Aeq9hr} — Maximum 72dBA L_{Amax} Change (increase) in railway noise from existing operations: — Daytime 6dBA $L_{Aeq15hr}$ — Night-time 6dBA L_{Aeq9hr} — Maximum 2dBA L_{Amax}	The daytime, night-time and maximum railway noise levels do not trigger a review of mitigation.
2039	At residential receivers, railway noise levels with the proposal are predicted up to: — Daytime 59dBA $L_{Aeq15hr}$ — Night-time 60dBA L_{Aeq9hr} — Maximum 72dBA L_{Amax} Change (increase) in railway noise from existing operations: — Daytime 8dBA $L_{Aeq15hr}$ — Night-time 7dBA L_{Aeq9hr} — Maximum 2dBA L_{Amax}	The daytime, night-time and maximum railway noise levels do not trigger a review of mitigation.

6.5 LEVEL CROSSING

The proposed upgrade to the Lachlan River Bridge does not include the existing level crossing located to the north of the bridge, where the rail line crosses Bathurst Street. On this basis, the proposed infrastructure upgrades will not influence noise from level crossings.

There is potential for the future railway operations to change the noise levels associated of the level crossing. The increased train movements in the daytime and night-time periods are likely to result in addition train horn and level crossing events. These additional events are not expected to materially influence the 15-hour daytime and 9-hour night-time L_{Aeq} railway noise levels.

The 95th percentile L_{Amax} noise levels at individual receivers can be influenced by the train horns depending on the number of events and the various noise level contributions from the train passbys, level crossing alarm bells and train horn events. Nonetheless, there is potential for annoyance or disturbance due to the increase in the number of highest noise events where receivers experience train horn and/or level crossing noise.

The track speed through the Forbes area is not proposed to change from the existing 80km/h and the northbound and southbound trains are expected to sound their horns on the approach to the level crossing at locations which are similar to the current operations.

It is recommended that a detailed assessment of noise from railway operations at level crossings is undertaken during detailed design when the various sources of noise during each 24-hour period are known, including the future location of train horn events for northbound and southbound rail traffic.

6.6 ASSESSMENT OF RAILWAY VIBRATION

6.6.1 GROUND-BORNE VIBRATION

In isolation, the upgrade of the track as part of the horizontal clearances is not expected to materially change the potential levels of ground-borne vibration that may be experienced at existing receivers.

The assessment has considered the future railway operations with Inland Rail. Referencing the proposed daytime and night-time train movements for 2027 and 2039. To assess potential impacts from ground-borne vibration a reference vibration dose value (VDV) for a freight train passby of 0.04m/s$^{1.75}$ at 15m was adopted from measurement and assessment of vibration on Inland Rail.

The calculated distance from the nearest rail to meet the VDV assessment criteria are detailed in Table 6.5.

Table 6.5 Ground-borne vibration assessment

RAILWAY OPERATIONS	GROUND-BORNE VIBRATION OFFSET DISTANCE	
	Daytime	Night-time
Proposal opening (2027)	7m	9m
Future capacity (2039)	7m	9m

Note: Daytime criterion 0.2m/s$^{1.75}$ and night-time criterion 0.13m/s$^{1.75}$

An offset distance of 9m is estimated to meet the assessment criteria. There are no sensitive receivers within 9m from the rail line, all other sensitive receivers are at least 45m from the rail line at the horizontal clearances. Some structures are located closer than this distance, however they are unoccupied and as such not subject to VDV assessment.

Based on the scoping assessment there is a relatively low risk of impact from railway induced vibration at most sensitive receivers. Notwithstanding, there can still be potential for train passbys to result in perceptible ground-borne vibration at sensitive receivers even where the assessment criteria are met.

6.6.2 GROUND-BORNE NOISE

In isolation, the upgrade of the track as part of the horizontal clearances is not expected to materially change the potential levels of ground-borne noise that may already be experienced at existing receivers.

Referencing a typical ground-borne noise emission level of 82dBA at 15m from a freight train passby, the more stringent night-time L_{ASmax} 35dBA criterion is conservatively estimated to be met at receivers located 45m or greater from the railway line.

The nearest receiver is approximately 45m from the rail line. Some structures are located closer than this distance, however they are unoccupied and as such not subject to an assessment of ground borne noise. At these distances the airborne railway noise is expected to be the dominant contribution and likely to mask the ground-borne noise component at habitable rooms facing the rail line.

Notwithstanding, the airborne noise may not fully mask the ground-borne noise within all rooms and there can still be a risk of minor perceptible ground-borne noise even where the criteria are achieved. The potential for impact will be dependent on the vibration propagation within individual buildings and the acoustic environment of the receiving rooms.

It is recommended that ground-borne noise is reviewed during the detailed design and pre-construction stage to verify the ground-borne noise levels and assessment outcomes.

7 MITIGATION AND MANAGEMENT MEASURES

7.1 CONSTRUCTION NOISE AND VIBRATION MANAGEMENT MEASURES

7.1.1 SITE SPECIFIC MITIGATION MEASURES

Based on the outcomes of this assessment, construction activities are anticipated to generate impacts at some receivers, requiring the implementation of noise management and mitigation measures.

The following site-specific construction noise mitigation measures should be considered during preparation of the CNVMP:

- Sections O9.1 to O9.16 of the ARTC EPL 3142.
- It is recommended that noisy works, particularly including the use of abrasive blasting and earthworks equipment are undertaken within ICNG standard hours (7am to 6pm Weekdays, 8am to 1pm Saturday) as far as practicable, to minimise impacts during sensitive sleeping/resting periods. Where work is required outside of ICNG standard hours, and there is an adverse impact to sensitive receivers resulting from the use of this equipment, sensitive periods such as after 10pm and before 7am should be avoided.
- Deliveries should be restricted to ICNG standard hours where practicable.
- Minimise speeds for project-related traffic in the vicinity of affected receivers.
- Minimise traffic movements during night-time on Bathurst Street.
- Avoid compression braking and the use of air brakes in the vicinity of affected receivers.
- It is recommended that screens are installed along the bridge scaffolding to minimise noise emissions.
- Screen or enclose stationary noisy equipment.
- Select the minimum feasible noise (or vibration) producing plant or method for each task.
- Maximise the separation distance between noisy plant items and sensitive receivers.
- Use equipment noise controls, such as the use of residential class mufflers to reduce noise from earthmoving plant and equipment.

7.1.2 ARTC INLAND RAIL ENVIRONMENTAL MANAGEMENT MEASURES

Construction noise and vibration would be managed in accordance with *ARTC Inland Rail Environmental Management Measures* (0-0000-900-EEC-00-PL-0001_0). Relevant management measures that would be implemented during construction and operation of the proposal are provided in Table 7.1 and Table 7.2.

Table 7.1 ARTC Inland Rail noise and vibration management measures for detailed design/pre-construction

REF	ISSUE / IMPACT	MITIGATION MEASURES – DETAILED DESIGN / PRE-CONSTRUCTION
CNV1	*Managing the potential for construction noise and vibration impacts*	Prior to the commencement of construction, noise and vibration impacts would be confirmed based on the final project design.
CNV2	*Minimising the potential for construction vibration (structural) impacts*	If vibration levels are predicted to exceed the screening criteria for a particular structure as a result of detailed design, a more detailed assessment of the structure and vibration monitoring would be carried out in accordance with the Inland Rail NSW Construction Noise and Vibration Management Framework, to ensure vibration levels remain below appropriate limits for that structure.

Table 7.2 Compilation of mitigation measures for construction

REF	ISSUE / IMPACT	MITIGATION MEASURES – CONSTRUCTION
CNV3	*Managing the potential for noise and vibration impacts during construction*	A construction noise and vibration management plan (CNVMP) would be prepared and implemented as part of the CEMP in accordance with the *Inland Rail NSW Construction Noise and Vibration Management Framework* and ARTC EPL3142. The plan would have measures, processes and responsibilities to manage and monitor noise and vibration and minimise the potential for impacts during construction. This plan will include: — construction noise and vibration criteria for the proposal — location of sensitive receivers in proximity to the construction area — specific management measures for activities that could exceed the construction noise and vibration criteria — notification of impacts would be undertaken in accordance with the communication management plan for the proposal.
CNV4	*Impacts of out-of-hours work*	An out-of-hours work protocol would be developed to define the process for considering, approving and managing out-of-hours work, including implementation of feasible and reasonable measures and communication requirements. Where noise impacts are identified, these would be reduced through pro-active communication and engagement with potentially affected receivers, selection of quieter equipment, provision of respite periods and/or alternative accommodation for defined exceedance levels. All work outside the primary proposal construction hours would be undertaken in accordance with ARTC EPL3142 and the *Inland Rail NSW Construction Noise and Vibration Management Framework* and in accordance with the out-of-hours work protocol. The protocol would provide guidance for the preparation of out-of-hours work plans for each construction work location and for key works. Out-of-hours work plans would be prepared in consultation with key stakeholders and the community and incorporated into the construction noise and vibration management plan.

7.2 OPERATIONAL NOISE MITIGATION

7.2.1 ARTC INLAND RAIL ENVIRONMENTAL MANAGEMENT MEASURES

During the detailed design and pre-construction phase the management and mitigation of railway noise and vibration shall adopt the measures outlined in the *ARTC Inland Rail Environmental Management Measures* (0-0000-900-EEC-00-PL-0001_0) The measures outlined in Table 7.3 would confirm the predicted operational outcomes and mitigate if required.

Table 7.3 ARTC Inland Rail noise and vibration management measures for detailed design/pre-construction

REF	ISSUE / IMPACT	MITIGATION MEASURES – DETAILED DESIGN / PRE-CONSTRUCTION / OPERATION
ONV1	*Noise and vibration impacts during operation*	Operational noise and vibration compliance monitoring would be undertaken, once Inland Rail has commenced operation, at representative locations to compare actual noise performance the RING.
ONV2		Feasible and reasonable mitigation measures would be identified where exceedances of operational noise and vibration criteria are confirmed. Measures would be identified in accordance with the Inland Rail Noise and Vibration Strategy. Where at-property noise treatment are identified as the preferred mitigation option, these would be developed in consultation with individual property owners.

8 CONCLUSION

WSP has undertaken a noise and vibration assessment for the Lachlan River Bridge section of the Inland Rail Project.

The assessment has identified residential properties surrounding the proposal site that may be affected by noise and vibration during construction of the project, particularly during work outside of Standard Hours.

Construction noise levels are primarily predicted to exceed construction NMLs at residential receivers during site establishment and demobilisation activities. As these work stages are expected to be short term and carried out primarily during Standard (daytime) hours, predicted impacts during these stages are considered to be minor, and can be managed with appropriate measures.

Where these works are conducted outside of standard hours, impacts may be more substantial and noise management measure shave been recommended. Following the adoption of recommended mitigation measures, residual impacts are substantially reduced, however impacts are still expected at several properties during these work stages. Noise impacts during the longest works period (bridge works) are expected to be much lower and impact up to 18 properties, with only 3 properties expected to experience noise more than 10dB above the NMLs. Sleep disturbance impacts have been predicted at up to 7 receivers.

Noise management and mitigation measures would therefore be required to be implemented during construction of the proposal within the extent that is reasonable and feasible. Details of such noise mitigation are included in Section 7.1.

Noise and vibration from railway operations have been assessed to meet the requirements of the RING at the identified sensitive receivers. On this basis mitigation is not required to control noise and vibration emissions for the operation of the proposal.

