WOOD & GRIEVE ENGINEERS

Campbelltown Sports and Health Centre of Excellence

Acoustic Report

Development Application

Prepared for:

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Contents

1. Introduction

Wood & Grieve Engineers has been engaged by Peter Hunt Architects to provide an acoustic report for the Development Application for the proposed sport and recreation development located along Goldsmith Avenue in the Macarthur Heights Precinct, Campbelltown NSW, 2560.

The reference design submitted with the development application consists of:

- Ground level parking
- Ground level plant room
- New community office
- New change rooms and showers
- New hydrotherapy pool
- New indoor sports hall
- Level 1 plant room
- Level 1 New weights gym
- New community health centre and clinical room for Western Sydney University
- New community health centre and clinical room (GP Clinic)

This assessment discusses the potential noise impact from the proposed development as detailed in the reference design on the nearest most-affected receivers and the requirements for the proposed development to achieve appropriate acoustic amenity within.

This assessment has been prepared considering the following documents:

- Campbelltown (Sustainable City) Development Control Plan (DCP – 2015)
- NSW Environmental Protection Authority (EPA) Noise Policy for Industry (NPI)
- Department of Planning (DoP) – Development near Rail Corridors and Busy Roads – Interim Guideline;
- AS/NZS 2107:2016 – Acoustics – Recommended Design Sound Level and Reverberation Times for Building Interiors
- NSW Environment Protection Authority (EPA) Interim Construction Noise Guideline (ICNG July 2009).
- NSW OEH Assessing Vibration: A technical guideline 2006
- NSW OEH Road Noise Policy 2011
- British Standard BS5228: Part 1:1997 “Noise and Vibration Control on Construction and Open Sites.”
- British Standard BS7358:1993 “Evaluation and Measurement for Vibration in Buildings” – Part 2: “Guide to Damage Levels from Groundborne Vibration”
- German Standard DIN4150-Part 3 “Structural vibration in buildings – Effects on structures”

This report provides:

- A statement of compliance with the Campbelltown Council (part 5) DCP acoustic requirements for the reference design including residential within the vicinity of the nearest potentially affected receivers
- Indicative recommendations for noise mitigation measures for the proposed development in order to meet the relevant criteria

The noise assessment is based on noise data collected by a combination of attended noise measurement and unattended noise loggers at representative locations around the site over 7 days from 20th February to 27th February.

This report is based on our understanding of the proposed project, application of the relevant state guidelines and professional experience within the acoustic field. Therefore, this report shall not be relied upon as providing any warranties or guarantees.

2. Background

2.1 Information sources

The following documents have been used for the preparation of this report:

- Site drawings presenting the location of the proposed development in relation to the nearest receivers
- Noise data collected on site through the use of noise monitors and a hand held spectrum analyser
- Architectural drawings provided by Peter Hunt Architect dated 26/02/18
    - SK101 – Site Plan
    - SK201 – Floor Plan
    - SK202 – Roof Plan
    - SK210 – Ground Floor Plan & Level 1 Plan
    - SK401 – 3D Views
    - SK402 – 3D Views
- Mechanical Services spatial drawings provided by Northrop Engineers dated 15/02/18
    - MSK01 a
    - MSK01 b
- Traffic Information provided by PTC Consultants

