

Macquarie Technology Centre

Extended hours construction noise assessment

Prepared for Taylor Construction Group

October 2022

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Taylor Construction Group

J200443 RP5

October 2022

Version	Date	Prepared by	Approved by	Comments
V0.1	9/09/2022	Andrew Durrer	James Small	Draft
V0.2	6/10/2022	Andrew Durrer	James Small	Draft
V1.0	18/10/2022	Andrew Durrer	James Small	Final
V2.0	20/10/2022	Andrew Durrer	James Small	Final

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20 October 2022

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1 Introduction

EMM Consulting Pty Limited (EMM) has been engaged by Taylor Construction Group Pty Ltd to prepare a construction noise assessment for the proposed out of work hours at the development at 11–17 Khartoum Road and 33–39 Talavera Road, Macquarie Park (the project).

The need for out of hours (OOH) work on Sundays between 8am and 4pm has been identified by Taylor Construction Group to complete structural construction works and internal fit out. EMM has conducted an assessment of existing background levels during weekend hours to assess the feasibility of extended working hours on Sundays.

EMM have been advised by Taylor Constructions that construction works have been previously undertaken on Sundays under the guidance of the EP&A (*COVID-19 Development – Construction Workdays*) Order Environmental Planning and Assessment 2022. During this time, no complaints were received regarding noise or vibration relating to construction works.

This document should be used in conjunction with the EMM 2021, *Construction noise and vibration management plan* (CNVMP) prepared for Taylor Constructions. The CNVMP covers both noise and vibration impacts due to initial demolition and structural foundation works.

Vibration generated by structural, fit-out and finishing works will be generally less than that previously generated during the demolition and excavation stages. As such, no additional vibration impacts are expected during the OOH works.

Proposed works during OOH on Sundays will not include the delivery of construction materials or concrete pours. The site will be pre-loaded in the days leading up to the Sunday work.

1.1 Project description

This construction noise assessment has been prepared to support proposed out of hour construction works to occur on Sunday. The requirements of the Development Consent are provided in Table 1.1 together with the relevant sections of this report.

Table 1.1 Construction noise management plan requirements

Relevant Condition from DA	Comments/Relevant section of CNVMP
Part 1	
(24) Construction Noise Management Plan	
A Construction Noise Management Plan must be prepared and submitted with any Stage 2 Development Application. This Plan must be prepared by a suitably qualified acoustic consultant and must detail, but not be limited to, the following:	EMM acoustical consultants have significant experience in the assessment and management of noise impacts from construction projects. EMM is a member firm of the Association of Australasian Acoustical Consultants (AAAC). The reviewer of this report is a member of the Australian Acoustic Society.
(a) The equipment to be used during the construction on site, the quantity of all equipment and a plan of how equipment will be operated on site cumulatively.	Section 2.4.
(b) The type of work that will be conducted during the construction process.	Section 2.4.
(c) Details of any respite periods and any noise mitigation measures required.	Section 5.

Table 1.1 Construction noise management plan requirements

Relevant Condition from DA	Comments/Relevant section of CNVMP
Part 1	
(24) Construction Noise Management Plan	
(d) Details of any work proposed to occur outside of Council's standard construction hours.	Section 5
(3) Details of any community consultation to be undertaken	Section 7.
Part 2	
(8) Hours of work	
Building activities (including demolition) may only be carried out between 7.00am and 7.00pm Monday to Friday (other than public holidays) and between 8.00am and 4.00pm on Saturday. No building activities are to be carried out at any time on a Sunday or public holiday	Section 3 dictates current regulation surrounding building work hours and proposed changes for OOH work.
(126) Construction Noise Control	
<p>All noise from construction work must comply with the Interim Construction Noise Guideline (DEC, 2009) and AS2436-2010 "Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites" and AS2436-2010 "Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites" this may include:</p> <p>identification of nearby affected residences or other sensitive receivers;</p> <p>an assessment of the expected noise impacts;</p> <p>details of the work practices required to minimise noise impacts;</p> <p>noise monitoring procedures;</p> <p>procedures for notifying nearby affected residents or businesses; and</p> <p>complaints management procedures.</p>	

This report presents an assessment of potential noise impacts from the proposed construction works on the surrounding community and provides recommended management measures. The assessment has been developed and guided by the following:

- NSW Department of Environment and Climate Change (DECC) 2009, *Interim Construction Noise Guideline* (ICNG);
- NSW Environment Protection Authority (EPA) 2017, *NSW Noise Policy for Industry* (NPfI);
- Standards Australia – AS 1055.1-1997 *Acoustics – Description and measurement of environmental noise – General procedures*; and
- Australian Standard AS 2436-2010 *Guide to Noise Control on Construction, Maintenance and Demolition Sites*.
- Australian Standard AS 2107-2016 *Recommended design sound levels and reverberation times for building interiors*.