9 REFERENCES

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APPENDIX

E

Lachlan River Bridge Modification Project

Noise and Vibration Impact Assessment

Appendix A Detailed noise monitoring results

Site Details	9-3, 1 LITTLE UNION STREET, FORBES	**Microphone Position**	1.5m - free field
Start Date	Wed 03 March 2021		
End Date	Mon 15 March 2021		

Measurement Summary

Date	03-03	04-03	05-03	06-03	07-03	08-03	09-03	10-03
$L_{eq,1\ hour\ day}$ dBA	56	58	60	55	53	59	57	54
$L_{eq,1\ hour\ night}$ dBA	50	50	49	47	46	53	51	48
$L_{eq,\ Day}$ dBA	54	52	52	49	47	56	53	49
$L_{eq,\ Evening}$ dBA	48	49	47	41	43	48	41	48
$L_{eq,\ Night}$ dBA	45	44	44	41	48	47	46	41
RBL, $_{Day}$ dBA		38	41	33	35	41	38	36
RBL, $_{Evening}$ dBA	39	38	39	37	35	38	38	37
RBL, $_{Night}$ dBA	33	32	31	31	33	30	33	40

Date	11-03	12-03	13-03	14-03	15-03			
$L_{eq,1\ hour\ day}$ dBA	52	50	58	57	53			
$L_{eq,1\ hour\ night}$ dBA	48	44	49	48	48			
$L_{eq,\ Day}$ dBA	49	45	51	50	51			
$L_{eq,\ Evening}$ dBA	45	43	46	42				
$L_{eq,\ Night}$ dBA	39	47	40	41				
RBL, $_{Day}$ dBA	38		38	41				
RBL, $_{Evening}$ dBA	40	35	39					
RBL, $_{Night}$ dBA		37		28				

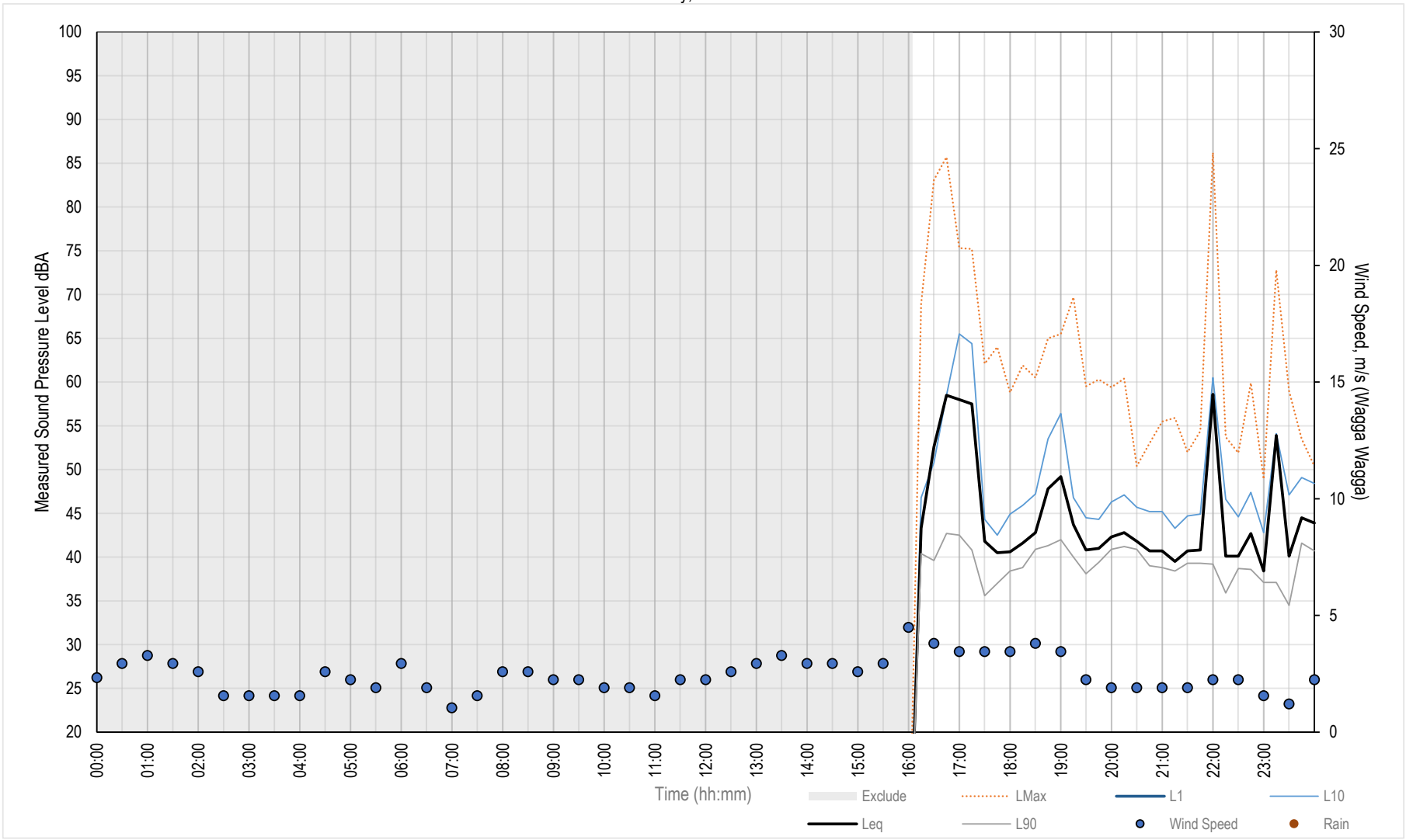
Summary	**Average (dBA)**
$L_{eq,\ Day}$ dBA	51
$L_{eq,\ Evening}$ dBA	45
$L_{eq,\ Night}$ dBA	44
RBL, $_{Day}$ dBA	38
RBL, $_{Evening}$ dBA	38
RBL, $_{Night}$ dBA	32

Summary	**Average (dBA)**
$L_{eq,1\ hour\ day}$ dBA	56
$L_{eq,1\ hour\ night}$ dBA	48
$L_{eq,\ 15\ hour\ day}$ dBA	51
$L_{eq,\ 9\ hour\ night}$ dBA	45

Site Photo

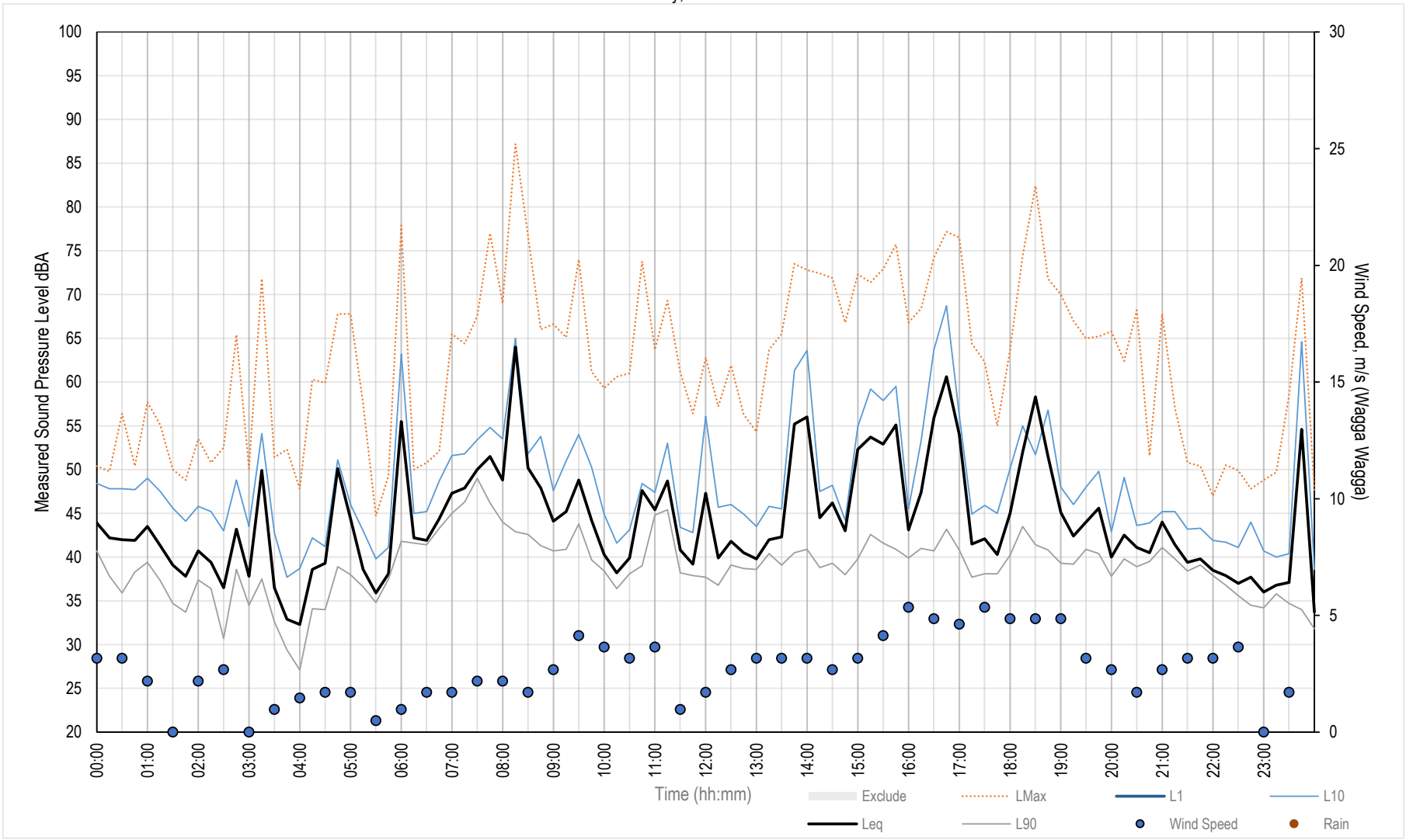
Measured Noise Levels - 9-3, 1 LITTLE UNION STREET, FORBES

Wednesday, 03 March 2021



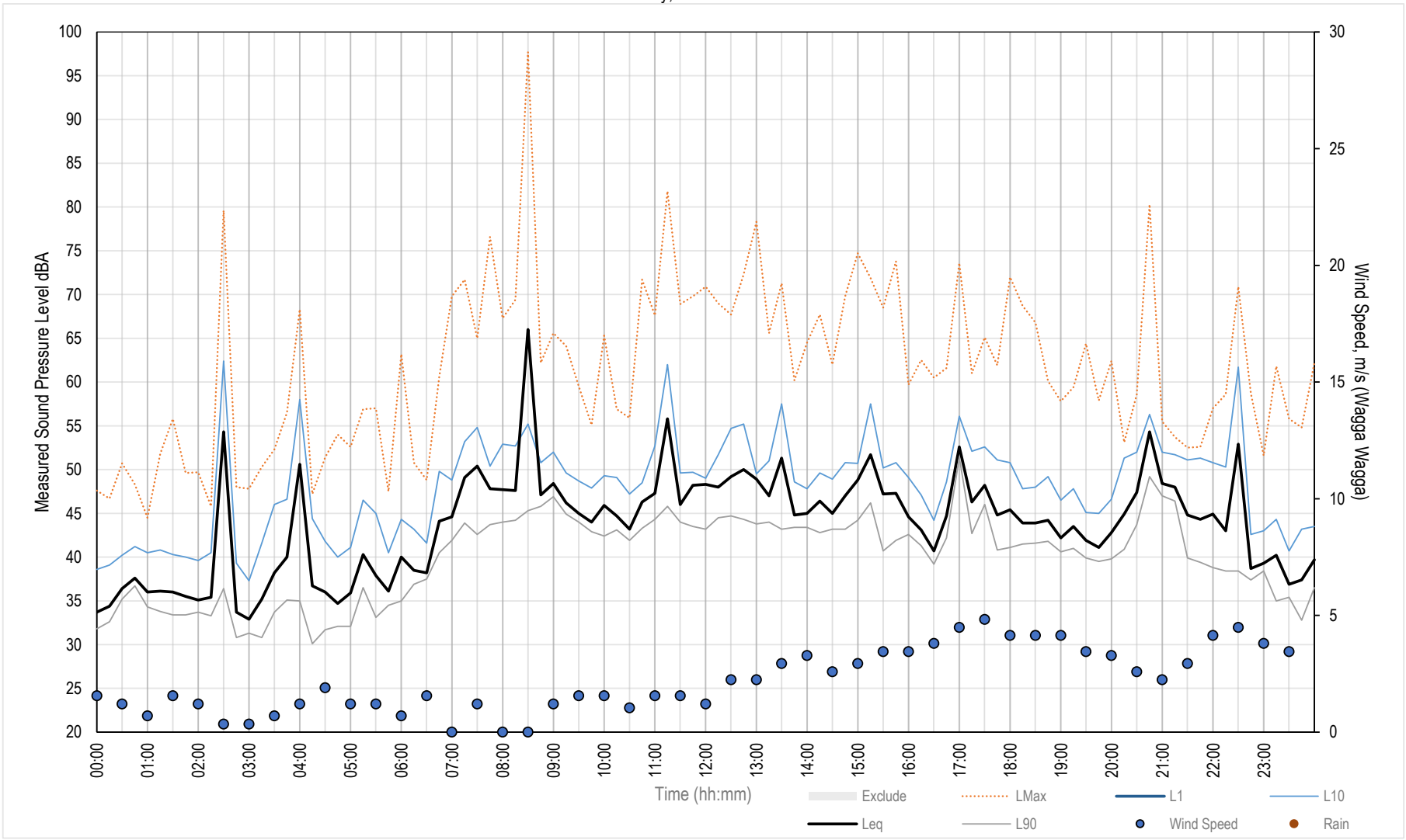
Measured Noise Levels - 9-3, 1 LITTLE UNION STREET, FORBES