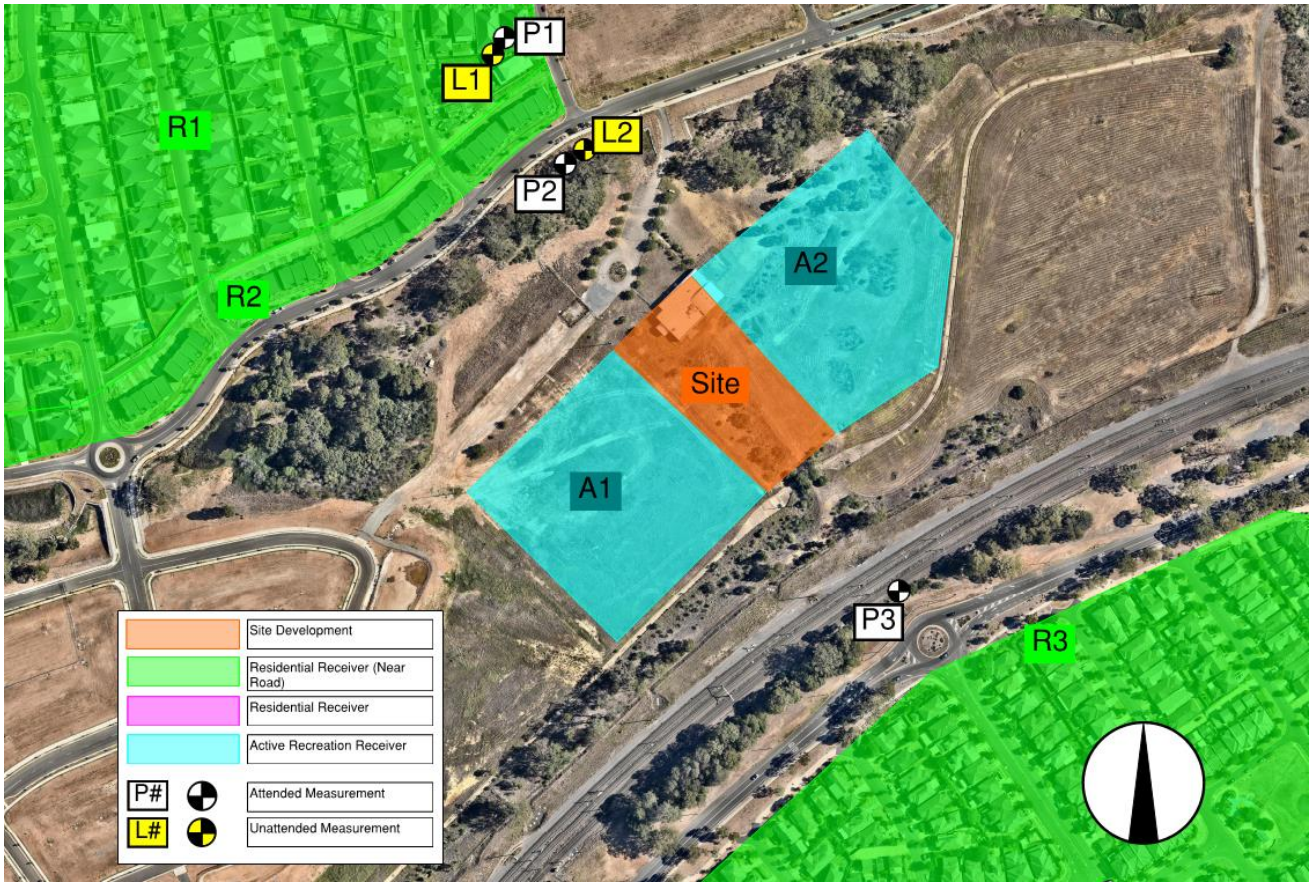
3. Project Overview

3.1 Site description

The proposed development is located on Goldsmith Avenue, Campbelltown NSW. The proposed development is bound by Goldsmith Avenue to the North West, active recreation to the North East and South West and a rail corridor to the South East.

Figure 1 provides details of the site location, long-term measurement noise logger locations (L1 & L2), attended short-term measurement locations (P1 & P2), existing active recreational receivers (A1 & A2) and existing residential receivers (R1 & R2).

Figure 1: Aerial photo of the area showing an overview of the site and measurement locations



Source: nearmap.com

3.2 Acoustic Issues

The acoustic issues relating to the reference design and future development of the property are as follows:

- Noise intrusion into the northwestern façade facing Goldsmith Avenue.
- Noise emissions from mechanical plant from the proposed development to the surrounding noise-sensitive receivers.
- Increased traffic noise associated with the proposed development affecting the surrounding residential receivers.

4. Noise Survey

4.1 Instrumentation

The following instrumentation has been used to conduct the noise surveys shown in the subsequent sections:

- ARL Environmental Noise Logger ARL EL-315 S/N 15203504
- ARL Environmental Noise Logger ARL EL-315 S/N 15203506
- Hand-held sound spectrum analyzer B&K 2250, S/N 2709742
- Sound Calibrator B&K Type 4231, S/N 2709826

All equipment was calibrated before and after the measurements and no significant drift was found. All equipment carries current traceable calibration certificates that can be provided upon request.

4.2 Attended Noise Survey Results

Attended noise measurements of 15-minute were conducted on site to characterize the acoustic environment for noise intrusion into the development and to determine any noise impact on the surrounding noise sensitive receivers. A summary of the attended noise measurements taken in the vicinity of the proposed development site are shown in Table 1. Refer to Figure 1 for measurement locations.

Table 1: Summary of attended noise measurements

Measurement Location	Measurement Time	$L_{Aeq,15mins}$ dB(A)	L_{A90} dB(A)	L_{Amax} dB(A)	Comments
P1	23/02/2018 – 16:55	46.6	43.7	63.2	General environmental noise
P2	23/02/2018 – 16:35	59.1	47.4	78.1	Dominated by intermittent vehicle movements along Goldsmith Avenue
P3	20/02/2018 – 14:47	86.0	74.9	92.4	Train movements within the adjacent rail corridor

4.3 Unattended Noise Survey Results

This assessment will consider the method for determining the RBL background for each period of the day in accordance NSW EPA Noise Policy for Industry (NPI, 2017). The NPI defines background and ambient noise for the daytime, evening and night time periods as follows;

Day: is defined as 7:00am to 6:00pm Monday to Saturday and 8:00am to 6:00pm Sundays & Public Holidays

Evening: is defined as 6:00pm to 10:00pm Monday to Sunday & Public Holidays.

