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2115 CASTLEREAGH RD, PENRITH

Acoustic Assessment

2 March 2021

Aon Ari Property

TL889-01F02 Acoustic Assessment (r4)

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Contents

List of tables

List of figures

1 Introduction

Renzo Tonin & Associates was engaged to undertake an acoustic assessment to support a Development Application (DA) for the proposed redevelopment of the former Crane Enfield Metals site located at 2115 Castlereagh Rd, Penrith. Noise impacts from the operation of the project are addressed in this report in accordance with relevant Council and NSW Environment Protection Authority (EPA) requirements and guidelines.

This assessment addresses impacts from the overall site which contains seven primary warehouses. It is advised that the proposed fit outs and end use of the respective warehouses will be subject to separate DA submissions and acoustic reports.

This assessment also includes advice with respect to building shell construction of warehouses to address both noise emitted from them, and the impact on them from the other warehouses/users of the site.

The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001. Appendix A contains a glossary of acoustic terms used in this report.

2 Project description

2.1 Site description and development overview

The site located at 2115 Castlereagh Rd, Penrith. Currently located on site is four large warehouses that are surrounded by hardstands and vehicle driveways. The warehouses have various vehicle access points, predominantly located at the western and eastern facades. Site access is located along Castlereagh Road and two carparks are located at the western end of the site.

The description of works is as follows:

- The adaptive reuse of the existing buildings on the site
- The addition of a new warehouse for existing tenants, Capral
- Two multi-storey carparking structures to the front of the site and one to the rear of the site
- New warehouses to the rear (eastern end) of the site

The site is surrounded by industrial and commercial premises. The nearest identified residential receiver is located approximately 650 metres to the east at 8 Ray Place, Penrith. A location map is presented in Figure 1.

2.2 Hours of operation

The proposed operation is 24 hours 7 days per week. Heavy vehicle movement and loading activities external to the warehouses will predominantly occur during the daytime.

2.3 Assessment methodology

In order to assess the potential noise impact from the proposed development the following methodology was used:

- Identify nearest most potentially affected noise sensitive receiver location/s to the subject site;
- Determine existing background noise levels at the nearest most potentially affected residential receiver location using a long term noise logger;
- Use measured background levels to establish noise goals in accordance with the NSW Noise Policy for Industry (NPfI) and local council;
- Use noise modelling to predict and determine the extent of noise impact from the proposed development at nearby receiver locations;
- Identify if noise emissions from the site may exceed the relevant criteria, and

- Where noise emission from the site may exceed the relevant criteria, provide recommendations to reduce noise impacts from the site.

2.4 Reference material

For this assessment the SJB Architects DA drawing package [ref: 6348 - Combined Drawing Set.pdf], dated 01.03.2021 has been referred to.

2.5 Assessment locations

The identified assessment locations are outlined in Table 2.1 below and shown in Figure 1.

Table 2.1: Assessment locations

ID	Address	Description	Distance from site (m)
A1	Residential 8 Ray Place, Penrith	Double storey residential house located east of the site.	650
A2	Residential 105 Gannet Drive, Cranebrook	Double storey residential house located north of the site.	770
A3	Residential 34 Empire Circuit, Penrith	Double storey residential house located south of the site.	770
A4	Active Recreation Nepean Rugby Park	Playing field located north east of the site.	560
A5	Active Recreation Brothers Penrith Junior Rugby League Club	Playing field located south east of the site.	440
A6	Industrial 9/20 Lemko Place, Penrith (Sydney RV Group)	Industrial premises located west of the site, across Castlereagh Rd.	100
A7	Industrial 2101-2113 Castlereagh Rd, Penrith (Meyer Timber)	Industrial premises located adjacent to northern boundary of site.	Adjacent

3 Existing noise environment

Criteria for the assessment of operational noise are usually derived from the existing noise environment of an area, excluding noise from the subject development.

Fact Sheet B of the NSW EPA *Noise Policy for Industry* (NPfI) outlines two methods for determining the background noise level of an area, being 'B1 – Determining background noise using long-term noise measurements' and 'B2 – Determining background noise using short-term noise measurements'. This assessment has used long-term noise monitoring.

As the noise environment of an area almost always varies over time, background and ambient noise levels need to be determined for the operational times of the proposed development. For example, in a suburban or urban area the noise environment is typically at its minimum at 3am in the morning and at its maximum during the morning and afternoon traffic peak hours. The NPfI outlines the following standard time periods over which the background and ambient noise levels are to be determined:

- Day: 07:00-18:00 Monday to Saturday and 08:00-18:00 Sundays & Public Holidays
- Evening: 18:00-22:00 Monday to Sunday & Public Holidays
- Night: 22:00-07:00 Monday to Saturday and 22:00-08:00 Sundays & Public Holidays

3.1 Noise measurement locations

Noise measurements are ideally carried out at the nearest or most potentially affected locations surrounding a development. An alternative, representative location should be established in the case of access restrictions or a safe and secure location cannot be identified. Furthermore, representative locations may be established in the case of multiple receivers as it is usually impractical to carry out measurements at all locations surrounding a site.

The long-term locations are outlined in Table 3.1 and shown in Figure 1. In addition, short-term measurements were undertaken on site at 2115 Castlereagh Road and used to quantify the existing site source noise levels.

Table 3.1: Noise monitoring locations

ID	Address	Description
Long-term noise monitoring		
L1	2 Echo Place, Penrith	The monitor was located in the free-field, in the backyard of the property, near the western property fence. The noise monitoring location is considered representative of receiver locations A1, A2 and A3

Figure 1: Assessment and noise monitoring locations (Source - Nearmap_Jan_2021)

3.2 Long-term noise measurement results

Long-term noise monitoring was carried out from Thursday 11 February 2021 to 19 February 2021. The long-term noise monitoring methodology is detailed in APPENDIX B, and noise level-vs-time graphs of the data are included in APPENDIX C.

Table 3.2 presents the overall single Rating Background Levels (RBL) and representative ambient L_{eq} noise levels for each assessment period, determined in accordance with the NPfI.

Table 3.2: Long-term noise monitoring results, dB(A)

Monitoring location	L_{A90} Rating Background Level (RBL)			L_{Aeq} Ambient noise levels		
	Day	Evening	Night	Day	Evening	Night
L1 - 2 Echo Place, Penrith	43	44	44	58	53	50

Notes: Day: 07:00-18:00 Monday to Saturday and 08:00-18:00 Sundays & Public Holidays

Evening: 18:00-22:00 Monday to Sunday & Public Holidays

Night: 22:00-07:00 Monday to Saturday and 22:00-08:00 Sundays & Public Holidays

As required by the NPfI, the external ambient noise levels presented are free-field noise levels. [ie. no façade reflection]

* The background and ambient noise levels during the night-time are higher than expected. Analysis of the logger audio files have determined that the RBL is controlled by industry and insect noise. These noise sources are considered typical of the area and accordingly the noise data is considered suitable to use.