Thursday, 04 March 2021



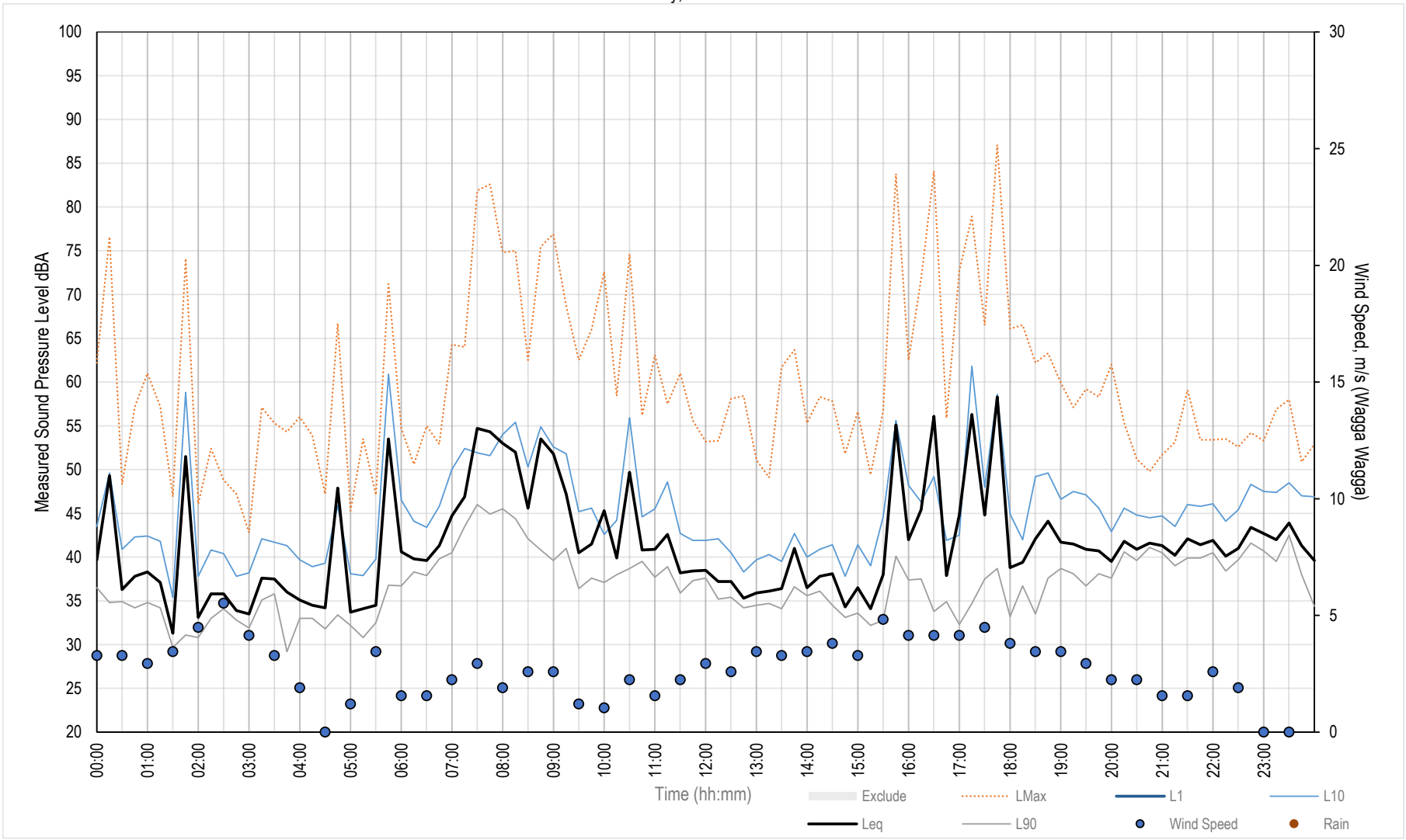
Measured Noise Levels - 9-3, 1 LITTLE UNION STREET, FORBES

Friday, 05 March 2021



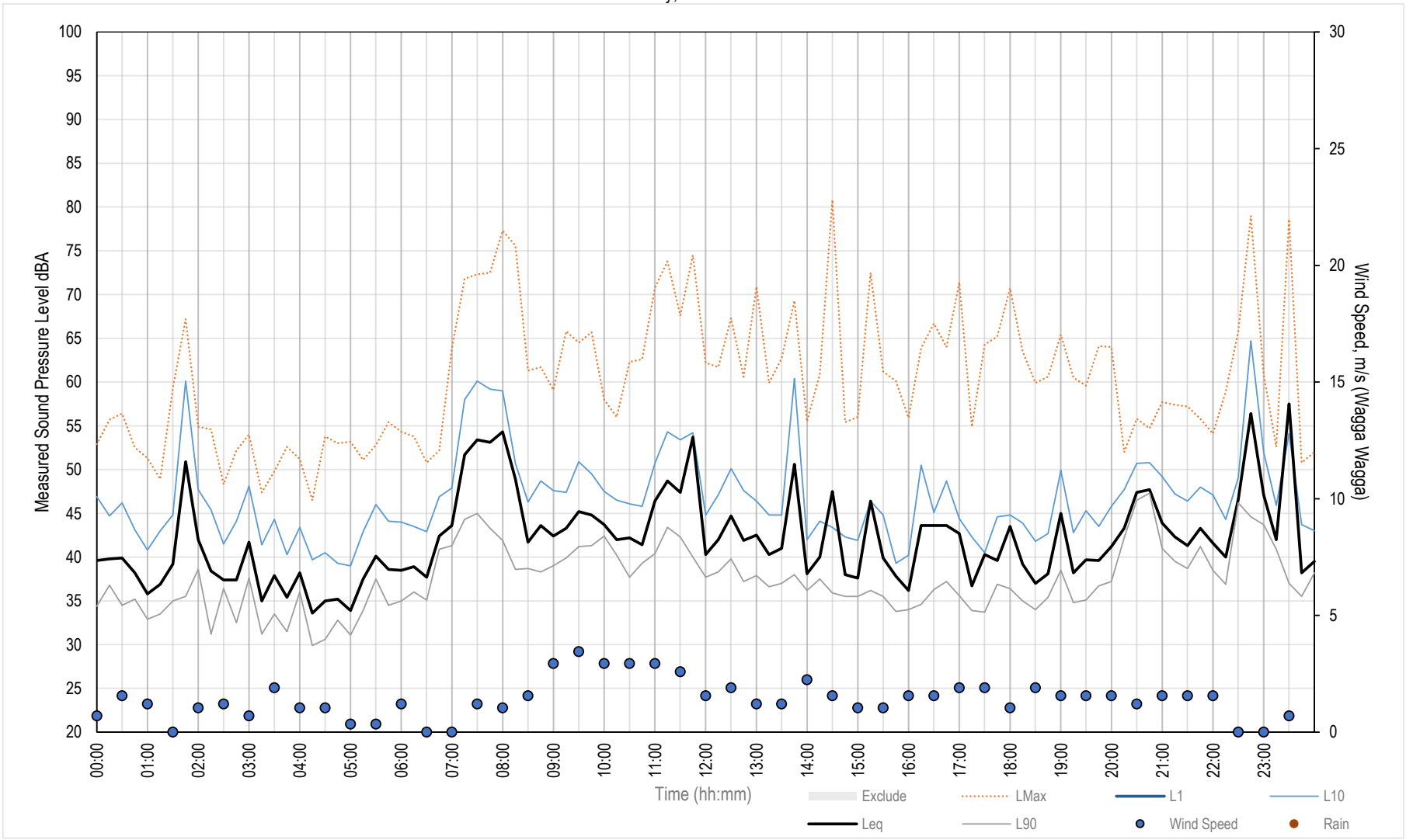
Measured Noise Levels - 9-3, 1 LITTLE UNION STREET, FORBES

Saturday, 06 March 2021



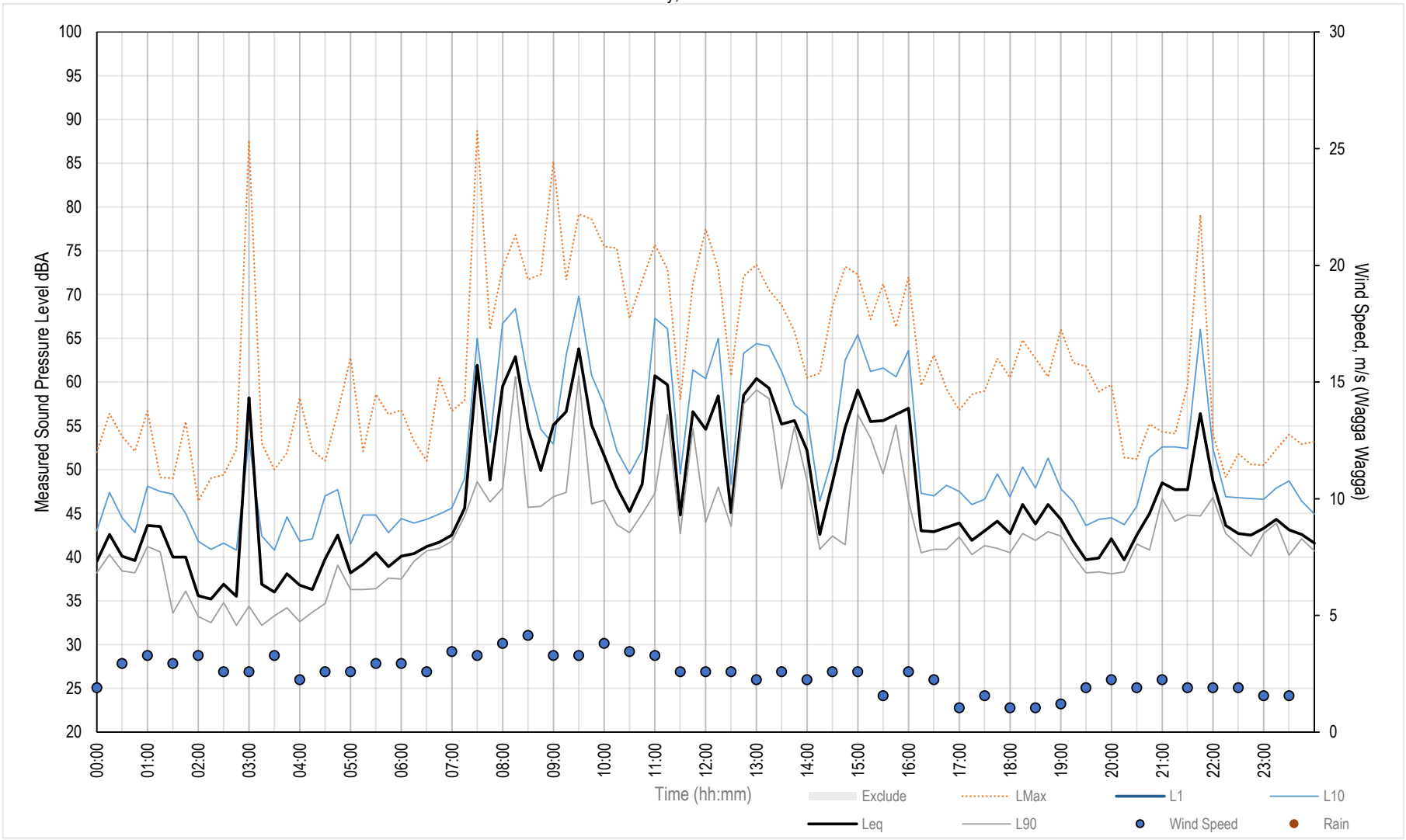
Measured Noise Levels - 9-3, 1 LITTLE UNION STREET, FORBES

Sunday, 07 March 2021



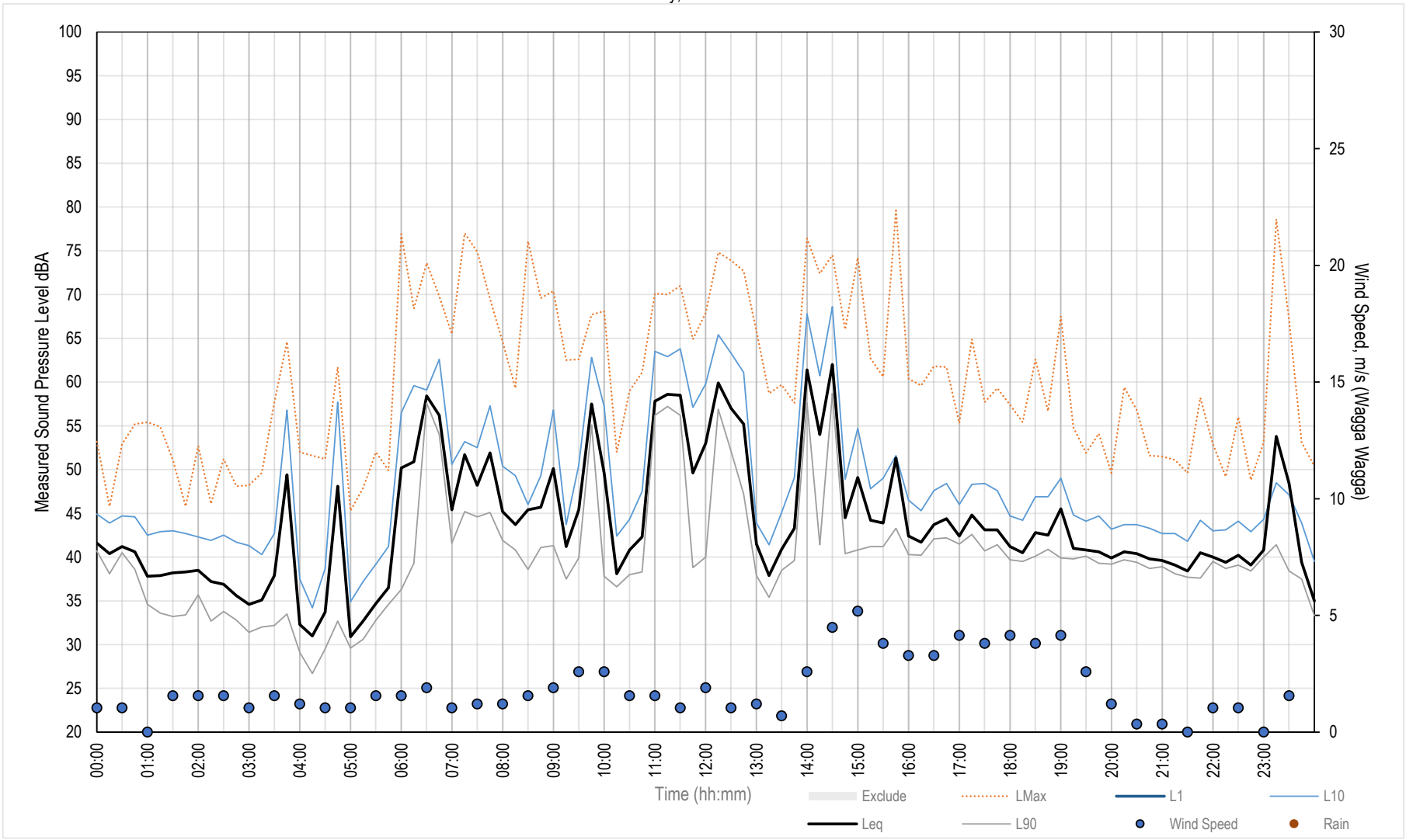
Measured Noise Levels - 9-3, 1 LITTLE UNION STREET, FORBES