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

4.3.1 Background and Ambient Noise Monitoring

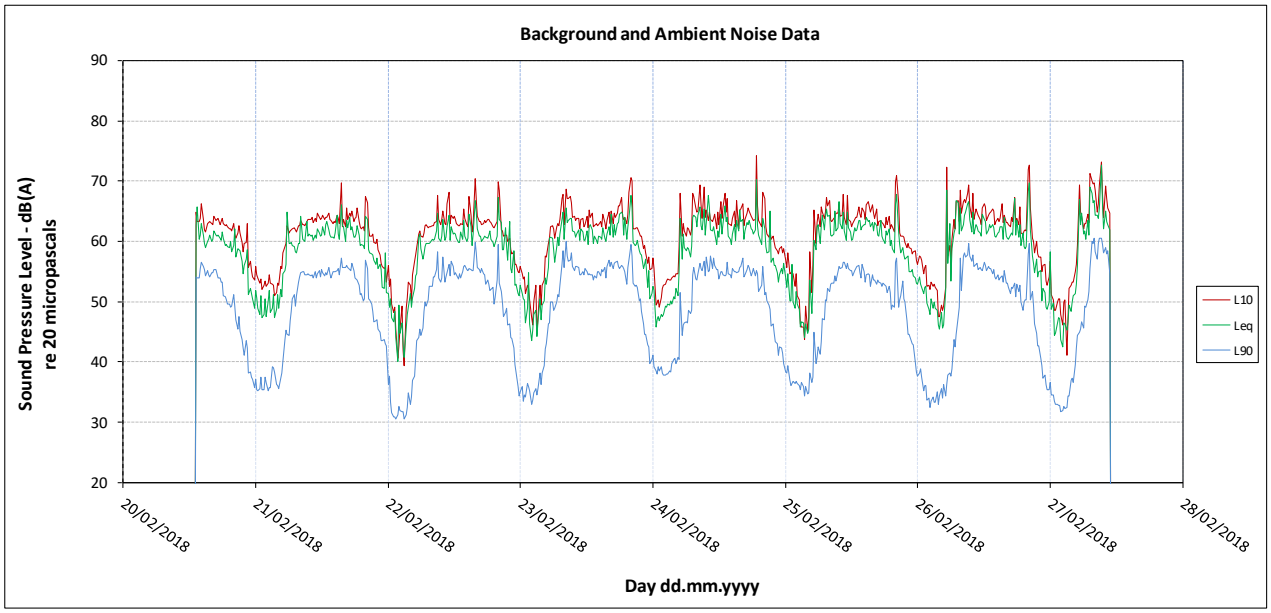
A noise monitor was placed at position L1 to measure the background and ambient noise. This data is representative of the background noise of the surrounding residential receivers to the North-west & South of the proposed sport and recreation development. Monitor L1 was installed from the 20th February to the 27th of February 2018. The noise monitor at position L2 was installed to measure the traffic noise along Goldsmith Avenue. The measurements are also representative of the existing background noise level at the façade of the residential receivers facing towards the proposed sport and recreation development. Monitor L2 was installed from the 20th February to the 27th of February 2018. The results for the unattended background noise surveys are shown in Table 2 below (for the day, evening and night periods). Note that any rain-affected data during the period of logging has been excluded from the calculations.

Table 2: Summary of the unattended noise measurements

Location	Equivalent Continuous Noise Level $L_{Aeq,period}$ - dB(A)			Background Noise Level RBL - dB(A)		
	Day	Evening	Night	Day	Evening	Night
L1	62	62	56	53	48	35
L2	60	58	54	43	45	39

The local ambient noise environment is typically that of a suburban environment and is dominated by traffic noise throughout the day, leaving the evening and night to predominately be dominated by general environmental noise. Refer to Figure 2 and Figure 3 for noise data.