4 Project noise goals

4.1 Penrith City Council

Noise impacts have been assessed in accordance with the below request from Penrith City Council.

> ***Noise Impacts***
>
> *A Noise Impact Assessment will need to be prepared by a suitably qualified acoustic consultant and is to take into account all noise generating activities on the site (including, but not limited to, use of plant and equipment, deliveries, dispatch, traffic and car parking, patrons) and the location of nearby receivers. The report is to be prepared with consideration of:*
>
> - *The Noise Policy for Industry in terms of assessing the noise impacts associated with development, including noise from all components, plant and equipment, carparking, deliveries and garbage removal. Noise impacts are to be considered in terms of receivers outside, as well as the various different components/uses within the development and achieving the noise criteria that applies to those.*
> - *The potential impact from road traffic noise resulting from vehicles entering and existing site, demonstrating compliance with 'NSW Road Noise Policy.*

4.2 NSW Noise Policy for Industry

Noise impact is assessed in accordance with the NSW 'Noise Policy for Industry' (NPfI), 2017. The assessment procedure has two components:

- Controlling intrusive noise impacts in the short-term for residences; and
- Maintaining noise level amenity for residences and other land uses.

In accordance with the NPfI, noise impact should be assessed against the project noise trigger level which is the lower value of the project intrusiveness noise levels and project amenity noise levels.

4.2.1 Project intrusive noise levels

According to the NPfI, the intrusiveness of a noise source may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (represented by the $L_{Aeq,15min}$ descriptor) does not exceed the background noise level measured in the absence of the source by more than 5dB(A). The project intrusiveness noise level, which is only applicable to residential receivers, is determined as follows:

$L_{Aeq,15minute}$ Intrusiveness noise level = Rating Background Level ('RBL') plus 5dB(A)

Based on the background noise monitoring results and the proposed operating hours of the facility, the intrusiveness noise levels for residential receivers are reproduced in Table 4.1 below.

Table 4.1: Intrusiveness noise levels

Receiver	Intrusiveness noise level, $L_{Aeq,15min}$		
	Day	Evening	Night
Residences	43 + 5 = 48	43 + 5 = 48*	43 + 5 = 48*

Notes: Day: 7:00 to 18:00 Monday to Saturday and 8:00 to 18:00 Sundays & Public Holidays

Evening: 18:00 to 22:00 Monday to Sunday & Public Holidays

Night: 22:00 to 7:00 Monday to Saturday and 22:00 to 8:00 Sundays & Public Holidays

*In accordance with NPfI, the community generally expects greater control of noise during the more sensitive evening and night-time periods than during the less sensitive daytime period. Therefore, in determining project noise trigger levels for this development, it is generally recommended that the project intrusiveness noise level for evening be set at no greater than the project intrusiveness noise level for daytime. As a result, the evening background noise levels have been adjusted to the daytime background noise levels.

4.2.2 Amenity noise levels

The project amenity noise levels for different time periods of day are determined in accordance with Section 2.4 of the NPfI. The NPfI recommends amenity noise levels ($L_{Aq,period}$) for various receivers including residential, commercial, industrial receivers and sensitive receivers such as schools, hotels, hospitals, churches and parks. These "recommended amenity noise levels" represent the objective for total industrial noise experienced at receiver location. However, when assessing a single industrial development and its impact on an area, "project amenity noise levels" apply.

The recommended amenity noise levels applicable for the subject area are reproduced in Table 4.2 below.

Table 4.2: Recommended amenity noise levels

Type of Receiver	Noise Amenity Area	Time of Day	Recommended amenity noise level, L_{Aeq}, dB(A)
Residential	Suburban	Day	55
		Evening	45
		Night	40
Active recreation (e.g. playground)	All	When in use	55
Industrial premises	All	When in use	70

Notes:
1. Daytime 7.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 7.00 am.
2. On Sundays and Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am.
3. The L_{Aeq} index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.
4. The recommended amenity noise levels refer only to noise from industrial sources. However, they refer to noise from all such sources at the receiver location, and not only noise due to a specific project under consideration. The levels represent outdoor level except where otherwise stated.

To ensure that the total industrial noise level (existing plus new) remain within the recommended amenity noise levels for an area, the project amenity noise level that applies for each new industrial noise source is determined as follows:

$L_{Aeq,period}$ Project amenity noise level = $L_{Aeq,period}$ Recommended amenity noise level – 5dB(A)

Furthermore, given that the intrusiveness noise level is based on a 15 minute assessment period and the project amenity noise level is based on day, evening and night assessment periods, the NPfI provides the following guidance on adjusting the $L_{Aeq,period}$ level to a representative $L_{Aeq,15minute}$ level in order to standardise the time periods.

$$L_{Aeq,15minute} = L_{Aeq,period} + 3dB(A)$$

The project amenity noise levels ($L_{Aeq,\ 15min}$) applied for this project are reproduced in Table 4.3 below, based on a 'suburban' noise amenity area.

Table 4.3: Project amenity noise levels

Type of Receiver	Noise Amenity Area	Time of Day	Recommended Noise Level, dB(A)	
			$L_{Aeq,\ Period}$	$L_{Aeq,\ 15min}$
Residence	Suburban	Day	55 – 5 = 50	50 + 3 = **53**
		Evening	45 – 5 = 40	40 + 3 = **43**
		Night	40 – 5 = 35	35 + 3 = **38**
Active recreation area	All	When in use	55 – 5 = 50	50 + 3 = **53**
Industrial premises	All	When in use	70 – 5 = 65	65 + 3 = **68**

Notes:
1. Daytime 7.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 7.00 am.
2. On Sundays and Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am.
3. The L_{Aeq} index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

4.3 Project noise trigger levels

In accordance with the NPfI the project noise trigger levels, which are the lower (i.e. more stringent) value of the project intrusiveness noise level and project amenity noise level, have been determined as shown in Table 4.4 below.

For the residential receivers, the project noise trigger levels have been further broken down to allocate a "budget" for each of the warehouses on site. This is to ensure that one particular tenancy does not use up all of the noise level allowance and the remaining tenancies are left unduly restricted in operation, and the cumulative noise from all warehouses on the site will still comply with the allowable noise emission.

When considering noise emitted from the site to the residences to the east, a greater amount of the allowable noise emission is allocated to the eastern most warehouses, as they are closest to the residences and there is no noise screening between them and the residences. The remaining warehouses are proposed to have a smaller share of the total allowable noise emission as noise from those warehouses to the residences to the east will be shielded by the warehouse on the eastern end of the site.

It would potentially be open to the centre management to agree some other allocation of noise budgets for individual warehouses.