Monday, 08 March 2021



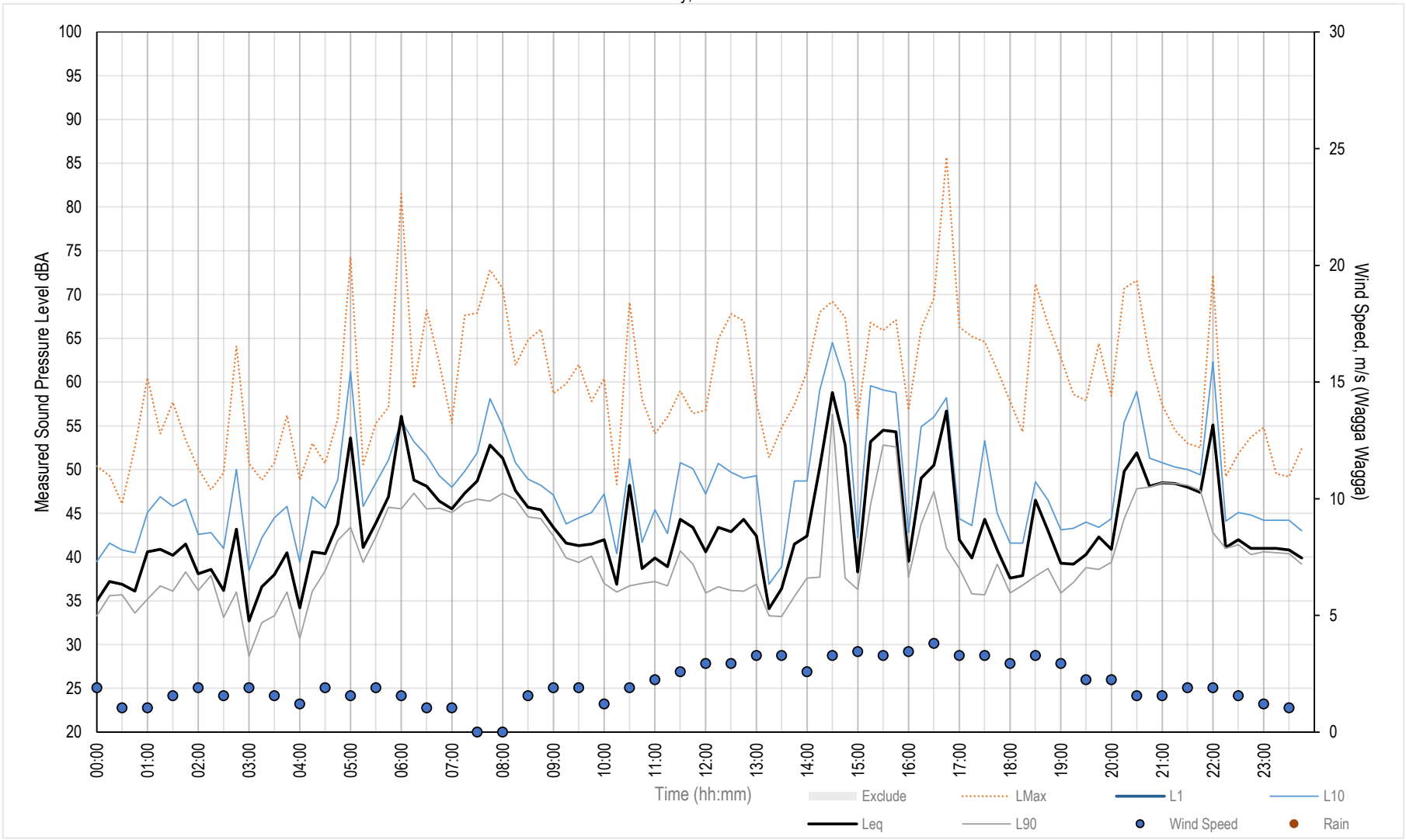
Measured Noise Levels - 9-3, 1 LITTLE UNION STREET, FORBES

Tuesday, 09 March 2021



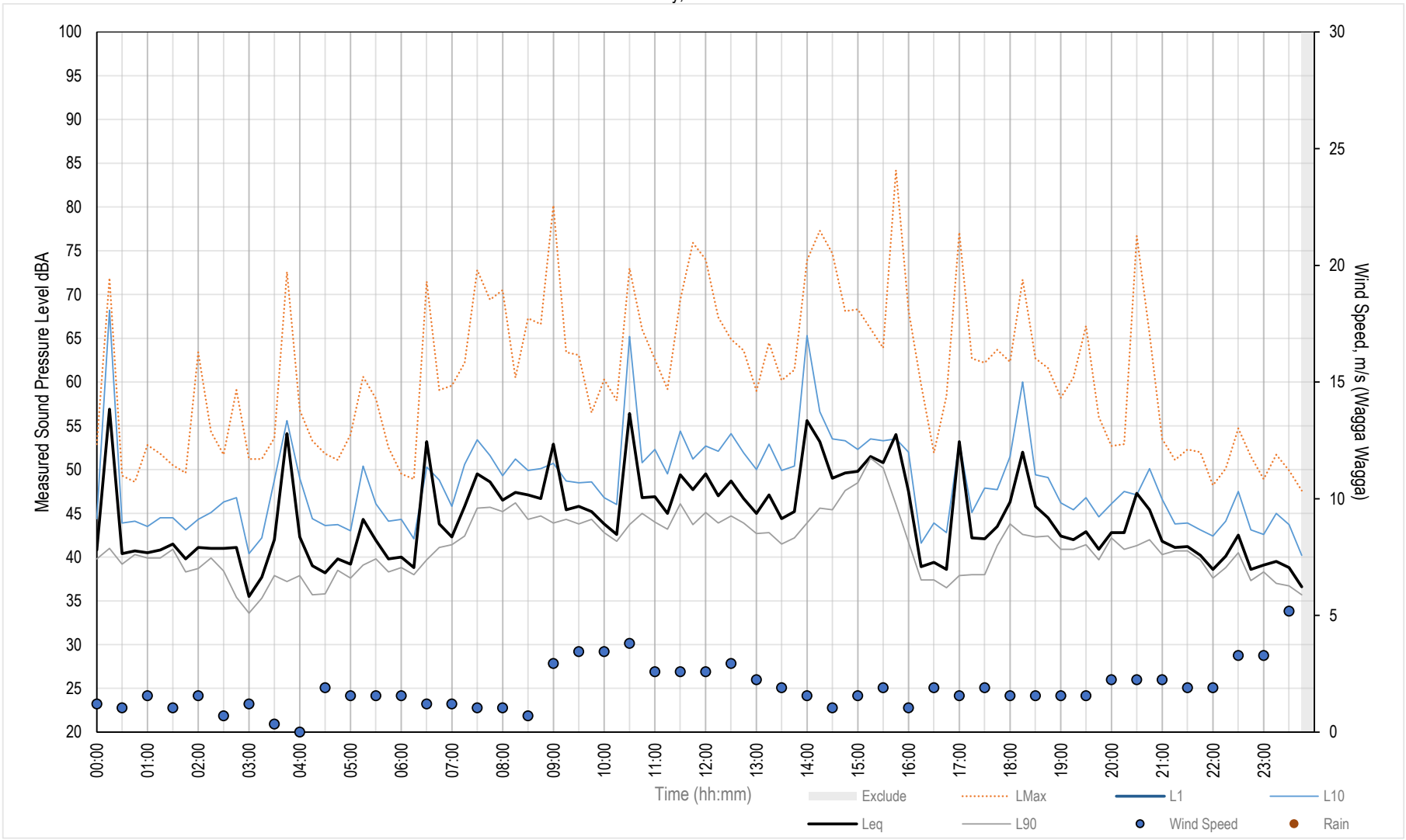
Measured Noise Levels - 9-3, 1 LITTLE UNION STREET, FORBES

Wednesday, 10 March 2021



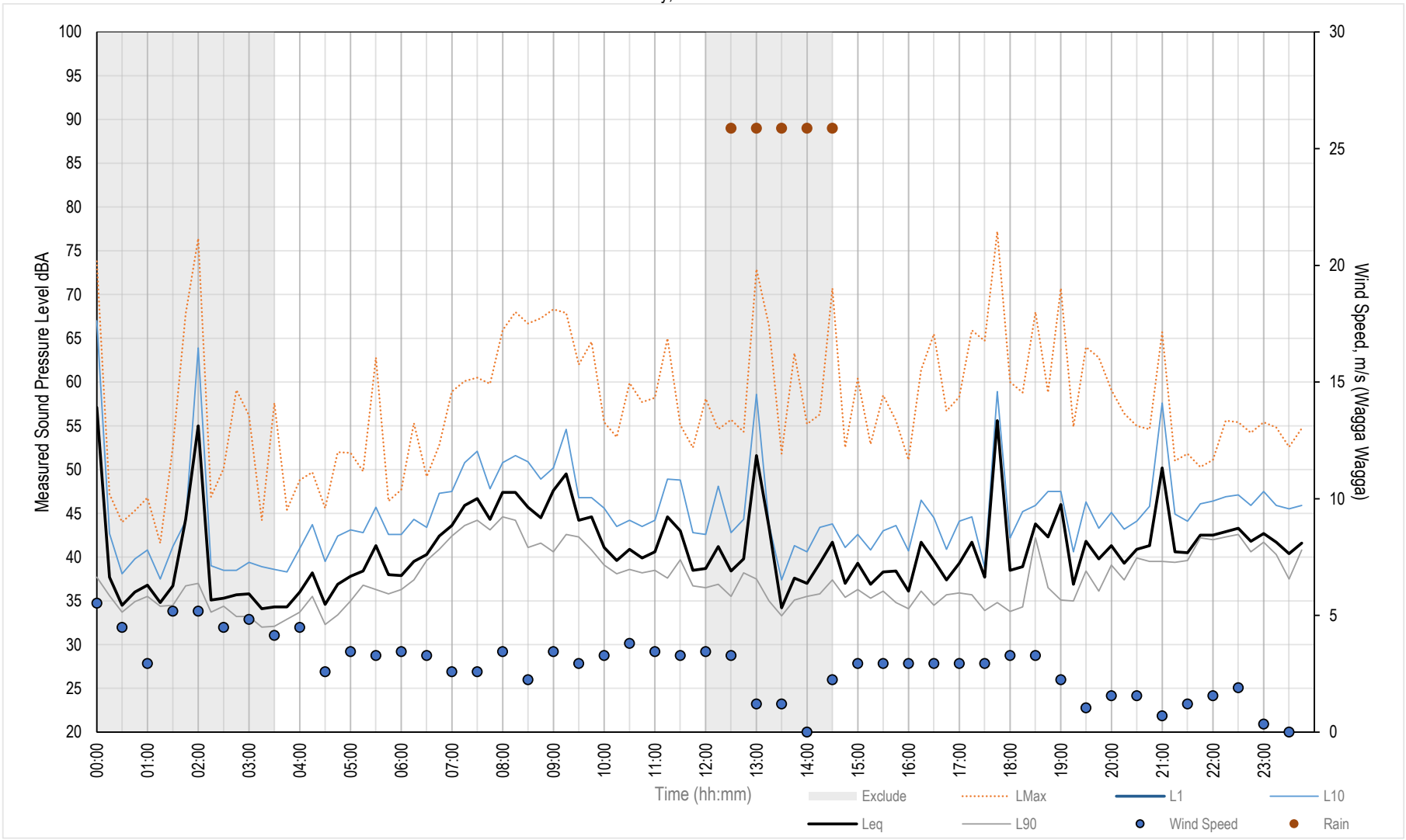
Measured Noise Levels - 9-3, 1 LITTLE UNION STREET, FORBES