Several technical terms are required for the discussion of noise. These are explained in Appendix A.

2 Project site and description

2.1 Project description

The proposed works will include construction activity associated with:

- 10-storey mixed use commercial and retail building with three levels of basement car parking;
- an internal private road connecting to Khartoum Road;
- external hard and soft landscaping works;
- pedestrian path through link site and associated landscaping;
- completion of all services infrastructure connects; and
- voluntary planning agreement (VPA) related item being the Stage a1 (Public Domain) works including:
 - associated pavement;
 - streetscape;
 - street furniture; and
 - lighting and landscaping works.

2.2 Site description

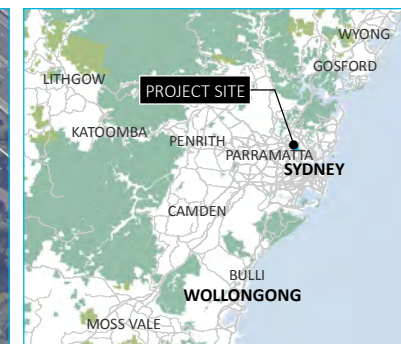
The proposed development site is bounded by the Kennards Self Storage to the west, Johnson & Johnson to the south-west, and an emergency clinic to the north-east, other commercial uses to the south-east and Khartoum Road directly adjacent to the site's north-west façade. The nearest residential premises are located approximately 310 metres (m) west of the proposed development. Figure 2.1 shows the boundary of the proposed development and surrounding land uses.

The nearest noise-sensitive receptors potentially affected by noise from the subject site are adjacent commercial businesses. The nearest commercial spaces are approximately 10 m from the north-eastern and north-western boundaries of the site.

Two nearby businesses adjacent to the site operate during Sunday business hours. These sites include:

- WiSE medical, 17 Khartoum Rd, Macquarie Park: (10:00 am - 11:00 pm); and
- Verace Pizzeria, 7 Khartoum Rd, Macquarie Park: (11:30 am - 2:30 pm, and 5:00 pm to late).

\\lemmsvr1\emms3\2020\J200443 - Taylor - M Park (Building A)\8 GIS\02 Maps\N001 MonitoringLocations 20210223 03.mxd 25/02/2021



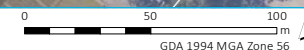
- KEY**
- Site boundary
 - Subject lot
 - Cadastral boundary
- Building type**
- Commercial
 - Residential
- Monitoring location**
- Attended ML
 - Unattended ML
 - Vibration ML
- INSET KEY**
- Major road
 - NPWS reserve
 - State forest

Monitoring Locations

Taylor - M Park (Building A)
Noise and vibration assessment
Figure 2.1



Source: EMM (2021); DFSI (2017)



2.3 Existing ambient noise environment

Unattended noise monitoring was conducted to establish the existing ambient noise environment and road traffic noise levels at the proposed development site. Measurements were completed from 6 to 19 October 2017 by Acoustic Logic Consultancy Pty Ltd using one Acoustic Research Laboratories Pty Ltd (ARL) noise monitor. The ARL noise logger was programmed to store 15-minute statistical noise levels throughout the monitoring period and was positioned on the northern end of the existing carpark, nearest to Khartoum Road. The attended and unattended noise monitoring locations can be seen in Figure 2.1.

The location of the noise logger was selected to record background and ambient noise levels of the proposed site location, which is generally dominated by traffic noise from surrounding roadways including Waterloo Road, Talavera Road and Khartoum Road.

An analysis of the unattended noise logger data has been conducted by EMM to determine the daytime RBL for out of hour works on Sundays. Results are consistent with expected weekend noise levels due to the nearby shopping centre which would likely increase general traffic in the area over the weekend period.

Further, attended measurements were conducted at the proposed site's façade location along Talavera Road, Khartoum Road and along the southern boundary of the site. A summary of the existing background and ambient noise levels is provided in Table 2.1 along with attended façade measurement results.