Table 4.4: Project noise trigger levels

Receiver Location	$L_{Aeq, 15min}$ Project noise trigger levels, dB(A)		
	Day	Evening	Night
A1 - Residential receivers to the east			
Warehouses PW1 and PW2	43	38	33
Warehouses CW1, EW1 and EW2	39	34	29
Warehouses EW3, EW4 and others (CAN, LAB and MEL)	34	29	24
Total	**48**	**43**	**38**
A2 - Residential receivers to the north			
Individual warehouses	40	35	30
Total	48	43	38
A3 - Residential receivers to the south			
Individual warehouses	40	35	30
Total	48	43	38
Active recreation area	**53**		
Industrial premises	**68**		

4.2.4 Sleep disturbance noise levels

The potential for sleep disturbance from maximum noise level events from premises during the night-time period needs to be considered. In accordance with NPfI, a detailed maximum noise level event assessment should be undertaken where the subject development night-time noise levels at a residential location exceed:

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

Where there are noise events found to exceed the initial screening level, further analysis is undertaken to identify:

- The likely number of events that might occur during the night assessment period,
- The extent to which the maximum noise level exceeds the rating background noise level.

The sleep disturbance noise levels for the project are presented in Table 4.5.

Table 4.5: Sleep disturbance assessment levels

Receiver type	Assessment Level $L_{Aeq,15min}$	Assessment Level L_{AFmax}
Residential	43 + 5 = 48	43 + 15 = 58

5 Noise emission assessment

5.1 Noise sources

The noise sources associated with the proposal for assessment are as follows:

- vehicle movements and car parking
- loading dock activities (trucks and forklifts)
- internal warehouse activities
- mechanical plant

5.1.1 Vehicle movements

5.1.1.1 Traffic volumes and composition

The predicted highest hourly traffic movements and compositions used for the noise impact assessment in this report are presented in the following table. The information was provided by Aon Ari Property.

Table 5.1: Highest hourly traffic movements and compositions

Period of the day	Light vehicles[1]	Semi-trailers[2]	
	Entry / exit	Entry	Exit
Day (7:00am to 6:00pm)	291	5	5
Evening (6:00pm to 10:00pm)	291	5	5
Night (10:00pm to 7:00am)	291	5	5

Notes
1. Based on three 8-hour shifts during a 24-hour period, it has been assumed that the 33% of the carpark spaces onsite will be filled or emptied within an hour period.
2. Based on 42 semi-trailer movements per 24-hour period (i.e. 3 semi-trailer 2-way movements per warehouse). For a conservative assessment assumed 25% of the 24-hour movements could occur in a one-hour peak period (rounded to 10 movements).

5.1.1.2 Carparking activities

Noise generated by car park activities includes vehicle doors closing, vehicle engines starting, vehicles accelerating and vehicles moving. To assess this noise, the $L_{Aeq\ 15\text{-}minute}$ noise level at the nearest affected residential premises was determined for each relevant time period based on the number of vehicle movements expected to occur during that period.

The carpark activity for this assessment is summarised in Table 5.2 for the highest one-hour period for the day, evening and night periods. Based on three 8-hour shifts during a 24-hour period, it has been assumed that the 33% of the carpark spaces on site will be filled or emptied within an hour period.

Table 5.2: Car parking activity distribution

Area ID[1]	Car Parking Area	Number of spaces	Number of Cars for Highest One-Hour
			All periods
PC1	Car Park north west corner of site (4 levels)	307	103
PC2	Car Park south west corner of site (4 levels)	187	62
PC3	Car Park eastern end of site (5 levels)	351	117
At grade	Around site	27	9
Total parking Area		**872**	**291**

Notes 1. ID referenced from DA drawing package [ref: 6348 - Combined Drawing Set.pdf], dated 01.03.2021

The sound power levels generated by carpark activities on site are presented in the following table.

Table 5.3: Carpark activity sound power levels

Activity	Metric	Sound Power Level, dB(A) re. 1pW
Vehicle moving (10km/h)	Passby L_W Leq	79
Door Slam	SEL	86
Engine Start	SEL	92

5.1.2 Loading activities and on-site truck movements

Loaded and empty trucks would arrive and enter the site to access the loading areas onsite. The main loading areas are located:

- Along the southern, eastern and northern facades of EW1
- At the northern and southern facade of EW2
- At the eastern facade of EW3
- Between EW4 and CW1
- Between CW1 and PW1
- At the northern and southern facade of PW3

Modelling of truck movements and loading operations have been based upon sound power levels measured and established by Renzo Tonin & Associates and are set out in the following table.

Table 5.4: Loading Activity Sound Power Levels

Activity	$L_{Aeq\ 15\text{-}minute}$ Sound power level, dB(A) re. 1pW	Modelled Source Height Above Ground Level (m)	Activity inside or outside shed
Truck moving (<30km/h)	106	2.0	Outside
Truck reversing alarm	92[1]	2.0	Outside

Activity	$L_{Aeq\ 15\text{-}minute}$ Sound power level, dB(A) re. 1pW	Modelled Source Height Above Ground Level (m)	Activity inside or outside shed
Truck Air brake, partial (single event)	77	0.5	Outside
Truck Air brake, full release (single event)	91	0.5	Outside
Truck wash bay (high pressure hose located on western side of EW2)	98	1	Outside
Electric/Gas Forklift (one per loading bay)	90	1.5	Inside / Outside

Note: 1. +5dB(A) added to source level to account for tonality in accordance with NPfI

It is noted that for loading and unloading activities during the day, evening and night-time periods, warehouse doors will be open. The exception is that warehouse doors located along the eastern facade of warehouse PW1 and PW2 are to be closed during the night-time period. This is reflected in the noise management recommendations set out in Section 8.

5.2 Noise predictions

5.2.1 Prediction methodology

Noise emissions were predicted by modelling the noise sources, receiver locations, topographical features of the intervening area and possible noise control treatments, using CadnaA (version 2021) noise modelling computer software. The software calculates the contribution of each noise source at each specified receptor point and allows for the prediction of the total noise from a site. The noise prediction model takes into account:

- location of noise sources and receiver locations
- height of sources and receivers
- separation distance between sources and receivers
- ground type between sources and receivers
- attenuation from barriers (natural and purpose-built)
- the attenuation of the shed building fabric
- meteorological effects

At relatively large distances from the noise source, meteorological effects are taken into account in the noise prediction because the resultant noise levels at receivers can be influenced by meteorological conditions, particularly temperature inversions and winds.

These noise-enhancing meteorological conditions comprise a ‘D’ atmospheric stability class with 3m/s winds or ‘F’ atmospheric stability class with 2m/s during the night-time periods (as per Fact Sheet D of NPfI), because this atmospheric stability class does not ordinarily occur during the day.

For consistency with the NPfI and in addition to modelling under noise-enhancing meteorological conditions, modelling was also conducted for standard meteorological conditions for the night period using 'D' atmospheric stability class with 0.5m/s wind.

A summary of model inputs is provided below.