Thursday, 11 March 2021



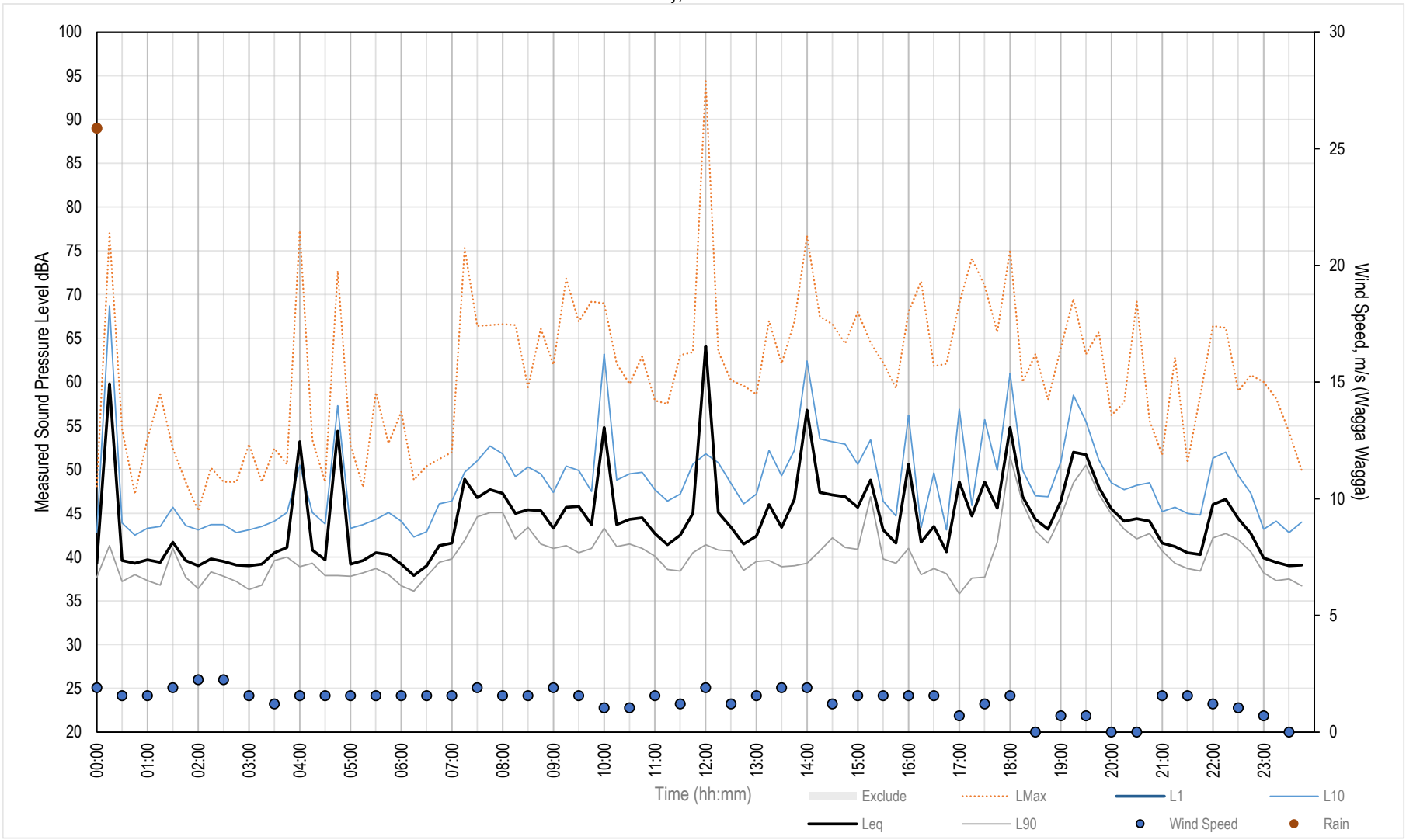
Measured Noise Levels - 9-3, 1 LITTLE UNION STREET, FORBES

Friday, 12 March 2021



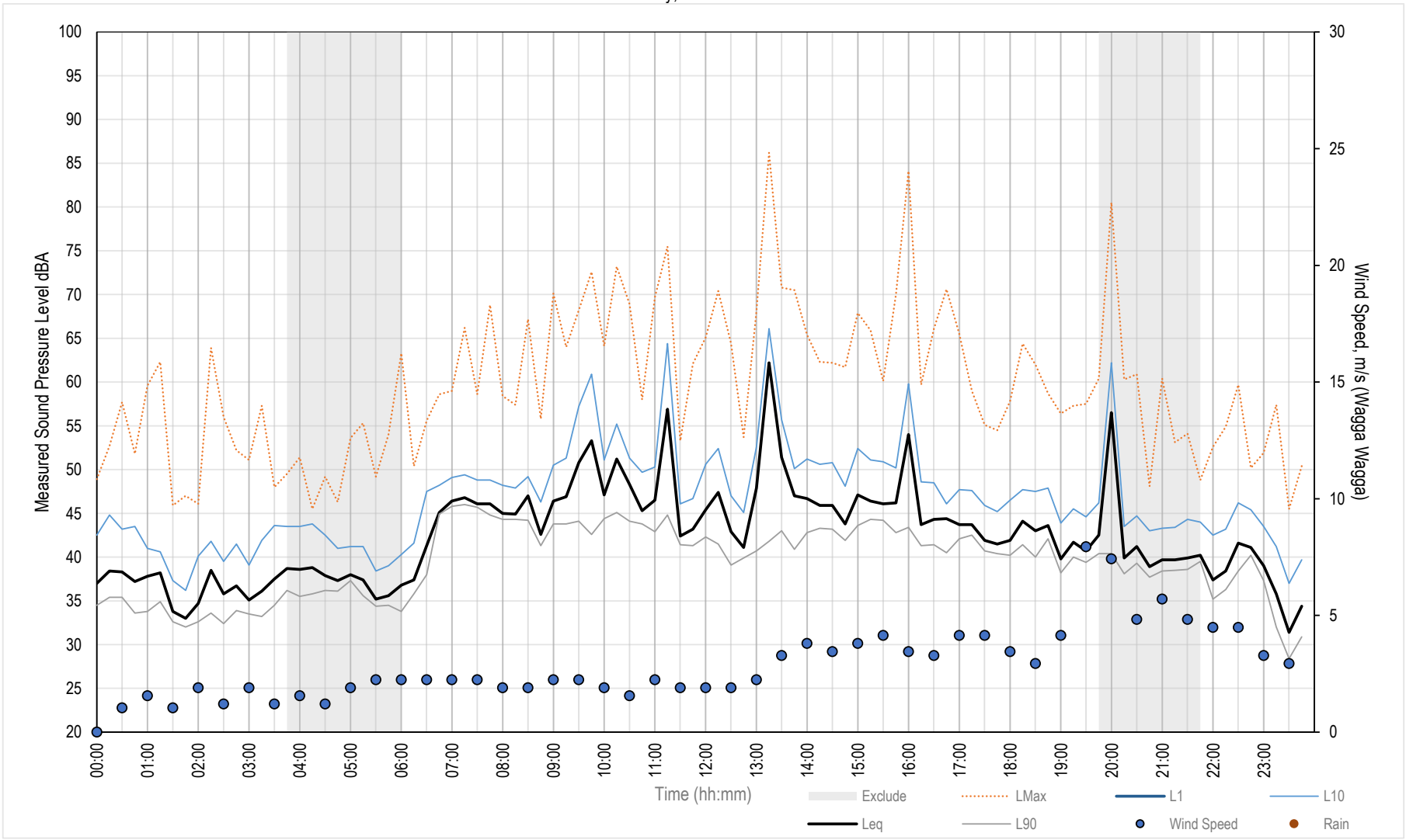
Measured Noise Levels - 9-3, 1 LITTLE UNION STREET, FORBES

Saturday, 13 March 2021



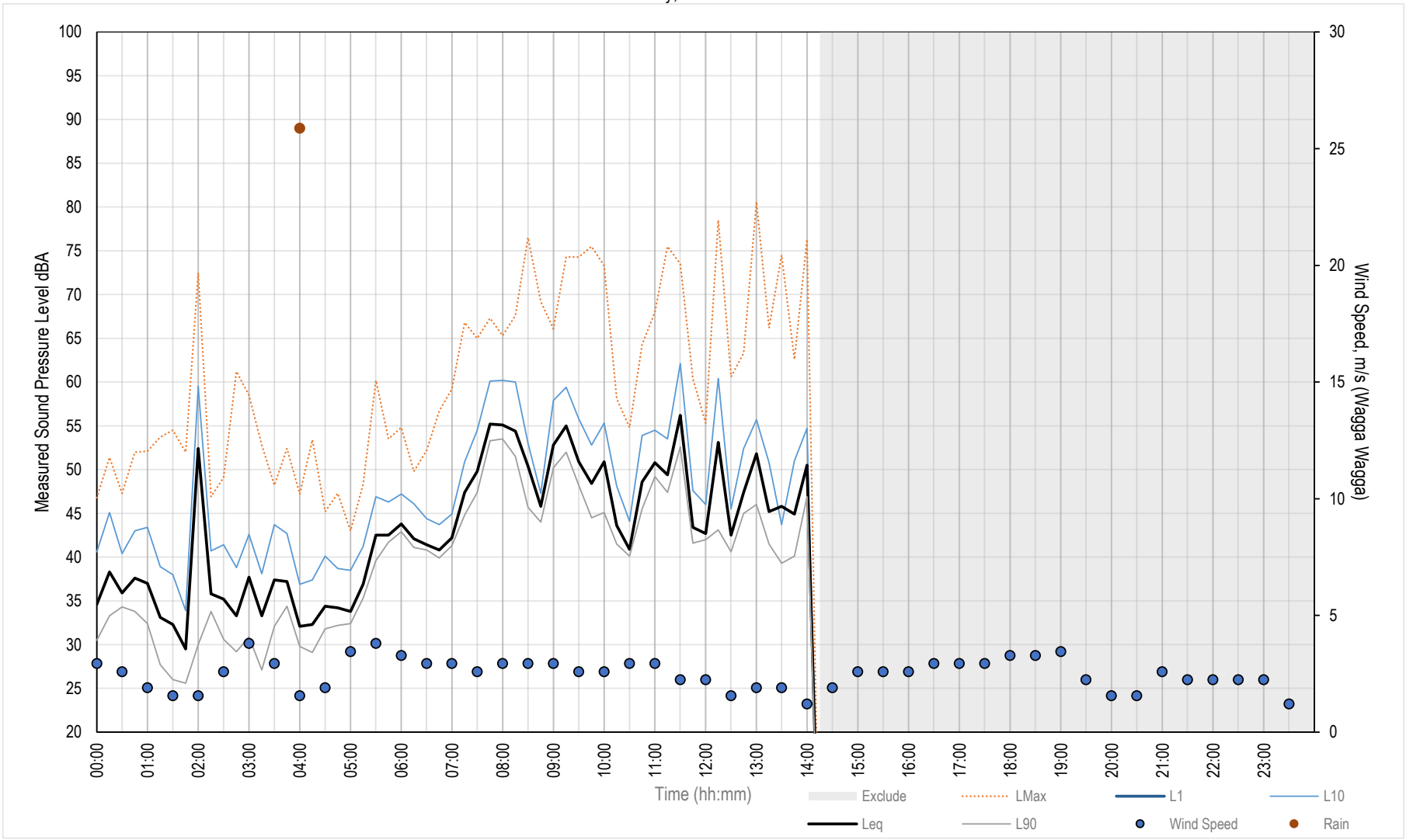
Measured Noise Levels - 9-3, 1 LITTLE UNION STREET, FORBES

Sunday, 14 March 2021



Measured Noise Levels - 9-3, 1 LITTLE UNION STREET, FORBES

Sunday, 14 March 2021



APPENDIX

E

Lachlan River Bridge Modification Project

Noise and Vibration Impact Assessment

Appendix B Construction façade noise maps (without mitigation)

Stockinbingal to Parkes Lachlan River Bridge

Appendix B - Daytime construction noise predictions - Figure B1 Site establishment

0 100 200 m

Coordinate System: GDA 1994 MGA Zone 55

Date: 29/07/2021 Paper: A3
Author: WSP Scale: 1:7,500
Data Sources: ARTC, NSWSS

- KM post
- Existing railway
- Main road
- Local road
- Track
- Watercourse
- Cadastre
- Proposal site

Exceedance of project construction noise criteria LAeq(15 minutes)

- <NML (Criteria)
- NML + 5dB
- NML + 10dB
- NML + 20dB
- NML + 30dB
- >30dB
- >75dB (Residences only)

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Stockinbingal to Parkes Lachlan River Bridge