Table 2.1 Ambient noise monitoring results summary (6-19 October 2017)

Monitoring location	Period	L _{Aeq(period)} (dB)	RBL ² (dB)
L1 (adjacent to Macquarie centre car park)	OOH ¹	57	53

Notes: 1. OOH works occurring between daytime period on Sundays, 8.00am to 4.00pm.

2.4 Construction methodology

EMM understands that the OOH work may include work from multiple stages. Construction work with the potential to cause the largest impact during out of hour periods include structural works on site. Table 2.2 presents the proposed equipment for noise intensive works.

Table 2.2 Proposed noise intensive equipment

Work Stage	Equipment Description	Equipment size	Equipment count
Structural works	Crane	400 t	1
	Jackhammer	-	1
	Forklifts	-	2
Internal fit out and finishing	Crane	400 t	1
	Hand tools	-	
	Generator	-	1
	Forklifts/Bobcat	-	2

3 Construction noise guidelines

Currently under Condition 8, Part 2 of the conditions of approval provides the allowed times for project construction works during standard hours:

- Monday to Friday 7.00 am – 7.00 pm;
- Saturday 8.00 am – 4.00 pm; and
- No construction work is to take place on Sundays or public holidays.

Taylor Constructions Group is seeking to extend construction hours to include OOH construction works during Sundays between 8.00 am and 4.00 pm.

Table 3.1 is an extract from the ICNG and provides noise management levels for residential receivers outside of standard hours. These time restrictions are the primary management tool of the ICNG.

Table 3.1 ICNG residential criteria

Time of day	Management level $L_{Aeq,15\text{ minute}}$	How to apply
Outside recommended standard hours	Noise affected RBL + 5 dB	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 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

Table 3.2 is an extract from the ICNG and provides noise management levels for other land uses.

Table 3.2 ICNG noise levels at other land uses

Land use	Management level, $L_{Aeq,15\text{ minute}}$
Industrial premises	External noise level 75 dB (when in use)
Offices, retail outlets	External noise level 70 dB (when in use)
Classrooms at schools and other educational institutions	Internal noise level 45 dB (when in use)
Hospital wards and operating theatres	Internal noise level 45 dB (when in use)
Places of worship	Internal noise level 45 dB (when in use)
Active recreation areas	External noise level 65 dB (when in use)
Passive recreation areas	External noise level 60 dB (when in use)

Source: ICNG (DECC, 2009).

The construction noise management levels (NMLs) for this assessment presented in Table 3.3 have been developed using the noise monitoring data provided in Section 2.3 and in accordance with the ICNG.

Table 3.3 **Construction noise management levels**

Receiver	Period	Representative RBL, dB(A)	NML ¹ , L _{Aeq,15 minute} , dB
Residential (nearest potentially affected)	OOH	53	58
Offices, retail outlets	When in use	N/A	70
Neighbouring industrial premises	When in use	N/A	75
Classrooms	When in use	N/A	45 (Internal)/55 (External)
Hospital wards and operating theatres	When in use	N/A	45 (Internal)/55 (External)
Places of worship	When in use	N/A	45 (Internal)/55 (External)
Active recreation areas	When in use	N/A	65
Passive recreation areas	When in use	N/A	60

Notes 1: External noise levels, except where noted.
N/A = not applicable.

The nearest affected tenancy to the north is a medical centre (WiSE medical). EMM have reviewed the floor plans for the tenancy to establish internal uses which have been used for the assessment of potential construction noise impacts. Internal construction noise objectives have been established based on the recommended maximum internal noise levels of AS2107:2016 consistent with the requirements of the ICNG. Table 3.4 is an extract from AS2107:2016 relevant to health buildings and provides noise management levels for internal room allocations potentially impacted by construction noise from the Project.

Table 3.4 **AS2107:2016 - Recommended design sound levels**

Health Buildings	Management level, L _{Aeq,15 minute}
Corridors and lobby spaces	<50

4 Construction noise assessment

4.1 Typical construction equipment

The construction noise impact assessment has adopted equipment noise emission values obtained from EMM's noise database for plant used on similar projects.

Table 4.1 summarises typical equipment items, sound power level and quantities adopted in the noise modelling for each proposed phase of works.