Table 5.5: Modelling inputs

Input Parameters	Description
Ground absorption	Numeric values varied between 0 (hard surface) to 1 (soft ground) Value of 0.5-1.0 was used to represent the ground between the proposed site and the receivers
Receiver heights	1.5 metre above ground level for ground floor, plus 3.0 metres for additional floors
Shed details	An internal sound pressure level at the inside face of the warehouse walls and roof of 75 dB(A) L_{eq} is adopted. This is a conservatively loud assumption of the average noise level within a typical warehouse.
	Doors to all loading docks are open, except for the doors located on the eastern facade of warehouses PW1 and PW2 during the night-time period.
	The walls and roof of the warehouses are 0.56mm galvanised steel cladding or equivalent.
Modelling standard	CONCAWE
Meteorological effects	
Weather category / Stability Class / wind speed	Standard meteorological conditions: 'D' atmospheric stability class with 0.5m/s wind Noise-enhancing meteorological conditions: 'D' atmospheric stability class with 3m/s winds or 'F' atmospheric stability class with 2m/s winds (for night only as per Fact Sheet D of NPfI)
Wind direction	Worst-case direction to the receiver

5.2.2 Noise prediction results and assessment

Based on the traffic volumes and compositions for vehicle movements associated with the site, the noise source levels presented in Section 5.1 and the above noise modelling methodology, the predicted noise impacts at the nominated receiver locations are presented in the following table. Based on noise predictions, compliance with the noise criteria is achieved at all surrounding receivers for all periods and under adverse meteorological conditions.

Table 5.6: Predicted $L_{Aeq,\ 15min}$ operational noise levels, dB(A)

Receiver	Predicted $L_{Aeq,\ 15min}$ Noise Level (dBA)				Noise Criteria (dBA)			Exceedance (dB)
	Day[1]	Evening[1]	Night[1]		Day[1]	Evening[1]	Night[1]	
	Adverse[3]	Adverse[3]	Standard[2]	Adverse[3,4]				
A1 - 8 Ray Place	37	37	36	37	48	43	38	0
A2 - 105 Gannet Drive	36	36	35	36	48	43	38	0
A3 - 34 Empire Circuit	32	32	31	32	48	43	38	0
A4 - Nepean Rugby Park	35	35	34	35	53 (external, when in use)			0

Receiver	Predicted $L_{Aeq, 15min}$ Noise Level (dBA)				Noise Criteria (dBA)			Exceedance (dB)
	Day[1]	Evening[1]	Night[1]		Day[1]	Evening[1]	Night[1]	
	Adverse[3]	Adverse[3]	Standard[2]	Adverse[3,4]				
A5 - Brothers Penrith Junior Rugby League Club	42	42	41	42	53 (external, when in use)			0
A6 - 9/20 Lemko Place	53	53	52	53	68 (external, when in use)			0
A7 - 2101-2113 Castlereagh Rd	67	67	67	67	68 (external, when in use)			0

Notes:
1. Daytime = 7.00am-6.00pm; Evening = 6.00pm-10.00pm; Night = 10.00pm-7.00am.
2. 'D' atmospheric stability class with 0.5m/s wind - standard meteorological conditions
3. 'D' atmospheric stability class with 3m/s winds - noise-enhancing meteorological conditions
4. 'F' atmospheric stability class with 2m/s winds (night-time only) noise-enhancing meteorological conditions

5.2.3 Sleep disturbance

Sleep disturbance would most potentially be caused by a single event of truck airbrake release, a vehicle door closing and/or engine starting in the carpark areas where there is a limited degree of acoustic shielding (compared with internal activities) and due to the relatively high L_{max} noise levels that can be generated. The following noise levels from Renzo Tonin & Associates' database have been used for the assessment and are shown in Table 5.7.

Table 5.7: Sleep disturbance - Sound power levels

Activity	Sound power level, dB(A) re: 1pW
	L_{max}
Truck airbrake	115
Vehicle door closing	96
Vehicle engine starting	97
Delivery Van (6m rigid vans)	98

Noise predictions at the identified assessment locations are presented in Table 5.8 below. The predicted noise levels comply with the established sleep disturbance criteria at all residential receivers for all periods.

Table 5.8: Sleep disturbance noise assessments

Assessment Location	Predicted Noise Level dB(A)		Sleep disturbance criteria	
	$L_{Aeq,15min}$	L_{Amax}	Assessment Level $L_{Aeq,15min}$	Assessment Level L_{AFmax}
A1 - 8 Ray Place	37	40	48	58
A2 - 105 Gannet Drive	36	41	48	58
A3 - 34 Empire Circuit	32	33	48	58

Note: Night is defined as 10:00pm to 7:00am, Monday to Saturday and 10:00pm to 8:00am Sundays & Public Holidays.

6 Road traffic noise assessment

Additional noise from traffic generated by a development on the public road network is assessed against the NSW EPA 'Road Noise Policy' (RNP), 2011. The assessment involves consideration of the existing traffic noise levels and the potential change in noise as a result of the development.

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

Traffic generated by the development would access and depart the site via the Castlereagh Road entrances. There are no residential receivers located in proximity to the site along Castlereagh Road. The most potentially affected residences have been identified along Andrews Road. Once site related vehicles utilise the Great Western Highway to the south and the Northern Road to the north, any increase in noise levels will be insignificant (less than 2 dB) given the existing traffic volumes on these road.

Andrews Road is classified as a sub-arterial road for which the RNP recommends a daytime (7am to 10pm) external noise level of $L_{Aeq,15hr}$ 60 dB(A) and a night-time (10pm to 7am) external noise level of $L_{Aeq,9hr}$ 55 dB(A) measured at the facade of a residence.

Noise predictions were based on a method developed by the United Kingdom Department of Environment entitled "Calculation of Road Traffic Noise (1988)" known as the CoRTN88 method. This method has been adapted to Australian conditions and extensively tested by the Australian Road Research Board.

Based on a receiver distance of 30m from the road and 42 truck movements per 24-hour period (half of which assumed to access the site from the north), a respective maximum daytime and night-time project traffic noise level of $L_{Aeq,15hr}$ 40 dB(A) and $L_{Aeq,9hr}$ 40 dB(A) was predicted. This complies with the RNP daytime criterion of 60 dB(A) and a night-time criterion of 55dB(A).

7 Noise Intrusion Assessment

This section addresses the noise impacts from the proposed industrial activities onto different components/ uses within the development.

7.1 Noise intrusion criteria

The internal noise criteria for the different spaces within the development is taken from AS NZS 2107-2016 "Recommended design sound levels and RT for building interiors". AS2107 recommends the following internal noise levels.

Table 7.1: Internal noise level criteria

Occupancy	Design Internal Noise Level
Warehouse	70 dB(A) Leq 15hr
Office spaces	45 dB(A) Leq 15hr

7.2 Noise intrusion recommendations

Based on noise measurements conducted on site, the noise sources in Section 5.1 and the noise prediction methodology within Section 5.2.1, noise levels were predicted at the facade of the proposed buildings within the development (ie. CW1, PW1, PW2, and EW2).

The following recommendations should be adopted in order to achieve the internal levels specified in Table 7.1. The recommended building treatments are indicative only and would be revised as building shell design is completed.

7.2.1 Warehouse building envelope

It is assumed that the walls and roof of the warehouses are 0.56mm galvanised steel cladding or equivalent and the insulation will be constructed as per the architect's detail. It is predicted that this will be sufficient in reducing the external noise levels to meet the internal noise goals for warehouse spaces [ie. 70dB(A)].