Appendix B - Daytime construction noise predictions - Figure B2 Bridge works

0 100 200 m

Coordinate System: GDA 1994 MGA Zone 55

Date: 29/07/2021 Paper: A3
Author: WSP Scale: 1:7,500
Data Sources: ARTC, NSWSS

- KM post
- Existing railway
- Main road
- Local road
- Track
- Watercourse
- Cadastre
- Proposal site

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- NML + 10dB
- NML + 20dB
- NML + 30dB
- >30dB
- >75dB (Residences only)

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BRIDGE STREET
596km
THE ESCORT WAY
LOWER BATHURST STREET
FORBES
BATHURST STREET
595km
LACHLAN RIVER
FLINT STREET
REYMOND STREET
LACHLAN VALLEY WAY
594km

Stockinbingal to Parkes Lachlan River Bridge

Appendix B - Daytime construction noise predictions - Figure B3 Demobilisation and rehabilitation

0 100 200 m

Coordinate System: GDA 1994 MGA Zone 55

Date: 29/07/2021 Paper: A3
Author: WSP Scale: 1:7,500
Data Sources: ARTC, NSWSS

- KM post
- Existing railway
- Main road
- Local road
- Track
- Watercourse
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- NML + 5dB
- NML + 10dB
- NML + 20dB
- NML + 30dB
- >30dB
- >75dB (Residences only)

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Stockinbingal to Parkes Lachlan River Bridge

Appendix B - Daytime construction noise predictions - Figure B4 Compound operations

0 100 200 m

Coordinate System: GDA 1994 MGA Zone 55

Date: 29/07/2021 Paper: A3
Author: WSP Scale: 1:7,500
Data Sources: ARTC, NSWSS

- KM post
- Existing railway
- Main road
- Local road
- Track
- Watercourse
- Cadastre
- Proposal site

Exceedance of project construction noise criteria LAeq(15 minutes)

- <NML (Criteria)
- NML + 5dB
- NML + 10dB
- NML + 20dB
- NML + 30dB
- >30dB
- >75dB (Residences only)

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BRIDGE STREET
596km
THE ESCORT WAY
LOWER BATHURST STREET
FORBES
BATHURST STREET
595km
LACHLAN RIVER
FLINT STREET
REYMOND STREET
LACHLAN VALLEY WAY
594km

Stockinbingal to Parkes Lachlan River Bridge

Appendix B - Night-time construction noise predictions - Figure B1 Site establishment

0 100 200 m

Coordinate System: GDA 1994 MGA Zone 55

Date: 29/07/2021 Paper: A3
Author: WSP Scale: 1:7,500
Data Sources: ARTC, NSWSS

- KM post
- Existing railway
- Main road
- Local road
- Track
- Watercourse
- Cadastre
- Proposal site

Exceedance of project construction noise criteria LAeq(15 minutes)

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- NML + 5dB
- NML + 10dB
- NML + 20dB
- NML + 30dB
- >30dB
- >75dB (Residences only)

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BRIDGE STREET
596km
THE ESCORT WAY
LOWER BATHURST STREET
FORBES
BATHURST STREET
595km
LACHLAN RIVER
FLINT STREET
REYMOND STREET
LACHLAN VALLEY WAY
594km

Stockinbingal to Parkes Lachlan River Bridge

Appendix B - Night-time construction noise predictions - Figure B2 Bridge works

0 100 200 m

Coordinate System: GDA 1994 MGA Zone 55

Date: 29/07/2021 Paper: A3
Author: WSP Scale: 1:7,500
Data Sources: ARTC, NSWSS

- KM post
- Existing railway
- Main road
- Local road
- Track
- Watercourse
- Cadastre
- Proposal site

Exceedance of project construction noise criteria LAeq(15 minutes)

- <NML (Criteria)
- NML + 5dB
- NML + 10dB
- NML + 20dB
- NML + 30dB
- >30dB
- >75dB (Residences only)

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Stockinbingal to Parkes Lachlan River Bridge

Appendix B - Night-time construction noise predictions - Figure B3 Demobilisation and rehabilitation

0 100 200 m

Coordinate System: GDA 1994 MGA Zone 55

Date: 29/07/2021 Paper: A3
Author: WSP Scale: 1:7,500
Data Sources: ARTC, NSWSS

- KM post
- Existing railway
- Main road
- Local road
- Track
- Watercourse
- Cadastre
- Proposal site

Exceedance of project construction noise criteria LAeq(15 minutes)

- <NML (Criteria)
- NML + 5dB
- NML + 10dB
- NML + 20dB
- NML + 30dB
- >30dB
- >75dB (Residences only)

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Stockinbingal to Parkes Lachlan River Bridge

Appendix B - Night-time construction noise predictions - Figure B4 Compound operations

0 100 200 m

Coordinate System: GDA 1994 MGA Zone 55

Date: 29/07/2021 Paper: A3
Author: WSP Scale: 1:7,500
Data Sources: ARTC, NSWSS

- KM post
- Existing railway
- Main road
- Local road
- Track
- Watercourse
- Cadastre
- Proposal site

Exceedance of project construction noise criteria LAeq(15 minutes)

- <NML (Criteria)
- NML + 5dB
- NML + 10dB
- NML + 20dB
- NML + 30dB
- >30dB
- >75dB (Residences only)

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APPENDIX

E

Lachlan River Bridge Modification Project

Noise and Vibration Impact Assessment

Appendix C Predicted operational railway noise levels

STOCKINBINGAL TO PARKES REVIEW OF ENVIRONMENTAL FACTORS

C1. OPERATIONAL RAILWAY NOISE LEVELS

OVERVIEW

The predicted noise levels for existing railway operations are detailed in the following graphs.

The noise levels have been referenced to determine where the introduction of the proposal, including the future railway operations with Inland Rail, are predicted to increase railway noise levels at the sensitive receivers. An assessment of existing railway noise levels is not required.

RAILWAY NOISE LEVELS – EXISTING OPERATIONS (2020)

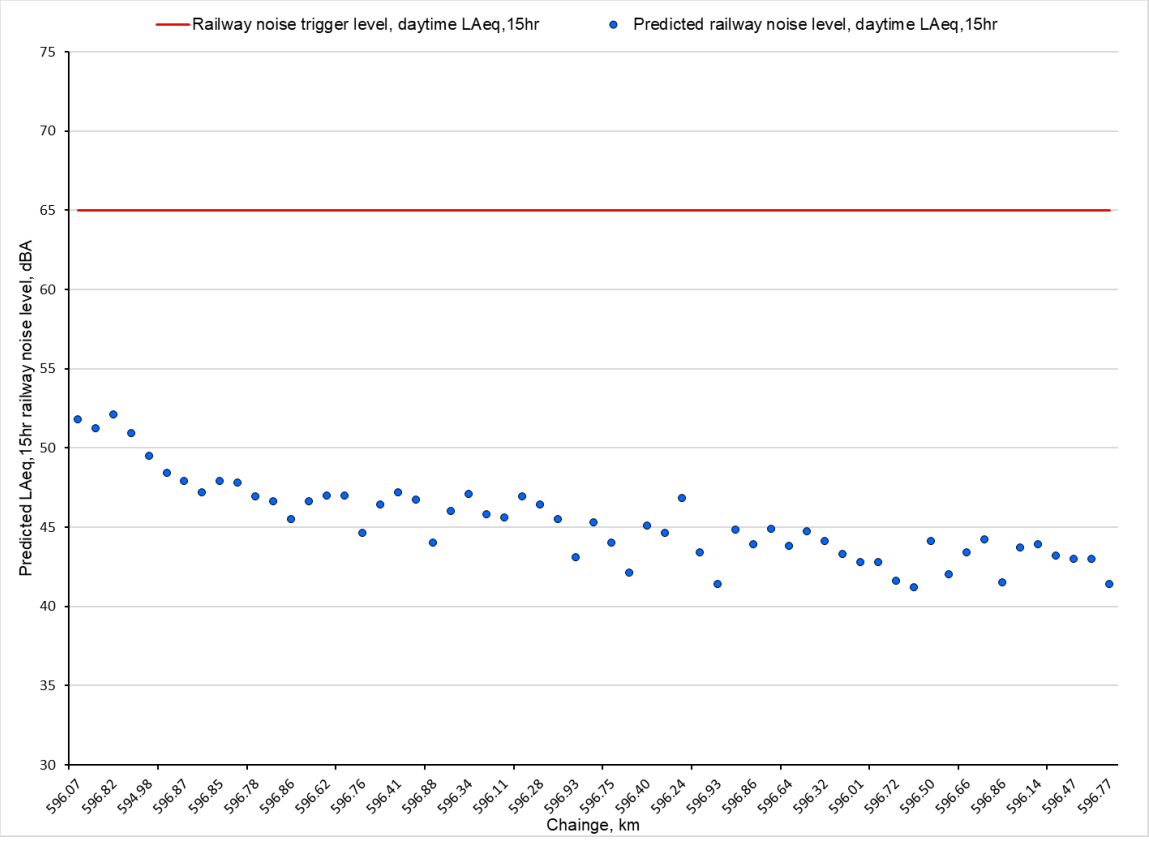

Figure C.1 Predicted daytime $L_{Aeq,15hr}$ railway noise levels (2020)

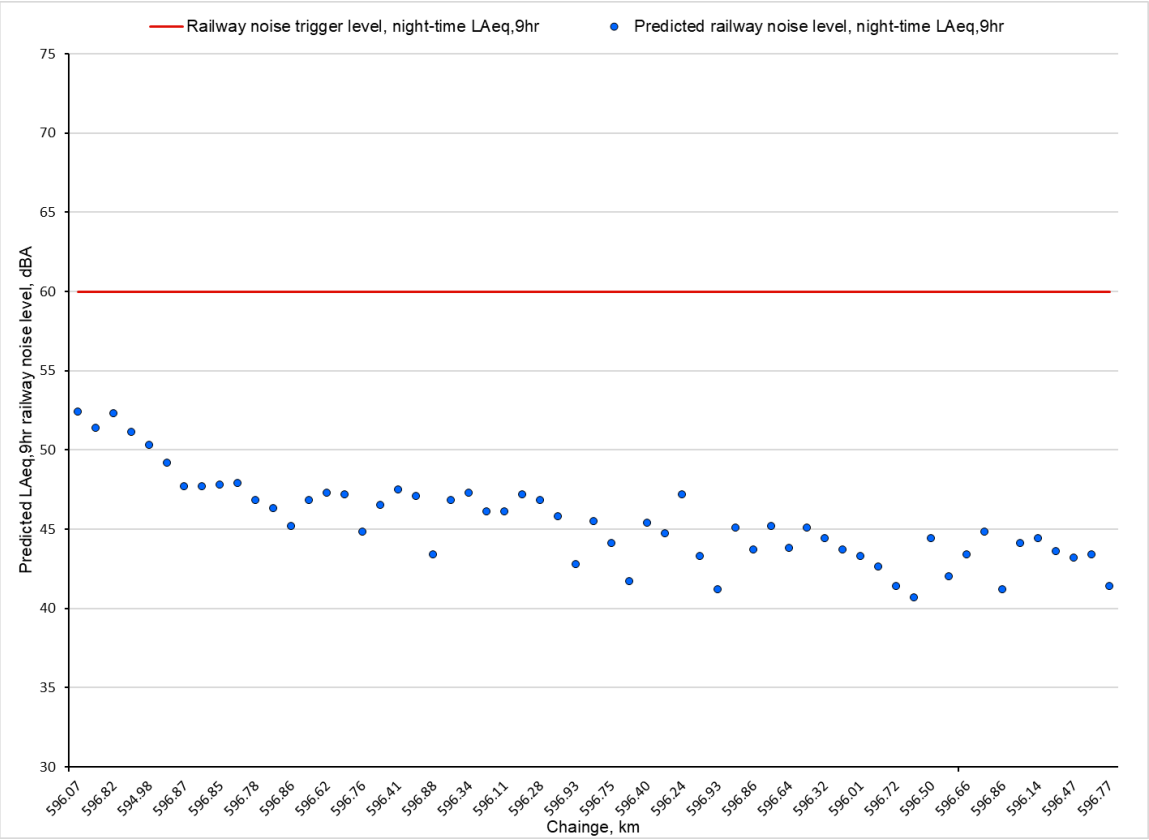

Figure C.2 Predicted night-time $L_{Aeq,9hr}$ railway noise levels (2020)