Table 4.1 Typical construction equipment

Equipment	Quantity (worst case per 15-minute period)	Sound power level, $L_{Aeq,15\text{minute}}$ (dB) ¹
Structural works		
Crane	2	105
Hand tools	1	102
Forklifts	2	104
Fit-out and finishing works		
Crane	2	105
Hand tools	1	102
Generator	1	101
Forklifts/Bobcat	2	104

Note: 1. Plant has been assumed to operate continuously in any 15-minute period.

4.2 Construction noise modelling method and results

Construction noise levels have been predicted to the nearest noise-sensitive receivers assuming attenuation due to distance only.

To ensure compliance with relevant noise goals, unscreened equipment used during the structural works and the fit-out and finishing works are to operate at the minimum offset distances from 17 Khartoum Rd as shown in Table 4.2.

Table 4.2 Offset distances from 17 Khartoum Road

Equipment Description	Offset Distance	Notes
Hand Tools	25 m	Hand tools are to be used no closer than 35 m to WiSE medical tenancy façade on 17 Khartoum Rd.
Generator	40 m	Generator (without screening) to be located a minimum of 65 m from WiSE medical tenancy façade on 17 Khartoum Rd.
Forklifts/bobcat	40 m	Forklifts/bobcats are to be used no closer than 50 m to WiSE medical Tenancy façade on 17 Khartoum Rd.

Construction equipment has been modelled at representative locations from the nearest residence to represent the range of noise levels that may be experienced over the relevant periods. Indicative noise predictions are provided in Table 4.3 for each phase of construction activity.

Table 4.3 Construction noise predictions

Representative receiver	Distance ³	Indicative predicted noise level L _{Aeq,15 minute}	Construction noise goal L _{Aeq,15 minute}
Nearest residence	240-340 m	Structural works 56-58 dB Fit-out and finishing works 54-56 dB	58 dB (OOH ¹ - Sunday)
Surrounding offices/retail outlets	10-70 m	Structural works 71-88 dB Fit-out and finishing 69-86 dB	70 dB (OOH ¹ – Sunday, when in use)
WiSE medical ⁴ , 17 Khartoum Rd	45 - 85 m	Structural works 42-47 dB ² Fit-out and finishing 46-50 dB ²	50 (Internal) ⁴
Verace Pizzeria, 7 Khartoum Rd	45 - 100 m	Structural works 40-42 dB Fit-out and finishing 43-48 dB	70 dB (OOH ¹ – Sunday, when in use)

- Notes:
1. OOH works occurring during daytime period on Sundays, 8 am to 4 pm.
 2. Noise predictions include a 20 dB façade noise reduction with the assumption that all external doors/windows on these premises will remain closed.
 3. Calculated from construction boundary to the nearest exposed façade for defined tenancy within their respective buildings.
 4. 17 Khartoum Rd has been assessed to the ground floor which is where the WiSE tenancy is located within the building.

Predictions presented in Table 4.3 indicate that construction noise levels are likely to meet the construction noise goal at the nearest residence during the proposed construction hours on Sundays.

Surrounding commercial spaces have the potential to be above the recommended noise goals at times during the structural works and fit-out and finishing works. Given that the predictions assume equipment operating simultaneously and at the nearest locations to the relevant receivers it is likely that actual construction noise levels would be less than those predicted for the majority of the time. It is further noted that construction works are unlikely to impact commercial uses given they are generally unoccupied on a Sunday (excluding WiSE medical and Verace Pizzeria). In this regard, out-of-hours works are typically favourable for commercial uses, as it reduces the overall construction period whilst having minimal additional acoustic impact due to works occurring outside periods of general occupation or trade.

Noise predictions at Verace Pizzeria are anticipated to meet the construction noise goal during Sunday business hours.

Noise predictions at WiSE medical show the internal criteria of 50 dBA (southern staff access corridor) during both structural and fit-out and finishing works to be satisfied provided construction equipment adhere to the minimum offset distances shown in Table 4.2. No other sensitive locations are present on the southern side of 17 Khartoum Rd which operate on Sundays, and hence site activities on Sundays will meet relevant noise goals at this location.

It is noted that during fit-out and finishing, noise levels are generally expected to be substantially lower than predictions in Table 4.3 as noise predictions presented assume all sources to be located outside the building with no façade reduction.