Figure 2 : Unattended noise monitoring data L1



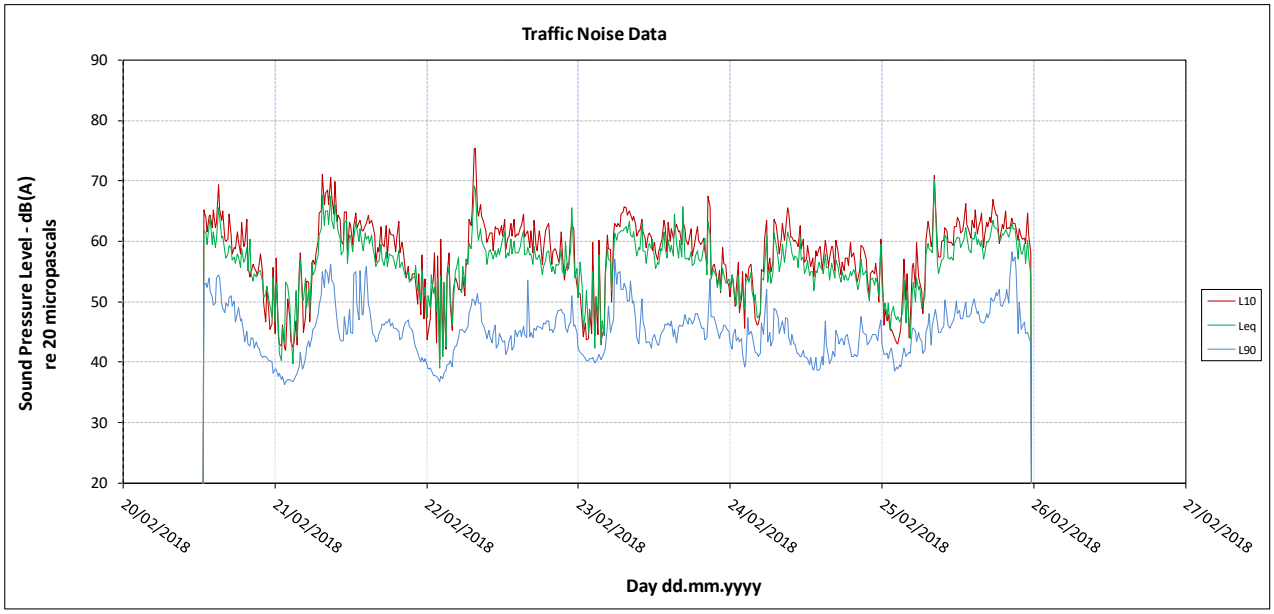
4.3.2 Traffic Noise Monitoring

Noise monitors were installed in locations L2 as shown in Figure 1 in order to measure the traffic noise from Goldsmith Avenue, respectively. The noise monitor was installed from the 20th February to the 27th April 2018. The results of the traffic noise survey from L2 are shown in Table 4 for the day and night time periods.

Table 3: Unattended Noise Measurements L2

Location	Equivalent Continuous Noise Level $L_{Aeq,period}$ - dB(A)	
	Day (7am – 10pm), Noisiest 1h	Night (10pm – 7am), Noisiest 1h
L2	63.5	57.4

Figure 3 : Unattended Noise Monitoring Data L2



5. Noise and Vibration Criteria

5.1 Internal Noise Levels

For the proposed development, Australian Standard AS/NZS 2107:2016 – *'Acoustics – Recommended design sound levels and reverberation times for building interiors'* has been used. AS/NZS2107:2016 specifies target noise levels for internal spaces for the proposed development, as summarised below in Table 4.

Table 4: Summary of Recommended Internal Noise Levels using AS/NZS 2107:2016

Type of occupancy / activity	Design sound level L_{Aeq}, dB(A) range
Sports and Clubs Building	
Indoor Pools	50 – 60
Indoor Sports (with coaching)	< 45
Indoor Sports (without coaching)	< 50
Leisure Centre and Gaming	40 – 50
General Office Areas	40 – 45
Weight Training/ Fitness Room	< 50

5.2 External Noise Emissions

5.2.1 NSW Noise Policy for Industry (NPI)

In the absence of any specific external noise requirements in the Campbelltown (Sustainable City) Development Control Plan, the NSW Noise Policy for Industry (NPI) has been applied to the address the noise emissions from both of the buildings at the site. The NPI sets out noise criteria to control the noise emission from industrial noise sources from activities listed in Schedule 1 of the POEO Act and regulated by the EPA. The external noise due to mechanical services from the proposed development is also addressed following the guideline in the NSW EPA's NPI.

The calculation is based on the results of the ambient and background noise unattended monitoring, addressing two components:

- Controlling intrusive noise into nearby residences (Intrusiveness Criteria)
- Maintaining noise level amenity for particular land uses (Amenity Criteria)

Once both criteria are established, the most stringent for each considered assessment period (day, evening, night) is adopted as the project-specific noise level (PSNL).

Intrusiveness Criteria

The NSW NPI states the following:

> *"The intrusiveness of an industrial noise source may generally be considered acceptable if the level of noise from the source (represented by the LAeq descriptor), measured over a 15minute period, does not exceed the background noise level by more than 5 dB when beyond a minimum threshold."*

The intrusiveness criterion can be summarised as L_{Aeq}, 15 minute $\leq$ RBL background noise level plus 5 dB(A).

Table 5: NSW NPI Rating background noise levels (RBLs)

Period	Noise Descriptor – dB(A)	Noise Criteria – dB(A)
Residential – R1		
Daytime 7am – 6pm	$L_{Aeq,15min} \leq$ RBL + 5	58
Evening 6pm – 10pm	$L_{Aeq,15min} \leq$ RBL + 5	53
Night 10pm – 7am	$L_{Aeq,15min} \leq$ RBL + 5	40
Residential – R2		
Day (7:00am to 6:00pm)	$L_{Aeq,15min} \leq$ RBL + 5	48
Evening (6:00pm to 10:00pm)	$L_{Aeq,15min} \leq$ RBL + 5	50
Night (10:00pm to 7:00am)	$L_{Aeq,15min} \leq$ RBL + 5	44

Amenity Criteria

The NSW NPI states the following:

> *"To limit continuing increases in noise levels from application of the intrusiveness level alone, the ambient noise level within an area from all industrial noise sources combined should remain below the recommended amenity noise levels specified in Table 2.2 where feasible and reasonable. The recommended amenity noise levels will protect against noise impacts such as speech interference, community annoyance and some sleep disturbance. The recommended amenity noise levels have been selected on the basis of studies that relate industrial noise to annoyance in communities (Miedema and Voss, 2004).*

The applicable parts of Table 2.2: Amenity noise levels from Industrial Noise Sources – L_{Aeq}, dB(A) which are relevant to the project are reproduced below:

the project are reproduced below:

Table 5: NSW NPI amenity criteria for external noise levels

Type of Receiver	Noise amenity area	Time of Day	L_{Aeq}, dB(A) Recommended amenity noise level	Project amenity noise level $L_{Aeq, period}$
Residential	Suburban	Day	55	50
		Evening	45	40
		Night	40	35
Active Recreation	All	When in use	55	50

*Urban area as defined in EPA NPI Table 2.2.