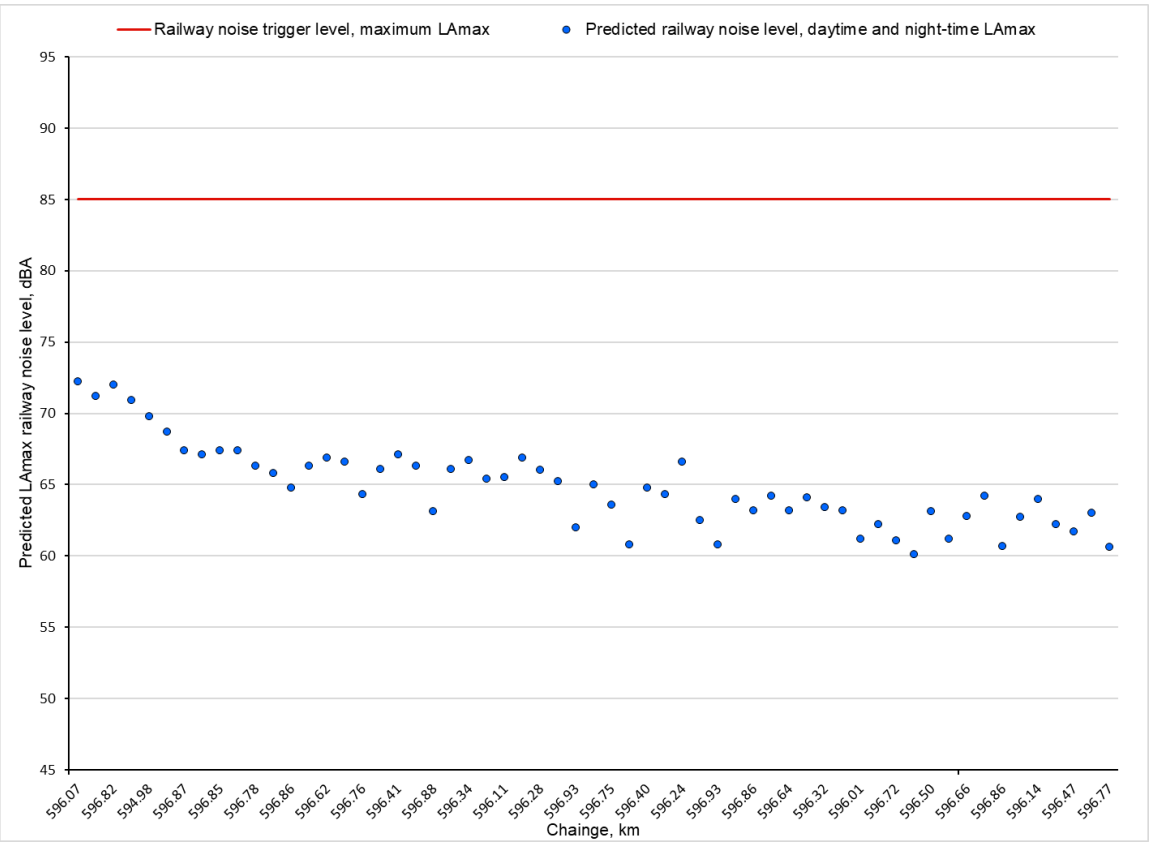

Figure C.3 Predicted daytime and night-time maximum (L_{Amax}) railway noise levels (2020)

RAILWAY NOISE LEVELS – PROPOSAL OPENING (2027)

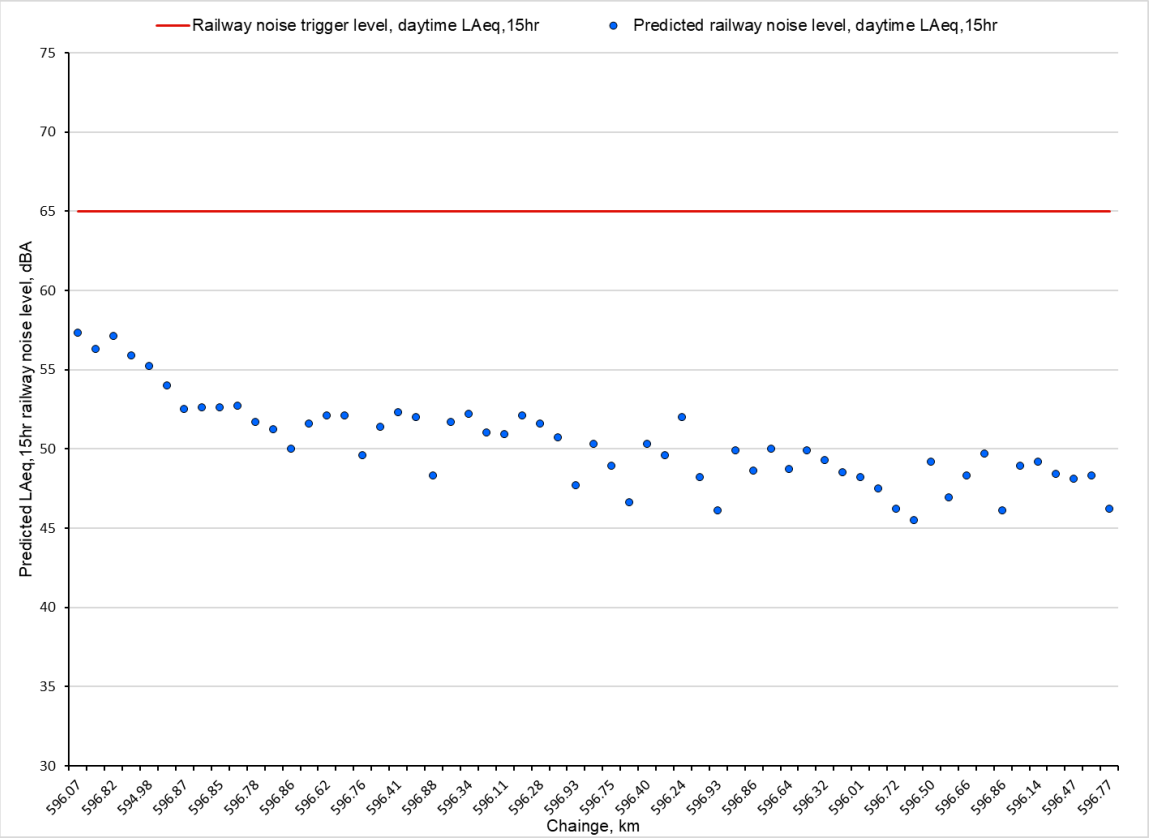

Figure C.4 Predicted daytime $L_{Aeq,15hr}$ railway noise levels (2027)

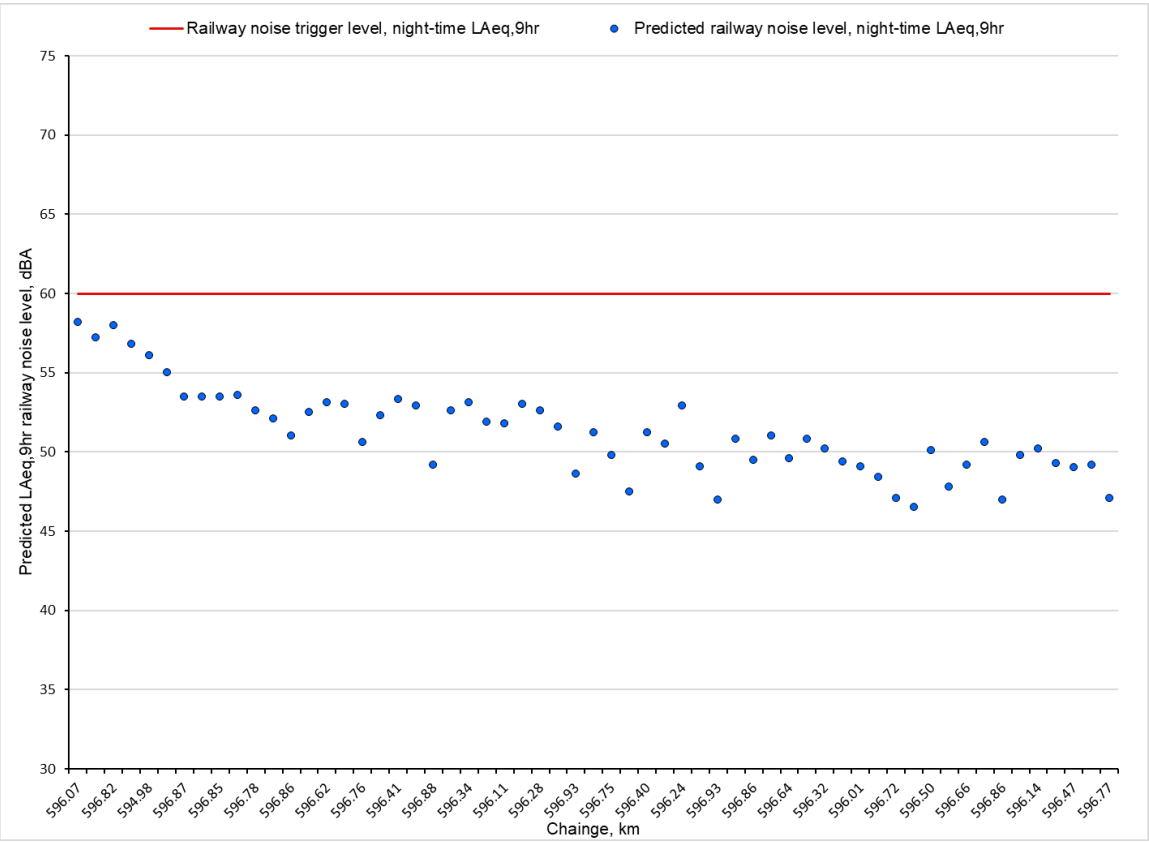

Figure C.5 Predicted night-time $L_{Aeq,9hr}$ railway noise levels (2027)

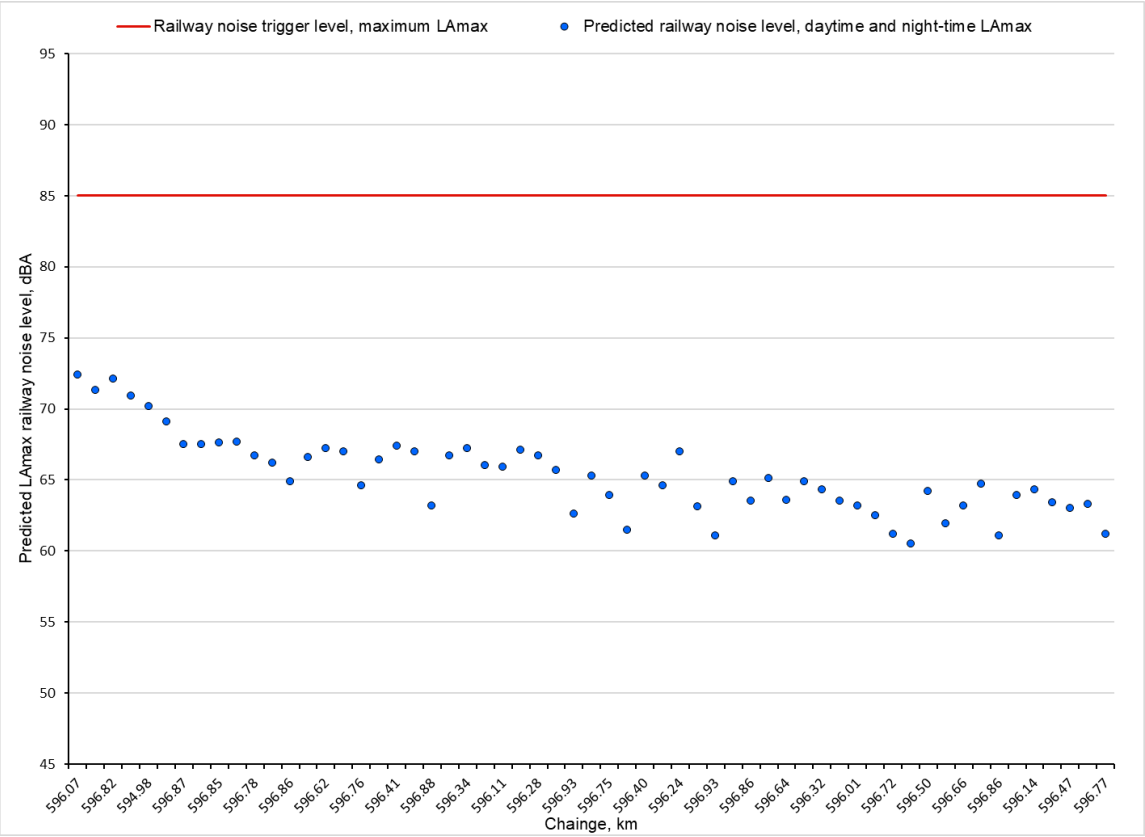

Figure C.6 Predicted daytime and night-time maximum (L_{Amax}) railway noise levels (2027)

RAILWAY NOISE LEVELS – FUTURE CAPACITY (2039)