Taylor Constructions have not received any complaints to date regarding construction noise or vibration impacts during the previous EP&A (*COVID-19 Development – Construction Work Days Order*). As initial works (demolition and earthworks) were considered to have the greatest impact on nearby receivers, remaining work stages (structural works and fit-out and finishing) are unlikely to cause disturbance at nearby receiver locations.

Notwithstanding, the proponent will actively manage construction noise from the site. Further advice and discussion are provided in Section 5 in this regard.

5 Mitigation and management

As provided in Section 4, it is possible that noise levels will be above the relevant noise goals at times during the proposed construction project for surrounding commercial receivers.

Section 5.1 provides site-specific noise mitigation and management measures that will be implemented at the site and the subsequent sections provide further good practice recommendations in this regard.

5.1 Adoption of general noise & vibration management practices (AS 2436-2010)

Site-specific mitigation measures in Table 5.1 will be implemented at the site with the aim of reducing construction noise levels below the relevant noise goals. AS 2436-2010 *“Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites”* sets out numerous practical recommendations to assist in mitigating construction noise emissions.

Example strategies of proactive mitigation methodologies that could be implemented to reduce noise impacts are shown in Table 5.1. These will be considered during the demo and excavation phases of the project.

Table 5.1 Noise mitigation methodologies

Item	Actions	Responsible Staff	When
Site-specific mitigation and management			
1	Minimise the need for vehicle reversing for example, by arranging for one-way site traffic routes where possible	All staff	At all times
2	Minimum offset distances shown in Table 4.2 will be adhered to in order to minimise site impact on WiSE medical tenancy.	All staff	At all times
Universal work practices			
1	regular identification of noisy activities and adoption of improvement techniques	Operations and Management	At all times
2	where possible, avoiding the use of equipment that generates impulsive noise	Construction contractors	At all times
3	minimising the movement of materials and plant and unnecessary metal-on-metal contact	Construction contractors	At all times
Plant and Equipment			
1	using temporary noise barriers (in the form of plywood hoarding or similar) to shield intensive construction noise activities from residences	Operations Staff	Planning phase
2	operating plant and equipment in the quietest and most efficient manner	Construction contractors	At all times
3	regularly inspecting and maintaining plant and equipment to minimise noise level increases, to ensure that all noise reduction devices are operating effectively	Construction contractors	At all times
Work Scheduling			
1	include contract conditions that include penalties for non-compliance with reasonable instructions by the principal to minimise noise or arrange suitable scheduling	Operations Staff	Planning phase

Table 5.1 Noise mitigation methodologies

Item	Actions	Responsible Staff	When
2	Planning work activities during OOH work to include work that is inherently quieter (less likely to disturb neighbouring retail outlets) such as fit-out and finishings	Operations Staff	Planning phase

5.2 Quantifying noise reductions

Approximate noise reductions provided by some of these measures are provided in Table 5.2.

Table 5.2 Relative effectiveness of various forms of noise control

Noise control	Nominal noise reduction possible, in total A-weighted sound pressure level, dB
Increase source to receiver distance ¹	approximately 6 dB for each doubling of distance
Reduce equipment operating times or turn off idling machinery ²	approximately 3 dB per halving of operating time
Operating training on quiet operation ²	Up to 3 to 5 dB
Screening (e.g. noise barrier) ¹	normally 5dB to 10 dB, maximum 15 dB
Enclosure (e.g. shed/building) ¹	normally 15 dB to 25 dB, maximum 50 dB
Silencing (e.g. exhaust mufflers) ¹	normally 5 dB to 10 dB, maximum 20 dB

Notes: 1. Sourced from AS2436-2010.
2. Based on EMM's measurement experience at construction and mining sites

6 Noise monitoring

To maximise the effectiveness of management strategies to minimise noise impacts, a monitoring program has been developed to guide, manage, quantify and control emissions from construction activities. Where exceedances of the relevant goals are identified, additional feasible and reasonable mitigation measures and controls would be considered to minimise impacts to nearby residential and commercial receivers.

6.1 Objectives

After the commencement of acoustically significant activities or where complaints are received, monitoring should be conducted to quantify construction noise levels and to verify these levels within the community.