Note that where the resultant project amenity noise level is 10dB or more lower than the existing industrial noise level the project amenity noise levels can be set at 10dB below existing industrial noise levels if it can be demonstrated that existing industrial noise levels are unlikely to reduce over time.

'Modifying Factor' Adjustments

The NSW NPI also states:

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

In order to take into account the potential annoying character of the noise an adjustment of 5 dB(A) for each annoying character aspect and cumulative of up to a total of 10 dB(A), is to be added to the measured value to penalise the noise for its potentially greater annoyance aspect.

Table C1 of Fact Sheet C of the NSW NPI (see Table 6 below) provides procedures for determining whether an adjustment should be applied for greater annoyance aspect.

Table 6: Table C1 from the NSW NPI – Modifying factor corrections

Factor	Assessment / Measurement	When to Apply	Correction[1]	Comments
Tonal Noise	One-third octave band analysis using the objective method for assessing the audibility of tones in noise – simplified method *(ISO1996.2-2007 – Annex D)*.	Level of one-third octave band exceeds the level of the adjacent bands on both sides by: • 5 dB or more if the centre frequency of the band containing the tone is in the range 500–10,000 Hz • 8 dB or more if the centre frequency of the band containing the tone is in the range 160–400 Hz • 15 dB or more if the centre frequency of the band containing the tone is in the range 25–125 Hz.	5 dB[2,3]	Third octave measurements should be undertaken using unweighted or Z-weighted measurements. **Note**: Narrow-band analysis using the reference method in *ISO1996-2:2007, Annex C* may be required by the consent/regulatory authority where it appears that a tone is not being adequately identified, e.g. where it appears that the tonal energy is at or close to the third octave band limits of contiguous bands.
Low Frequency Noise	Measurement of source contribution C-weighted and A-weighted level and one-third octave measurements in the range 10–160 Hz	Measure/assess source contribution C- and A-weighted $L_{eq,T}$ levels over same time period. Correction to be applied where the C minus A level is 15dB or more and: • where any of the one-third octave noise levels in Table C2 are exceeded by up to and including 5 dB and cannot be mitigated, a 2dB(A) positive adjustment to measured/predicted A-weighted levels applies for the evening/night period • where any of the one-third octave noise levels in Table C2 are exceeded by more than 5 dB and cannot be mitigated, a 5-dB(A) positive adjustment to measured/predicted A-weighted levels applies for the evening/night period and a 2dB(A) positive adjustment applies for the daytime period.	2 or 5 dB[2]	A difference of 15 dB or more between C- and A-weighted measurements identifies the potential for an unbalance spectrum and potential increased annoyance. The values in Table C2 are derived from Moorhouse (2011) for DEFRA fluctuating low-frequency noise criteria with corrections to reflect external assessment locations.
Intermittent Noise	Subjectively assessed but should be assisted with measurement to gauge the extent of change in noise level.	The source noise heard at the receiver varies by more than 5 dB(A) and the intermittent nature of the noise is clearly audible.	5 dB	Adjustment to be applied for **night-time only.**
Duration	Single-event noise duration may range from 1.5 min to 2.5 h	One event in any assessment period.	0 to 20 dB(A)	The project noise trigger level may be increased by an adjustment depending on duration of noise (see Table C3).
Maximum Adjustment	Refer to individual modifying factors	Where two or more modifying factors are indicated	Maximum correction of 10dB(A)[2] (excluding duration correction)	

1. Corrections to be added to the measured or predicted levels, except in the case of duration where the adjustment is to be made to the criterion.

2. Where a source emits tonal and low-frequency noise, only one 5-dB correction should be applied if the tone is in the low-frequency range, that is, at or below 160 Hz.

3. Where narrow-band analysis using the reference method is required, as outlined in column 5, the correction will be determined by the ISO1996-2:2007 standard.

Sleep Disturbance

The NPI establishes sleep disturbance criteria for residential receivers in close proximity to industrial noise sources during the night-time period, such as vehicle movements and car door slams on private roads. The criteria for protecting the amenity of surrounding residential receivers in regards to sleep disturbance is:

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

Table 7 summarises the sleep disturbance criteria for the proposed development.