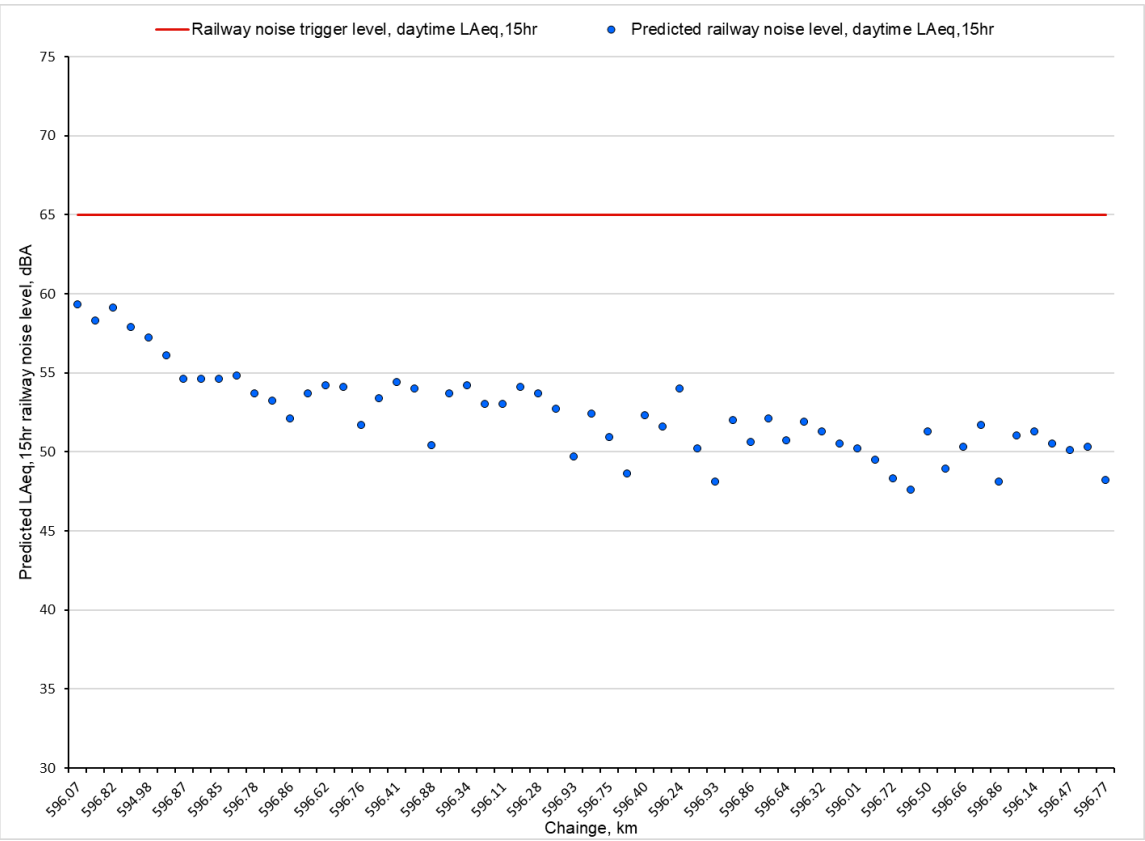

Figure C.7 Predicted daytime $L_{Aeq,15hr}$ railway noise levels (2039)

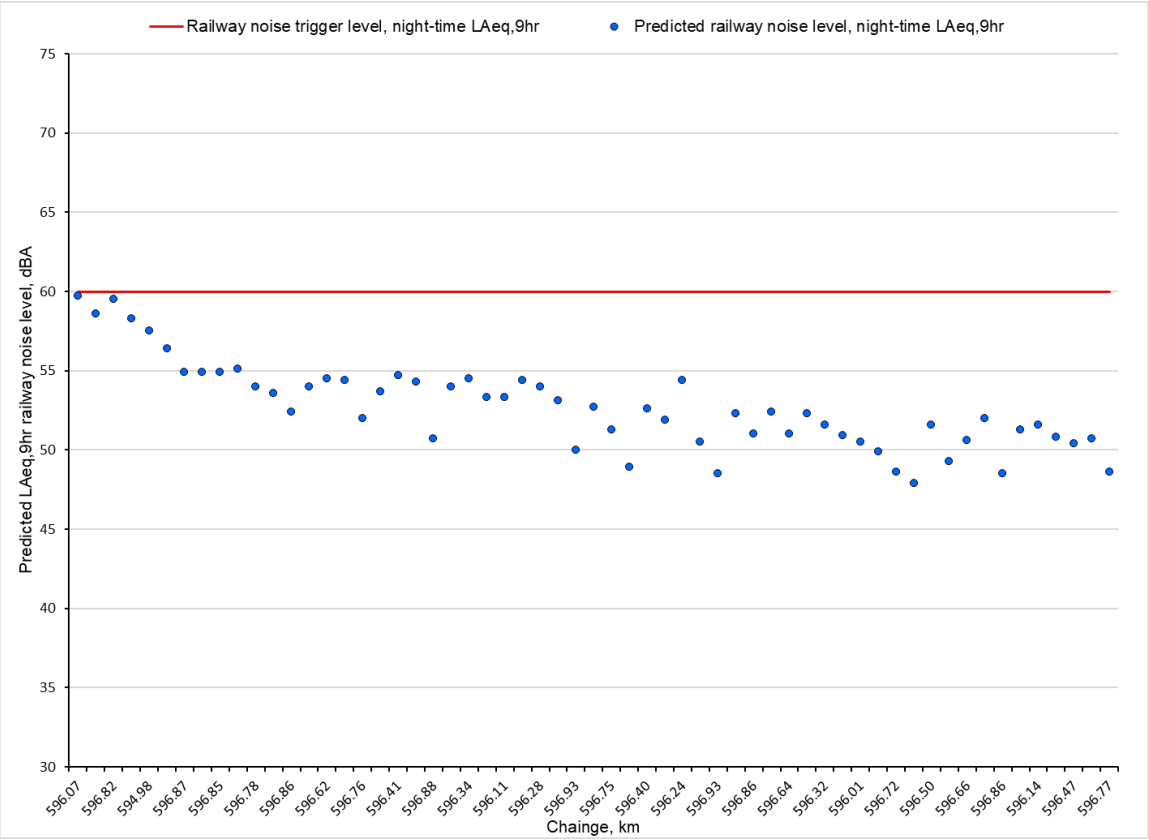

Figure C.8 Predicted night-time $L_{Aeq,9hr}$ railway noise levels (2039)

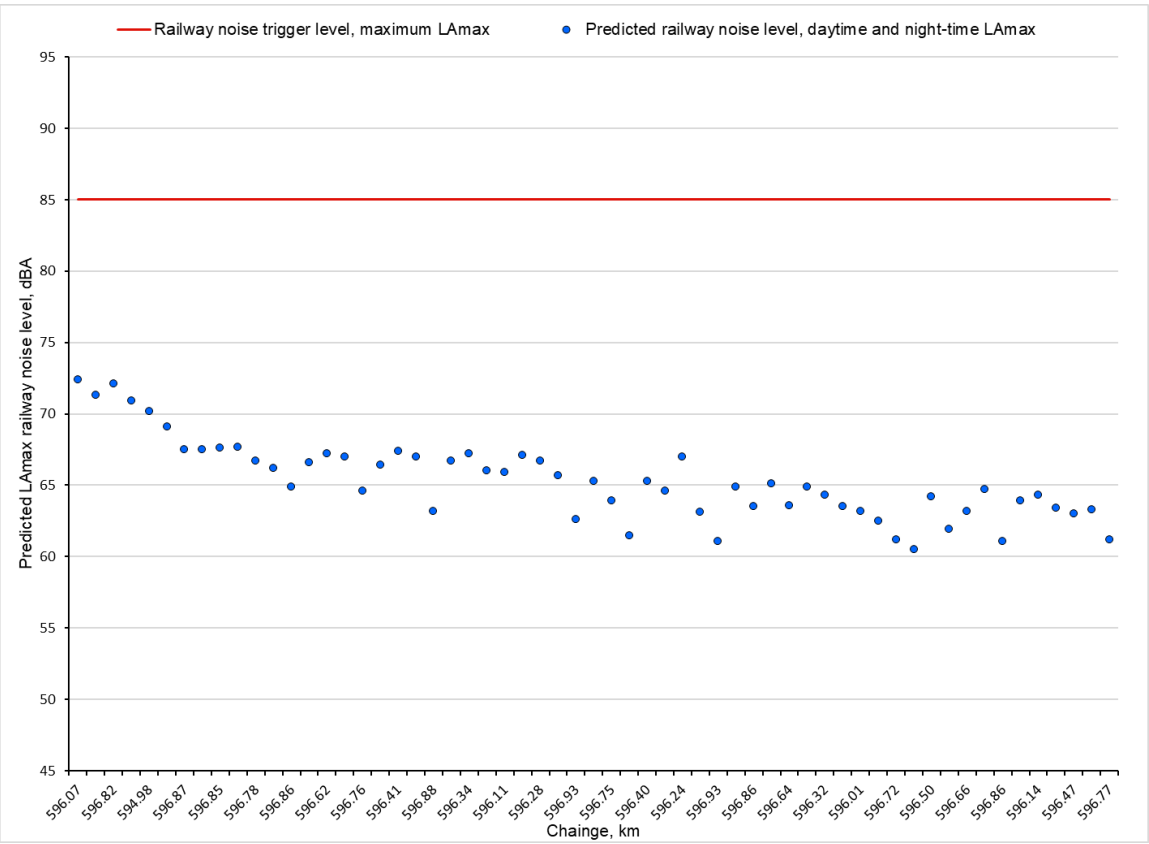

Figure C.9 Predicted daytime and night-time maximum (L_{Amax}) railway noise levels (2039)

APPENDIX

E

Lachlan River Bridge Modification Project

Noise and Vibration Impact Assessment

Appendix D Operational noise contour maps

STOCKINBINGAL TO PARKES REVIEW OF ENVIRONMENTAL FACTORS

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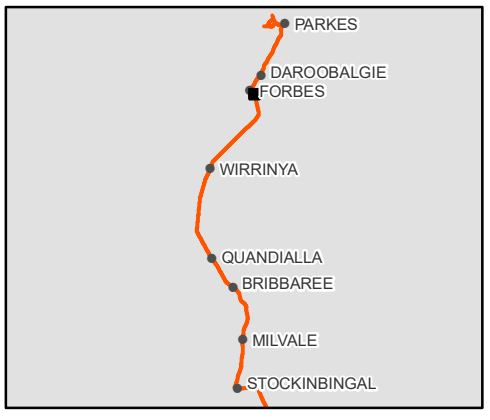
Stockinbingal to Parkes

Lachlan River Bridge operational noise contours - 2020

Figure Appendix D1

LEGEND

- KM post
- Existing railway
- Local road
- Track
- Watercourse
- Proposal site
- Cadastre
- $L_{eq,15hr}$ 65dBA (daytime criteria)
- $L_{eq,9hr}$ 60dBA (night-time criteria)
- L_{max} 85dBA (Lmax criteria)



0 25 50 m

Coordinate System: GDA 1994 MGA Zone 55

Date: 22/11/2021 Paper: A3

Author: WSP Scale: 1:1,500

Data Sources: WSP, ARTC, NSWSS

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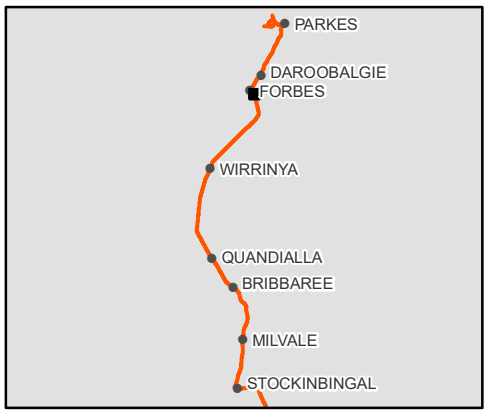
Stockinbingal to Parkes

Lachlan River Bridge operational noise contours - 2027

Figure Appendix D2

LEGEND

- KM post
- Existing railway
- Local road
- Track
- Watercourse
- Proposal site
- Cadastre
- $L_{eq,15hr}$ 65dBA (daytime criteria)
- $L_{eq,9hr}$ 60dBA (night-time criteria)
- L_{max} 85dBA (Lmax criteria)



0 25 50 m

Coordinate System: GDA 1994 MGA Zone 55

Date: 22/11/2021 Paper: A3

Author: WSP Scale: 1:1,500

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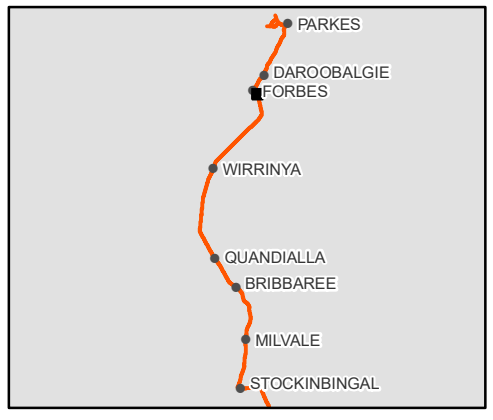
Stockinbingal to Parkes

Lachlan River Bridge operational noise contours - 2039

Figure Appendix D3

LEGEND

- KM post
- Existing railway
- Local road
- Track
- Watercourse
- Proposal site
- Cadastre
- $L_{eq,15hr}$ 65dBA (daytime criteria)
- $L_{eq,9hr}$ 60dBA (night-time criteria)
- L_{max} 85dBA (Lmax criteria)



0 25 50 m

Coordinate System: GDA 1994 MGA Zone 55

Date: 22/11/2021 Paper: A3

Author: WSP Scale: 1:1,500

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