The objectives of the monitoring program would be as follows:

- assess construction noise levels against relevant goals, with consideration given to non-site related ambient and background noise at the time of measurements;
- identify potential noise sources and their relative contribution to impacts from construction activity;
- specify appropriate intervals for monitoring to evaluate, assess and report the relative contribution due to construction activity;
- outline the methodologies to be adopted for monitoring construction noise, including justification for monitoring intervals or triggers, weather conditions, monitoring location selection and timing; and
- incorporate noise management and mitigation strategies outlined in this plan.

6.2 General noise measurement procedures

The noise measurement procedures adopted for the project shall be in accordance with AS 1055-1997 *Acoustics – Description and Measurement of Environmental Noise*.

All acoustic instrumentation used in the monitoring of construction should comply with the requirements of IEC 61672.1-2004 and carry current NATA or manufacturer calibration certificates. All instrumentation will be programmed to record statistical noise level indices in 15-minute intervals which include the L_{Amax} , L_{A1} , L_{A10} , L_{A90} , L_{Amin} and the L_{Aeq} .

Instrument calibration shall be checked before and after each measurement survey, ensuring a valid variation in calibrated levels not exceeding ± 0.5 dBA.

6.3 Operator attended noise surveys

Operator attended noise measurements will be conducted during construction activities at the potentially most affected receiver locations or representative thereof, relevant to the construction activities. Attended noise measurements are conducted to quantify noise emissions and estimate the $L_{A1,adj,15\text{ minute}}$ noise contribution from construction activities with respect to the overall level of ambient noise. Importantly, the background and ambient noise levels at that time and in the absence of site contribution must also be quantified.

The operator shall quantify and characterise noise levels from both extraneous (non-site) and construction noise sources over a period of 15 minutes for representative potentially affected receivers.

6.4 Reporting

A report will be prepared outlining the results of monitoring and how exceedances (where relevant) were managed. A site layout, outlining the locations of construction equipment and monitoring locations, is to be included in the monitoring reports.

6.5 Training

All personnel involved in noise monitoring will be adequately trained and up to date with relevant measurement standards, methodologies and product technology with respect to noise measurements.

7 Community consultation and complaints handling

A programme to engage in active community consultation and maintain positive relations with nearby building occupants and residents will be implemented in order to minimise complaints by addressing their concerns. It is important that advice and detail be given to the community regarding any works outside the standard construction hours (which is unlikely and not planned in this case).

With regard to potentially offensive noise events associated with construction activities, AS 2436 – 2010 provides the following:

If noisy operations must be carried out, then a responsible person should maintain liaison between the neighbouring community and the contractor. This person should inform the public at what time to expect noisy operations and also inform the contractor of any special needs of the public.

Consultation and cooperation between the contractor and his neighbours and the removal of uncertainty and rumour can help to reduce the adverse reaction to noise.

To effectively manage any requests for information or respond to any public concerns in relation to the proposed construction activities and site operation, the following systems shall be maintained:

- The proponent will supply the relevant governing authorities with the names and appropriate contact numbers for the site construction manager during the construction period and one other senior staff member.
- An emergency after hours contact phone number will be put in place to allow contact with the proponent in relation to any environmental matter including those concerned with noise issues. This phone number will be clearly displayed on the fence surrounding the construction site.
- The proponent will use a complaint handling system to monitor environmental noise complaints. All information relating to such complaints will be kept in a register. The register will include but not be restricted to the following information:
 - date and time of complaint;
 - complainant details (i.e., full name, address and contact details);
 - nature and source of complaint;
 - action taken; and
 - follow-up with complainant.
- The complaint register will be made available to any relevant regulatory authority upon request.
- The proponent will endeavour to respond to any complaint within one working day of its receipt.

Response measures, which would be adopted following complaints regarding noise, would include:

- Identify the source that has caused the complaint. This would be done by consultation with the complainant and by conducting a noise survey to quantify the level of disturbance.

- Reassess the mitigation and management techniques employed at the site to reduce the impact of the source in question. Particular attention should be given to the scheduling of activities and the siting of equipment used on site.
- Following the adoption of additional or alternative mitigation, a further noise survey would be conducted at the complainant's location to demonstrate the effectiveness of the mitigation strategy.

8 Conclusion

EMM has prepared an extended hours construction noise assessment for the development at 11–17 Khartoum Road and 33–39 Talavera Road, Macquarie Park (the project) in NSW. This CNVMP has been prepared to address Condition 24 of the development consent conditions (development application no. 2017/0547) and subsequent approvals currently in effect.