Table 7: Sleep Disturbance Criteria

Period	Sleep Disturbance Criteria	
	L_{AFmax} – dB(A)	**$L_{Aeq,15min}$ – dB(A)**
Residential – R1		
Night (10:00pm to 7:00am)	52	40
Residential – R2		
Night (10:00pm to 7:00am)	54	44

5.2.2 Project Noise Trigger Levels

Refer to Table 8 for the NSW NPI criteria applicable to the mechanical noise emissions from the proposed development. These project noise trigger levels are in accordance with the requirements of the NSW NPI, and shall be assessed to the most affected point on or within the residential boundary.

Table 8: Project specific noise levels

Receiver	Period	Descriptor	PSNL dB(A)
R1	Day	$L_{Aeq,period}$	52
	Evening	$L_{Aeq,15min}$	53
	Night	$L_{Aeq,15min}$	40
		L_{AFmax}	52
A1 & A2	All	When in use	50

5.3 Traffic Noise Criteria

Road traffic noise impact is assessed in accordance with the introduced NSW Road Noise Policy. The criterion (Table 3 – Road Traffic Noise Assessment Criteria for Residential Land Uses) divides land use developments into different categories and lists the respective criteria for each case. The category that is relevant to the proposed use of the site is shown below in Table 9.

Table 9 : NSW Road Noise Policy – Traffic noise assessment criteria

Road Category	Type of project/land use	Assessment Criteria – dB(A)	
		Day (7am – 10pm)	Night (10pm – 7am)
Local road	Existing residences affected by additional traffic on existing local roads generated by land use developments	L_{Aeq}, (1 hour) 55 (external)	L_{Aeq}, (1 hour) 50 (external)

In the event that the traffic noise at the site is already in excess of the criteria noted above, the NSW RNP states that the primary objective is to reduce the existing level through feasible and reasonable measures to meet the criteria above.

If this is not achievable, Section 3.4.1 Process for applying the criteria – Step 4 states that for existing residences affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise should be limited to 2 dB above that of the corresponding 'no build option'. The inherent quality of noise from vehicles on public roads arriving to and departing from the site would be indistinguishable from other traffic noise on public roads.

5.4 Construction Noise Criteria

Noise criteria for construction sites are established in accordance with the Interim Construction Noise Guideline (ICNG July 2009) by the NSW Office of Environment &Heritage (NSW OE&H). It is important to note that the recommended criteria are for planning purposes only. Numerous other factors need to be considered when assessing potential noise impacts from construction works.

However, in undertaking the assessment of potential noise intrusion associated with the proposed construction activities, Chapter 4 of the NSW OE&H ICNG (July 2009) were specifically referenced. The noise limits are presented in Table 10, and are applicable to the development.

Table 10: NSW DECCW ICNG Construction Noise Criteria

Time of Day	Management Level $L_{Aeq,15min}$ *	How to Apply
Recommended Standard Hours: Mon – Fri (7am – 6pm) Sat (8am – 1pm) No work on Sunday & Public Holidays	Noise Affected 63dB(A)	The noise-affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq,15min}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residences of the nature of works to be carried out, the expected noise levels and duration as well as contact details.
	Highly Noise Affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur in, taking into account: 1. Times identified by the community when they are less sensitive to noise (such as before and after school, for works near schools, or mid-morning or mid-afternoon for works near residences) 2. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside Recommended Standard Hours	Noise Affected Evening – 53dB(A) Night – 40dB(A)	• 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. • For guidance on negotiating agreements see section 7.2.2.

*** Note:** Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

Source: Chapter 4 (Table 2 Sec 4.1.1) of NSW OE&H ICNG

5.5 Construction Vibration Criteria

The Office of Environment and Heritage (OEH) developed a document, "Assessing vibration: A technical Guideline" in February 2006 to assist in preventing people from exposure to excessive vibration levels within buildings. The guideline does not however address vibration induced damage to structures or structure-borne noise effects. Vibration and its associated effects are usually classified as continuous, impulsive or intermittent.

5.5.1 Human Comfort – Continuous and Impulsive Vibration Criteria

Structural vibration in buildings can be detected by occupants and can affect them in many ways including reducing their quality of life and also their working efficiency. Complaint levels from occupants of buildings subject to vibration depend upon their use of the building and the time of the day.

Maximum allowable magnitudes of building vibration with respect to human response are shown in Table 11. It should be noted that the human comfort for vibration are more stringent than the building damage criteria.

Table 11: Preferred and maximum weighted RMS values for continuous and impulsive vibration acceleration (m/s2) 1-80Hz

Location	Assessment period[1]	Preferred values		Maximum values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Continuous vibration					
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and place of worship	Day or night time	0.020	0.014	0.040	0.028
Impulsive vibration					
Residences	Daytime	0.30	0.21	0.60	0.42
	Night time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and place of worship	Day or night time	0.64	0.46	1.28	0.92

5.5.2 Human Comfort – Intermittent Vibration Criteria

Disturbance caused by vibration will depend on its duration and its magnitude. This methodology of assessing intermittent vibration levels involves the calculation of a parameter called the Vibration Dose Value (VDV) which is used to evaluate the cumulative effects of intermittent vibration. Various studies support the fact that VDV assessment methods are far more accurate in assessing the level of disturbance than methods which is only based on the vibration magnitude.