However, in the event where a truck (belonging to another tenancy) idles in front of a warehouse door, there may be localised exceedance located near the door opening. This is to be managed by ensuring that trucks belonging to one tenancy are not left idling in front of warehouse door openings that belong to a different tenant.

No additional treatment to the warehouse spaces is required.

7.2.2 Building envelope and glazing requirements for office spaces

Calculations of external noise intrusion into the office areas were conducted taking into account external noise levels, facade transmission loss and room sound absorption characteristics. Noise levels were calculated for each building facade to account for any variation in the external noise levels affecting different parts of the building.

Furthermore, the wall construction of the office spaces was assumed to be as follows:

- 0.56mm galvanised sheet cladding on 90mm steel stud and a single layer of 13mm plasterboard and minimum 50mm thick 11kg/m3 glasswool insulation.

- Office areas located immediately below roof level would have a mineral tile or minimum 10mm plasterboard ceiling.

Glazing constructions required to comply with the nominated noise criteria are presented in Table 7.2.

Table 7.2 Recommended glazing assembly

Building ID	Facade Location	Recommended Minimum Sound Insulation Rating of Glazing Assembly	Typical Compliance Glazing Configuration	Laboratory Test Reference
CW1	East and south	Rw 33	6.38mm laminated glass or double glazing consisting of 6mm/ 12mm airgap/ 6mm	ESTIMATE
PW1	West and south	Rw 33	6.38mm laminated glass or double glazing consisting of 6mm/ 12mm airgap/ 6mm	ESTIMATE
PW2	North	Rw 33	6.38mm laminated glass or double glazing consisting of 6mm/ 12mm airgap/ 6mm	ESTIMATE
EW2	North	Rw 33	6.38mm laminated glass or double glazing consisting of 6mm/ 12mm airgap/ 6mm	ESTIMATE

By way of explanation, the Sound Insulation Rating Rw is a measure of the noise reduction property of the partition, a higher rating implying a higher sound reduction performance.

Note that the Rw rating of systems measured as built on site (R'w Field Test) may be up to 5 points lower than the laboratory result.

LEGEND where no appropriate test certificate exists:

1. ESTIMATE: The client is advised not to commence detailing or otherwise commit to partition construction systems which have not been tested in an approved laboratory or for which an opinion only is available. Testing of partition construction systems is a component of the quality control of the design process and should be viewed as a priority because there is no guarantee the forecast results will be achieved thereby necessitating the use of an alternative which may affect the cost and timing of the project. No responsibility is taken for use of or reliance upon untested partition construction systems, estimates or opinions. The advice provided here is in respect of acoustics only.
2. ESTIMATE – APPROVED FOR CONSTRUCTION: Use of the form of construction is approved prior to laboratory certification. To complete the quality control of the design process and confirm the acoustical performance of the construction, we recommend testing in a laboratory to confirm the Rw rating as soon as practicable. In the case of impact rating for floor systems, no particular impact rating is guaranteed to comply with either the Building Code of Australia or Strata Scheme Management Act and hence carpet runners may still be required.
3. ESTIMATE – TEST NOT REQUIRED: Use of the form of construction is approved without laboratory certification. The STC/Rw of the form of construction exceeds the project requirements.
4. The advice provided here is in respect of acoustics only. Supplementary professional advice may need to be sought in respect of fire ratings, structural design, buildability, fitness for purpose and the like.

Building ID	Facade Location	Recommended Minimum Sound Insulation Rating of Glazing Assembly	Typical Compliance Glazing Configuration	Laboratory Test Reference

NOTES FOR GLAZING CONSTRUCTIONS:

5. The information in this table is provided for the purpose of Council approvals process and cost planning and shall not be used for construction unless otherwise approved in writing by the acoustic consultant.
6. The design in this table is preliminary and a comprehensive assessment shall be conducted prior to Construction Certification.
7. Before committing to any form of construction or committing to any builder, advice should be sought from an acoustic consultant to ensure that adequate provisions are made for any variations which may occur as a result of changes to the form of construction where only an "estimate" is available for the sound insulation properties of recommended materials.
8. The glazing supplier shall ensure that installation techniques will not diminish the Rw performance of the glazing when installed on site.
9. All openable glass windows and doors shall incorporate full perimeter acoustic seals equivalent to Q-Lon, which enable the Rw rating performance of the glazing to not be reduced.
10. The above glazing thicknesses should be considered the minimum thicknesses to achieve acoustical ratings. Greater glazing thicknesses may be required for structural loading, wind loading etc.

GENERAL

11. The sealing of all gaps in partitions is critical in a sound rated construction. Use only sealer approved by the acoustic consultant.
12. Check design of all junction details with acoustic consultant prior to construction.
13. Check the necessity for HOLD POINTS with the acoustic consultant to ensure that all building details have been correctly interpreted and constructed.
14. The information provided in this table is subject to modification and review without notice.
15. The advice provided here is in respect of acoustics only. Supplementary professional advice may need to be sought in respect of fire ratings, structural design, buildability, fitness for purpose and the like.

8 Recommendations

8.1 Acoustic performance of building envelope

- The building envelopes and glazing requirements as set out in Section 7.2.2 are to be provided as a minimum.

8.2 Management of onsite activities

- All vehicle/loading access doors located on the eastern facade of warehouses PW1 and PW2 to be closed during the night-time period (10pm to 7am).
- No material dumping external to the warehouses to occurring the night-time (10pm to 7am).
- Doors of Capral warehouse to be closed when aluminium press and saw are operating during the night-time (10pm to 7am).
- Where practical, trucks belonging to one tenancy are not left idling in front of warehouse door openings or outside offices that belong to a different tenant.
- Use of atypical, noisy external equipment (for example generators, diesel forklifts) should be reviewed as part of any development application for use of an individual tenancy.

8.3 Mechanical plant and equipment

Mechanical plant associated with the development has the potential to impact on nearby noise sensitive properties. In order to carry out a quantitative assessment of mechanical equipment, a complete specification of equipment is required. At this stage of the development appropriate detail for mechanical plant is not typically available. A qualitative assessment has therefore been carried out and in-principle noise management measures outlined:

- Given the large separation distance to the nearest residential receivers, mechanical plant noise emission will be able to be controlled.
- Acoustic assessment of mechanical services equipment should be undertaken during the detail design phase of the development to ensure that the cumulative noise of all equipment does not exceed the applicable noise criteria.
- Noise control treatment can affect the operation of the mechanical services system. An acoustic engineer should be consulted during the initial design phase of mechanical services system to reduce potential redesign of the mechanical system.
- Mechanical plant noise emission can be controlled by appropriate mechanical system design and implementation of common engineering methods, which may include:
  - procurement of 'quiet' plant

- strategic positioning of plant away from sensitive neighbouring premises to maximise intervening acoustic shielding between the plant and sensitive neighbouring premises
- commercially available acoustic attenuators for air discharge and air intakes of plant
- acoustically lined and lagged ductwork
- acoustic barriers between plant and sensitive neighbouring premises
- partial or complete acoustic enclosures over plant

- The specification and location of mechanical plant (and acoustic treatments) should be confirmed prior to installation on site, and

9 Conclusion

Renzo Tonin & Associates has carried out an acoustic assessment to support a Development Application (DA) for the proposed redevelopment of the former Crane Enfield Metals site located at 2115 Castlereagh Rd, Penrith.