The proposed OOH works will include structural and fit-out and finishing works. In this regard we note:

- the work zone fronting Khartoum Road will not be used during the OOH works;
- no deliveries will occur during the OOH period; and
- all site materials required for the OOH period will be preloaded during normal construction hours.

Predictions during daytime OOH work (to take place on Sundays) indicate that construction noise levels are likely to meet the noise management levels at residential locations and adjacent commercial receivers. Noise predictions assume minimum offset distances from nearby sensitive receivers are adhered to during construction hours. Predicted noise levels are for peak periods of construction activity (with all equipment operating simultaneously) and ignore mitigation and management measures which may be employed to reduce construction noise impacts.

Noise impacts during the fit-out and finishing works assume worst case works to be occurring external to the building façade.

Construction works are unlikely to impact adjacent tenancies Verace Pizzeria and WiSE medical while work practices and offset distances are maintained as outlined previously. It is further noted that construction works are unlikely to impact all remaining commercial uses given they are generally unoccupied on a Sunday.

Recommendations have been provided regarding work practices to minimise construction noise from the project.

Appendix A

Acoustic Terminology

A.1 Acoustic Terminology

Several technical terms are discussed in this report. These are explained in Table A.1.

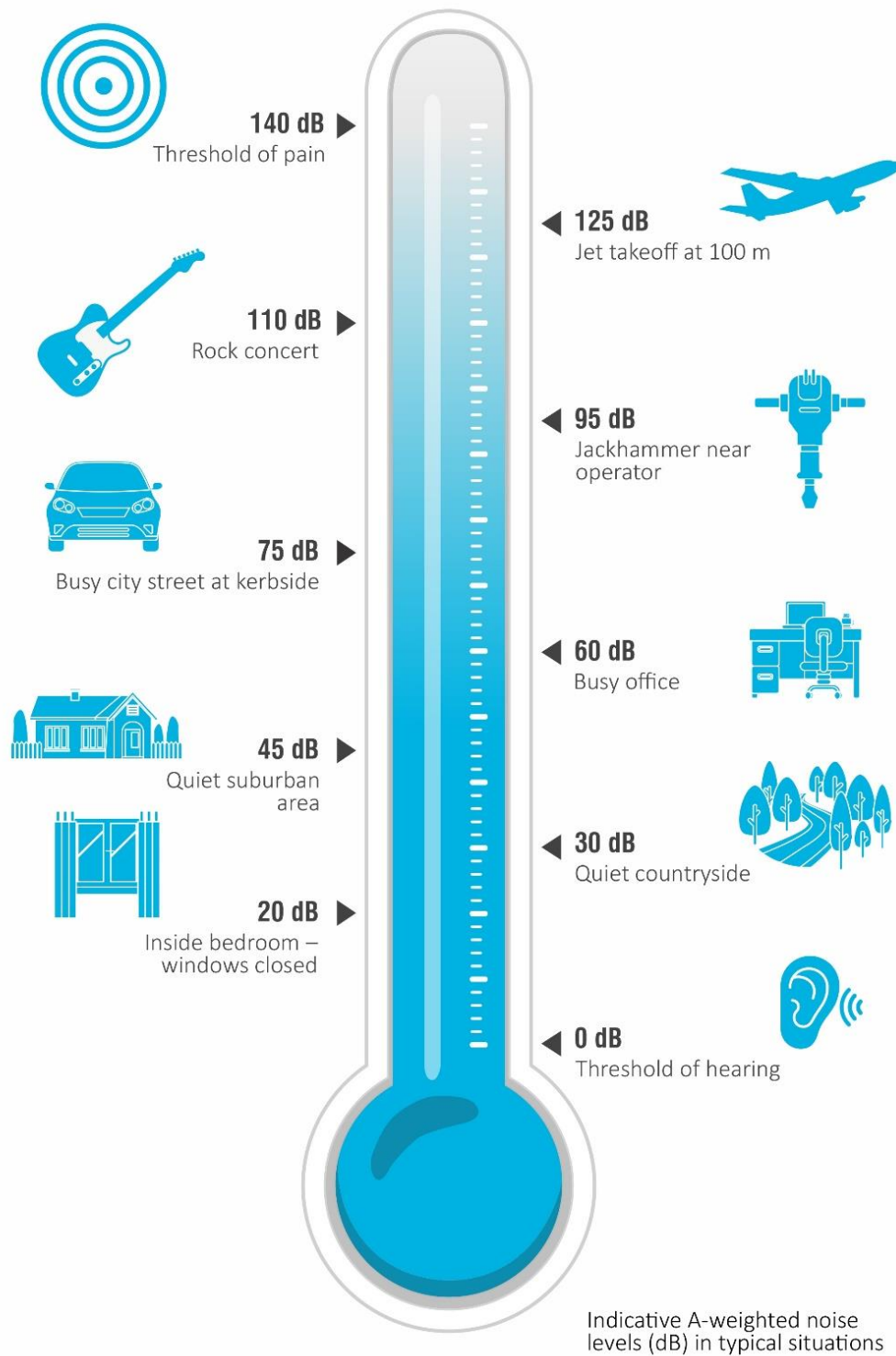
Table A.1 Glossary of acoustic terms

Term	Description
dB	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
L_{A1}	The 'A-weighted' noise level which is exceeded 1% of the time.
$L_{A1,adj,15\ min}$	This is the equivalent 'A-weighted' noise level which is exceeded 1% of the time over a 15-minute period.
L_{A10}	The 'A-weighted' noise level which is exceeded 10% of the time. It is approximately equivalent to the average of maximum noise level.
L_{A90}	Commonly referred to as the background noise level. The 'A-weighted' noise level exceeded 90% of the time.
$L_{A90,adj,15\ min}$	This is the equivalent continuous 'A-weighted' background noise level over a 15-minute period. The $L_{A90, adj, 15min}$ descriptor refers to an L_{A90} noise level measured over a 15-minute period.