Table 12: Acceptable Vibration Dose Values for Intermittent Vibration (m/s1.75)

Location	Daytime (7:00am to 10:00pm)		Night-time (10:00pm to 7:00am)	
	Preferred value	Maximum value	Preferred value	Maximum value
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and place of worship	0.40	0.80	0.40	0.80

5.5.3 Structural Damage – Vibration Criteria

Ground vibration criteria are defined in terms of levels of vibration emission from infrastructures or from the construction activities which will avoid the risk of damaging surrounding buildings or structures. It should be noted that human comfort criteria are normally expressed in terms of acceleration whereas structural damage criteria are normally expressed in terms of velocity.

Most commonly specified structural vibration levels are defined to minimize the risk of cosmetic surface cracks and are set below the levels that have the potential to cause damage to the main structure. Structural damage criteria are presented in German Standard DIN4150-Part 3 “Structural vibration in buildings – Effects on structures” and British Standard BS7385-Part 2: 1993 “Evaluation and Measurement for Vibration in Buildings”. indicates the vibration limits presented in DIN4150-Part 3 to ensure structural damage doesn’t occur.

Table 13: Guideline value of vibration velocity, vi, for evaluating the effects of short-term vibration

Line	Type of Structure	Vibration velocity, vi, in mm/s			
		Foundation			Plane of floor of uppermost full storey
		At a frequency of			
		Less than 10Hz	10 to 50Hz	50 to 100*Hz	All Frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
3	Structures that, because of their particular sensitivity to vibration, do not correspond to those listed in lines 1 and 2 and are of great intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8
*For frequencies above 100Hz, at least the values specified in this column shall be applied					

Table 14 presents guide values for building vibration, based on the lowest vibration levels above which cosmetic damage has been demonstrated as per BS7385-Part 2:1993.

Table 14: Transient vibration guide values for cosmetic damage

Type of Building	Peak Particle Velocity in frequency range of predominant pulse (PPV)	
	4 Hz to 15 Hz	15 Hz and above
Residential or light commercial type buildings	15mm/s at 4Hz increasing to 20mm/s at 15Hz	20mm/s at 15Hz increasing to 50mm/s at 40Hz and above

5.5.4 Construction Vibration Objectives

Table 15 indicates the construction vibration criteria for the nearest residential and commercial properties to the proposed development.

Table 15: Construction vibration criteria summary

Location	Period	Human Comfort Vibration Objectives			Building damage Objectives – Velocity (mm/s)
		Continuous mm/s^2 (RMS)		Intermittent $m/s^{1.75}$ (VDV)	
		z-axis	x- and y-axis		
Residential	Daytime	10-20	7-14	0.24-0.4	5
	Night time	7-14	5-10	0.13-0.26	5

6. Impact Noise Assessment

6.1 External Car Park Emissions

The noise relating to the vehicle movements within the external car park has been assessed to the boundary of the nearest noise-affected receiver, approximately 72 meters from the boundary of the carpark. In the absence of any specific criteria addressing external car park noise to surrounding noise-sensitive receivers, the project noise trigger levels established in Section 5.2.2 have been used in the assessment. It should be noted that though it is typical to conduct an assessment of this nature, noise emissions from vehicle movements on private roads are not a noise source listed in Schedule 1 of the POEO Act and hence should not be restricted to comply with the NPI project trigger noise levels.

For each assessment, the operational car park noise emissions will be assessed based on these assumptions:

- Average noise of LA_{eq} 86dB(A) from the cars manoeuvring and parking.
- The car manoeuvring with maximum of km/hour in the car park areas.
- Average noise of LA_{eq} 95dB(A) from the cars doors closing.
- Average noise of LA_{eq} 90dB(A) from the cars engine starting.
- There are 20 vehicles entering and exiting the car park (in total) during a 15 minute peak hour period.
- Vehicles will be moving for an approximate time of 20 seconds in the car park before coming to a stop.

The main sources of car park noise that will exist due to the proposed refurbishment are:

- Car doors closing
- Car engines starting
- Movement of cars entering and exiting the carpark

Table 16 presents a summary of the sound power levels of typical vehicle noise sources, while Table 17 provides the predicted noise levels at the boundary of the nearest noise-affected premises.

Table 16: Typical sound power levels of carpark noise sources

Typical Vehicle Noise Source	Typical SWL, dB(A)
Loud car door closing	95
Car engine starting	90
Car movement	86

Table 17: Predicted vehicle noise levels at the nearest receiver

Receiver Location	Predicted Noise Level $L_{Aeq,15min}$ - dB(A)	Criteria dB(A)	Compliance (Yes/No)
Nearest noise-affected premises	31.8	40	Yes

The sleep disturbance assessment will be conducted assuming the loudest source of noise during the night time period (10pm – 7am) associated with the external car park is the movement of vehicles exiting the carpark. Table 18 presented the predicted noise level in the nearest receiver façade.