The report has quantified operational noise emission from the proposed development and has assessed noise at the nearest sensitive receivers. The report has been prepared in accordance the NSW EPA requirements. Based on the assumptions and inputs within this report, it has been established that operation of the site is capable of complying with relevant EPA and Council noise emission requirements.

It is advised that the proposed fit outs and end use of the individual warehouses will be subject to separate DA submissions and acoustic reports. The recommended building treatments within Section 7 are indicative only and would be revised as building shell design is completed.

APPENDIX A Glossary of terminology

The following is a brief description of the technical terms used to describe noise to assist in understanding the technical issues presented.

Absorption Coefficient α	The absorption coefficient of a material, usually measured for each octave or third-octave band and ranging between zero and one. For example, a value of 0.85 for an octave band means that 85% of the sound energy within that octave band is absorbed on coming into contact with the material. Conversely, a low value below about 0.1 means the material is acoustically reflective.		
Adverse weather	Weather effects that enhance noise (particularly wind and temperature inversions) occurring at a site for a significant period of time. In the NSW INP this occurs when wind occurs for more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of nights in winter.		
Air-borne noise	Noise which is fundamentally transmitted by way of the air and can be attenuated by the use of barriers and walls placed physically between the noise source and receiver.		
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.		
Amenity	A desirable or useful feature or facility of a building or place.		
AS	Australian Standard		
Assessment period	The time period in which an assessment is made. e.g. Day 7am-10pm & Night 10pm-7am.		
Assessment Point	A location at which a noise or vibration measurement is taken or estimated.		
Attenuation	The reduction in the level of sound or vibration.		
Audible Range	The limits of frequency which are audible or heard as sound. The normal hearing in young adults detects ranges from 20 Hz to 20 kHz, although some people can detect sound with frequencies outside these limits.		
A-weighting	A filter applied to the sound recording made by a microphone to approximate the response of the human ear.		
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation. 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 represented as the LA90 noise level if measured as an overall level or an L90 noise level when measured in octave or third-octave bands.		
Barrier (Noise)	A natural or constructed physical barrier which impedes the propagation of sound and includes fences, walls, earth mounds or berms and buildings.		
Berm	Earth or overburden mound.		
Buffer	An area of land between a source and a noise-sensitive receiver and may be an open space or a noise-tolerant land use.		
Bund	A bund is an embankment or wall of brick, stone, concrete or other impervious material, which may form part or all of the perimeter of a compound.		
BS	British Standard		
CoRTN	United Kingdom Department of Environment entitled "Calculation of Road Traffic Noise (1988)"		
Decibel [dB]	The units that sound is measured in. The following are examples of the decibel readings of common sounds in our environment:		
	threshold of hearing	0 dB	The faintest sound we can hear, defined as 20 micro Pascal
		10 dB	Human breathing

	almost silent	20 dB	
		30 dB	Quiet bedroom or in a quiet national park location
	generally quiet	40 dB	Library
		50 dB	Typical office space or ambience in the city at night
	moderately loud	60 dB	CBD mall at lunch time
		70 dB	The sound of a car passing on the street
	loud	80 dB	Loud music played at home
		90 dB	The sound of a truck passing on the street
	very loud	100 dB	Indoor rock band concert
		110 dB	Operating a chainsaw or jackhammer
	extremely loud	120 dB	Jet plane take-off at 100m away
	threshold of pain	130 dB	
		140 dB	Military jet take-off at 25m away
dB(A)	A-weighted decibel. The A- weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter is denoted as dB(A). Practically all noise is measured using the A filter.		
dB(C)	C-weighted decibels. The C-weighting noise filter simulates the response of the human ear at relatively high levels, where the human ear is nearly equally effective at hearing from mid-low frequency (63Hz) to mid-high frequency (4kHz), but is less effective outside these frequencies. The dB(C) level is not widely used but has some applications.		
Diffraction	The distortion of sound waves caused when passing tangentially around solid objects.		
DIN	German Standard		
ECRTN	Environmental Criteria for Road Traffic Noise, NSW, 1999		
EPA	Environment Protection Authority		
Field Test	A test of the sound insulation performance in-situ. See also 'Laboratory Test' The sound insulation performance between building spaces can be measured by conducting a field test, for example, early during the construction stage or on completion. A field test is conducted in a non-ideal acoustic environment. It is generally not possible to measure the performance of an individual building element accurately as the results can be affected by numerous field conditions.		
Fluctuating Noise	Noise that varies continuously to an appreciable extent over the period of observation.		
Free-field	An environment in which there are no acoustic reflective surfaces. Free field noise measurements are carried out outdoors at least 3.5m from any acoustic reflecting structures other than the ground.		
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.		
Ground-borne noise	Vibration propagated through the ground and then radiated as noise by vibrating building elements such as wall and floor surfaces. This noise is more noticeable in rooms that are well insulated from other airborne noise. An example would be vibration transmitted from an underground rail line radiating as sound in a bedroom of a building located above.		
Habitable Area	Includes a bedroom, living room, lounge room, music room, television room, kitchen, dining room, sewing room, study, playroom, family room, home theatre and sunroom. Excludes a bathroom, laundry, water closet, pantry, walk-in wardrobe, corridor, hallway, lobby, photographic darkroom, clothes drying room, and other spaces of a specialised nature occupied neither frequently nor for extended periods.		

Heavy Vehicle	A truck, transporter or other vehicle with a gross weight above a specified level (for example: over 8 tonnes).
IGANRIP	Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects, NSW DEC 2007
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
INP	NSW Industrial Noise Policy, EPA 1999
Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
Intrusive noise	Refers to noise that intrudes above the background level by more than 5 dB(A).
ISEPP	State Environmental Planning Policy (Infrastructure), NSW, 2007
ISEPP Guideline	Development Near Rail Corridors and Busy Roads - Interim Guideline, NSW Department of Planning, December 2008
L1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L10	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L10(1hr)	The L10 level measured over a 1 hour period.
L10(18hr)	The arithmetic average of the L10(1hr) levels for the 18 hour period between 6am and 12 midnight on a normal working day.
L90	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).
LAeq or Leq	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time, which would produce the same energy as a fluctuating sound level. When A-weighted, this is written as the LAeq.
LAeq(1hr)	The LAeq noise level for a one-hour period. In the context of the NSW EPA's Road Noise Policy it represents the highest tenth percentile hourly A-weighted Leq during the period 7am to 10pm, or 10pm to 7am (whichever is relevant).
LAeq(8hr)	The LAeq noise level for the period 10pm to 6am.
LAeq(9hr)	The LAeq noise level for the period 10pm to 7am.
LAeq(15hr)	The LAeq noise level for the period 7am to 10pm.
LAeq (24hr)	The LAeq noise level during a 24 hour period, usually from midnight to midnight.
Lmax	The maximum sound pressure level measured over a given period. When A-weighted, this is usually written as the LAmax.
Lmin	The minimum sound pressure level measured over a given period. When A-weighted, this is usually written as the LAmin.
Loudness	A rise of 10 dB in sound level corresponds approximately to a doubling of subjective loudness. That is, a sound of 85 dB is twice as loud as a sound of 75 dB which is twice as loud as a sound of 65 dB and so on. That is, the sound of 85 dB is four times or 400% the loudness of a sound of 65 dB.
Microphone	An electro-acoustic transducer which receives an acoustic signal and delivers a corresponding electric signal.
NCA	Noise Catchment Area. An area of study within which the noise environment is substantially constant.
NCG	Noise Criteria Guideline, Roads and Maritime Services (Transport for NSW)
NMG	Noise Mitigation Guideline, Roads and Maritime Services (Transport for NSW)
Noise	Unwanted sound