L_{Aeq}	The energy average noise from a source. This is the equivalent continuous 'A-weighted' sound pressure level over a given period.
$L_{Aeq,adj,15min}$	This is the equivalent continuous 'A-weighted' sound pressure level over a 15-minute period. The $L_{Aeq,15min}$ descriptor refers to an L_{Aeq} noise level measured over a 15-minute period.
L_{Amin}	The minimum 'A-weighted' noise level received during a measuring interval.
L_{Amax}	The maximum root mean squared 'A-weighted' sound pressure level (or maximum noise level) received during a measuring interval.
L_{Ceq}	This is the equivalent continuous 'C-weighted' sound pressure level over a given period. The $L_{Ceq,15min}$ descriptor refers to an L_{Ceq} noise level measured over a 15-minute period. C-weighting can be used to measure low frequency noise.
Day period	Monday – Saturday: 7 am to 6 pm, on Sundays and Public Holidays: 9 am to 6 pm at a sensitive place and 7 am to 6 pm at a commercial place.
Evening period	All days: 6 pm to 10 pm.
Night period	Monday – Saturday: 10 pm to 7 am, on Sundays and Public Holidays: 10 pm to 9 am at a sensitive place and 10 pm to 7 am at a commercial place.

It is useful to have an appreciation of decibels (dB), the unit of noise measurement. Table A.2 gives an indication as to what an average person perceives about changes in noise levels. Examples of common noise levels are provided in Figure A.1.

Table A.2 Perceived change in noise

Change in sound pressure level (dB)	Perceived change in noise
3	Just perceptible
5	Noticeable difference
10	Twice (or half) as loud
15	Large change
20	Four times (or quarter) as loud



Source: Noise Measurement Manual (Department of Environment and Heritage Protection 2013).

Figure A.1 Common noise levels

Australia

SYDNEY

Ground floor 20 Chandos Street
St Leonards NSW 2065
T 02 9493 9500

NEWCASTLE

Level 3 175 Scott Street
Newcastle NSW 2300
T 02 4907 4800

BRISBANE

Level 1 87 Wickham Terrace
Spring Hill QLD 4000
T 07 3648 1200

CANBERRA

Level 2 Suite 2.04
15 London Circuit
Canberra City ACT 2601

ADELAIDE

Level 4 74 Pirie Street
Adelaide SA 5000
T 08 8232 2253

MELBOURNE

Suite 8.03 Level 8 454 Collins
Street
Melbourne VIC 3000
T 03 9993 1900

PERTH

Suite 9.02 Level 9 109 St
Georges Terrace
Perth WA 6000

Canada

TORONTO

2345 Young Street Suite 300
Toronto ON M4P 2E5

VANCOUVER

60 W 6th Ave Suite 200
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