Pre-construction	Work in respect of the proposed project that includes design, survey, acquisitions, fencing, investigative drilling or excavation, building/road dilapidation surveys, minor clearing (except where threatened species, populations or ecological communities would be affected), establishing ancillary facilities such as site compounds, or other relevant activities determined to have minimal environmental impact (e.g. minor access roads).
Reflection	Sound wave reflected from a solid object obscuring its path.
RING	Rail Infrastructure Noise Guideline, NSW, May 2013
RMS	Root Mean Square value representing the average value of a signal.
Rw	Weighted Sound Reduction Index A measure of the sound insulation performance of a building element. It is measured in very controlled conditions in a laboratory. The term supersedes the value STC which was used in older versions of the Building Code of Australa. Rw is measured and calculated using the procedure in ISO 717-1. The related field measurement is the DnT,w. The higher the value the better the acoustic performance of the building element.
R'w	Weighted Apparent Sound Reduction Index. As for Rw but measured in-situ and therefore subject to the inherent accuracies involved in such a measurement. The higher the value the better the acoustic performance of the building element.
RNP	Road Noise Policy, NSW, March 2011
Sabine	A measure of the total acoustic absorption provided by a material. It is the product of the Absorption Coefficient (alpha) and the surface area of the material (m2). For example, a material with alpha = 0.65 and a surface area of 8.2m2 would have 0.65 x 8.2 = 5.33 Sabine. Sabine is usually calculated for each individual octave band (or third-octave).
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound absorption	The ability of a material to absorb sound energy by conversion to thermal energy.
Sound Insulation	Sound insulation refers to the ability of a construction or building element to limit noise transmission through the building element. The sound insulation of a material can be described by the Rw and the sound insulation between two rooms can be described by the DnT,w.
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 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 of 1 pico watt.
Sound pressure level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone referenced to 20 mico Pascal.
Spoil	Soil or materials arising from excavation activities.
STC	Sound Transmission Class A measure of the sound insulation performance of a building element. It is measured in controlled conditions in a laboratory. The term has been superseded by Rw.

Structure-borne Noise	Audible noise generated by vibration induced in the ground and/or a structure. Vibration can be generated by impact or by solid contact with a vibrating machine. Structure-borne noise cannot be attenuated by barriers or walls but requires the isolation of the vibration source itself. This can be achieved using a resilient element placed between the vibration source and its support such as rubber, neoprene or springs or by physical separation (using an air gap for example). Examples of structure-borne noise include the noise of trains in underground tunnels heard to a listener above the ground, the sound of footsteps on the floor above a listener and the sound of a lift car passing in a shaft. See also 'Impact Noise'.
Tonal Noise	Sound containing a prominent frequency and characterised by a definite pitch.
Transmission Loss	The sound level difference between one room or area and another, usually of sound transmitted through an intervening partition or wall. Also the vibration level difference between one point and another. For example, if the sound level on one side of a wall is 100dB and 65dB on the other side, it is said that the transmission loss of the wall is 35dB. If the transmission loss is normalised or standardised, it then becomes the Rw or R'w or DnT,w.

APPENDIX B Long-term noise monitoring methodology

B.1 Noise monitoring equipment

A long-term unattended noise monitor consists of a sound level meter housed inside a weather resistant enclosure. Noise levels are monitored continuously with statistical data stored in memory for every 15-minute period.

Long term noise monitoring was conducted using the following instrumentation:

Description	Type	Octave band data	Logger location(s)
RTA07 (NTi Audio XL2)	Type 1	1/1	L1

Notes: All meters comply with AS IEC 61672.1 2004 "Electroacoustics - Sound Level Meters" and designated either Type 1 or Type 2 as per table, and are suitable for field use.

The equipment was calibrated prior and subsequent to the measurement period using a Bruel & Kjaer Type 4231 calibrator. No significant drift in calibration was observed.

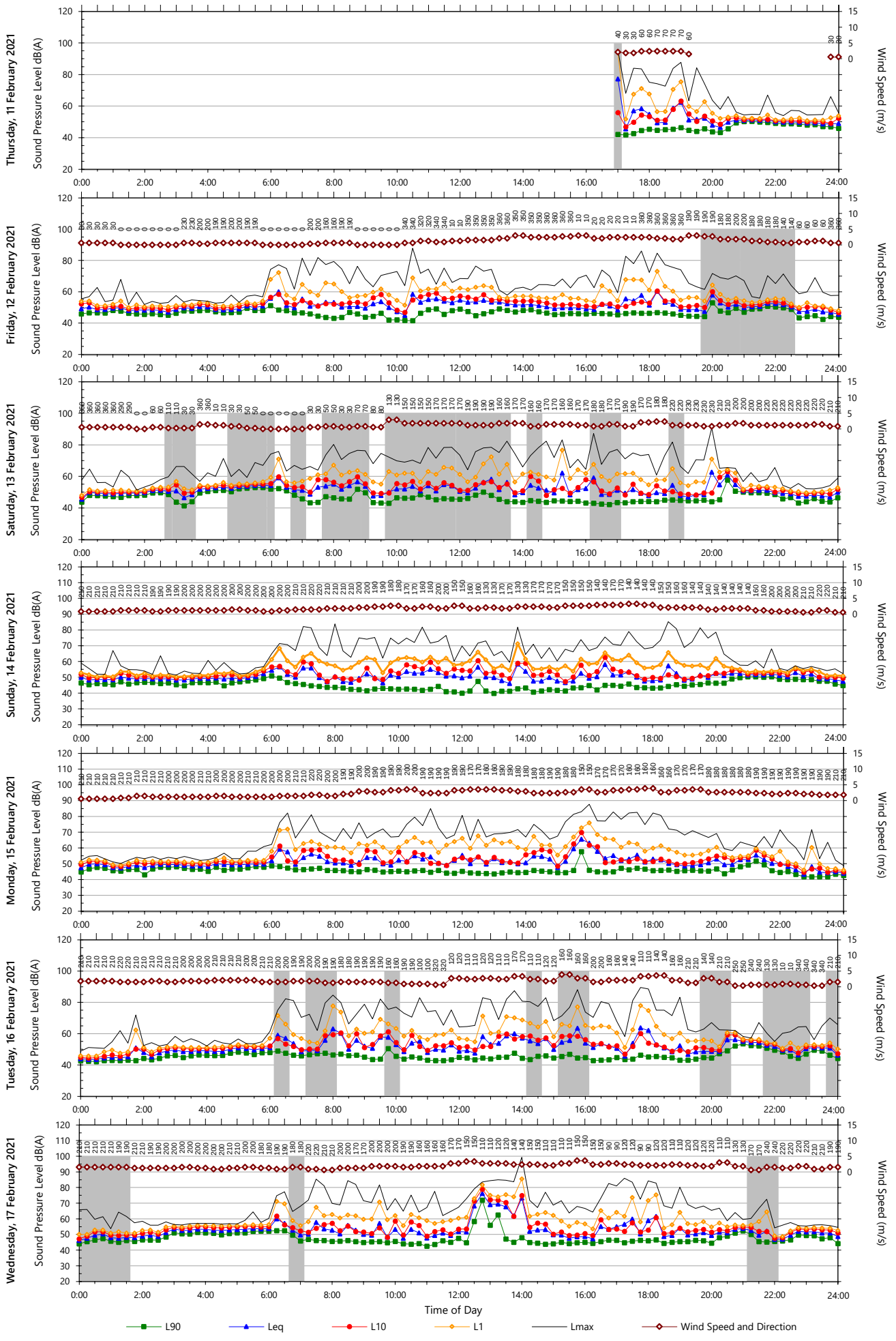
B.2 Meteorology during monitoring

Measurements affected by extraneous noise, wind (greater than 5m/s) or rain were excluded from the recorded data in accordance with the NSW INP. Determination of extraneous meteorological conditions was based on data provided by the Bureau of Meteorology (BOM), for a location considered representative of the noise monitoring location(s). However, the data was adjusted to account for the height difference between the BOM weather station, where wind speed and direction is recorded at a height of 10m above ground level, and the microphone location, which is typically 1.5m above ground level (and less than 3m). The correction factor applied to the data is based on Table C.1 of ISO 4354:2009 '*Wind actions on structures*'.

B.3 Noise vs time graphs

Noise almost always varies with time. Noise environments can be described using various descriptors to show how a noise ranges about a level. In this report, noise values measured or referred to include the L_{10}, L_{90}, and L_{eq} levels. The statistical descriptors L_{10} and L_{90} measure the noise level exceeded for 10% and 90% of the sample measurement time. The L_{eq} level is the equivalent continuous noise level or the level averaged on an equal energy basis. Measurement sample periods are usually ten to fifteen minutes. The Noise -vs- Time graphs representing measured noise levels, as presented in this report, illustrate these concepts for the broadband dB(A) results.

APPENDIX C Noise logger graphs



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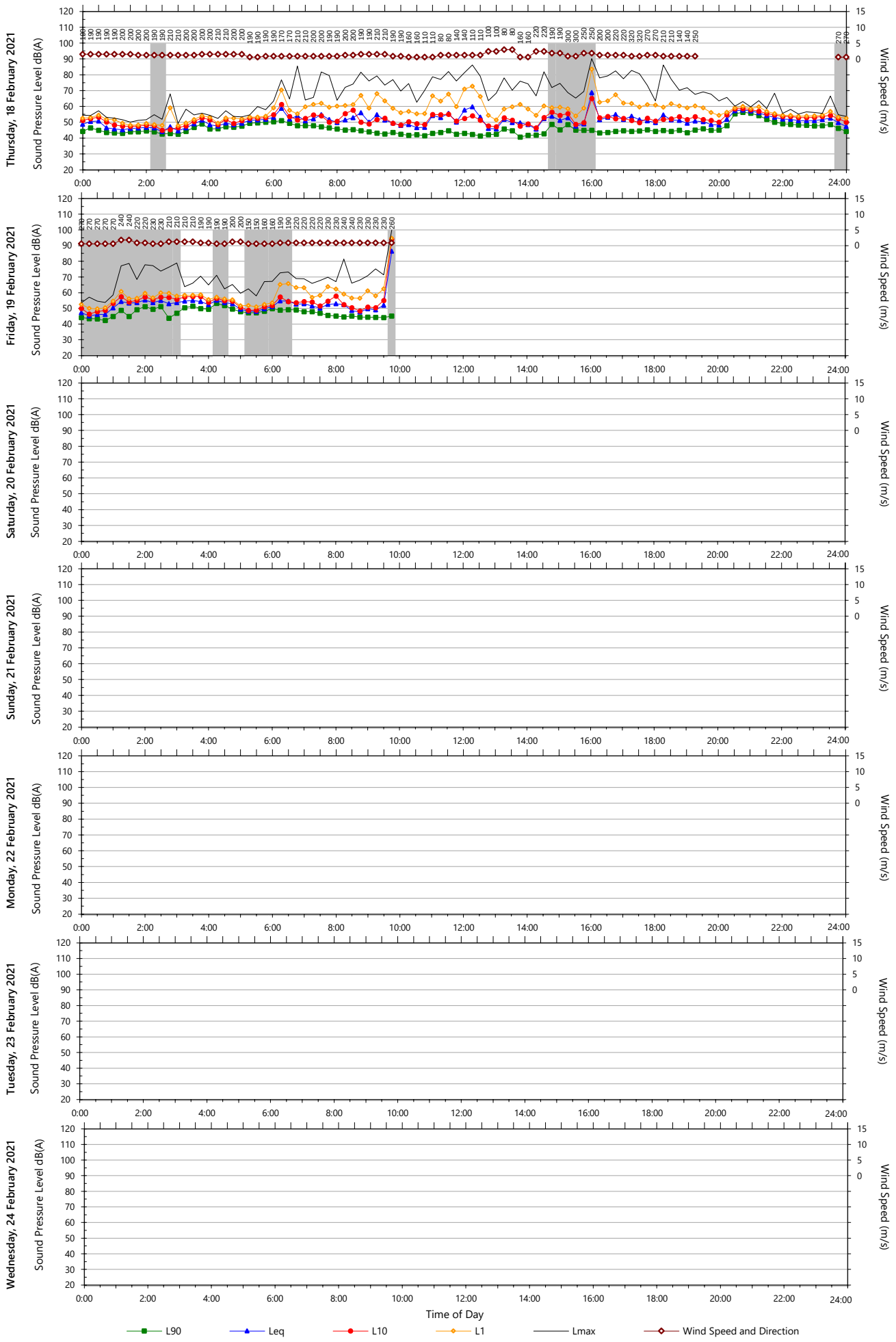
Template: QTE-26 Logger Graphs Program (r34)



Data File: 2021-02-11_SLM_000_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r34)