Table 18: Predicted car door closing noise levels at the nearest receiver

Receiver Location	Predicted Noise Level at The Facade		Criteria		Compliance? (Yes/No)
	LA_{Fmax}	$L_{Aeq,15min}$	L_{AFmax} dB(A)	$L_{Aeq,15min}$	
Nearest noise-affected premises	50	36	52	40	Yes

Based on the predicted noise level, the noise emissions from the vehicle movements during the night time period comply with the project noise trigger levels established in Section 5.2.2.

6.2 External Glazing

The general limiting factor of the performance of a building façade in terms of noise attenuation is the glazing. In this particular case of the proposed development, the traffic noise on Goldsmith Avenue provides the most acoustic demand on the facades of the development facing the road.

In order to achieve the internal noise levels specified in the AS/NZS 2107:2016 Interim Guideline, the minimum recommended glazing selection for the facades of the proposed development is presented in Table 19 below. The data presented in this table is based on the external noise levels obtained from the conducted measurements. The glazing thicknesses presented below should be considered as the minimum thicknesses to achieve the required internal noise levels. Greater glazing thicknesses may be required for structural loading, wind loading, thermal requirements etc.

Table 19: Recommended Acoustic Performance of Glazing System

Façade (facing)	Level	Proposed glass system	Required acoustic rating of proposed glazing assembly, Rw[1]
All	All	6mm Float	31
The required acoustic rating of glazing assembly, refers to the acoustic performance of the glazing once installed on site (including the frame)			

[1] See Appendix 1 for Rw definition

6.3 Mechanical Noise Emissions

The following noise sources are associated with the site operation, and details about expected noise levels from these sources are given in the ensuing sub-sections. Noise sources from general operations at the site typically include mechanical services noise from air-conditioning equipment and exhaust and supply fans servicing the proposed sport and recreation development. These noise sources have been used to predict the worst case scenario noise impact of the proposed use of the site to nearby residential receivers.

The proposed active recreational development has proposed 2 options for mechanical services:

- AHUs to supply fresh air-conditioned air to each of the spaces within the proposed sport and recreation development (refer to Figure 4 in Appendix B)
- AHU supplying fresh air to the pool room and fan coil units cooling/heating each of the spaces within the proposed sport and recreation development (refer to Figure 5 in Appendix B)
- A chiller within a dedicated plantroom is proposed in both options

In order to assess the worst case scenario, it was assumed that the air conditioning units associated with the the proposed sport and recreational development are running at any time throughout a 24hr period. With all, night time is the most stringent period for the noise generated by the operation of the mechanical plant, therefore this criterion was used as the noise target at the boundary of the nearest sensitive receivers for the project.

6.3.1 Proposed Noise Levels

The proposed maximum sound power levels for each mechanical noise source are given in Table 20 below.

Table 20: Proposed maximum sound power levels for mechanical plant

Item	SWL re 1pW								
	63 Hz	125 Hz	250 Hz	500 Hz	1 KHz	2 KHz	4 KHz	8 KHz	Overall dB(A)
L1 Air Handling Unit Plantroom Louvre	83	80	81	82	81	80	76	69	86
L1 Chiller Plantroom Louvre	81	81	83	84	88	84	78	81	91

6.3.2 Mechanical Services Mitigation Measures

Mitigation measures for the mechanical plant should be considered during the Design Development stage so as to comply with the outlined criteria at the nearest sensitive receivers. These amelioration measures could include but not limited to the following:

- Positioning mechanical plant away from nearby receivers
- Acoustic attenuators fitted to duct work
- Screening around mechanical plant
- Acoustic insulation within duct work

6.4 Traffic Noise Assessment

For the road traffic noise assessment, traffic numbers and generated vehicles was based on the information provided by PTC. Consultants. This data has been used to calculate the expected noise increase due to traffic associated with the development onto Goldsmith Avenue. It is assumed all traffic uses Goldsmith Avenue to enter and exit the proposed development. The results are summarized in Table 21.

Table 21: Existing and predicted traffic flow volumes (peak hour)

Road	Existing Vehicles	Predicted Increase	Post-Development	Road Noise Level Increase (dB)
Goldsmith Avenue (AM Peak)	360	82	442	1.2
Goldsmith Avenue (PM Peak)	289	82	371	1.3

Based on this assessment, the future increase in noise level on Goldsmith Avenue is not expected to be in excess of 2dB during the AM and PM peak periods.

7. Conclusion

An acoustic assessment for the proposed sport and recreation development located along Goldsmith Avenue in the Macarthur Heights Precinct, Campbelltown NSW, 2560 has been conducted. This document forms part of the documentation package to be submitted to local authorities as part of the DA process.

This report has provided criteria, in-principle treatment and design requirements that aim to achieve the statutory criteria discussed in Section 5.2. With regards to noise criteria, we have provided the following:

- Maximum internal noise levels in accordance with the AS/NZS 2107:2016 recommendations provided in Section 5.1 for the different variety of spaces within the CCoE.
- Noise criteria for emissions from the development to receivers in accordance with the NPI provided in Section 5.2.
- Traffic noise criteria for additional vehicle movements on public roads generated by the proposed development presented in Section 5.3.
- Construction noise and vibration criteria provided in Sections 5.4 and 5.5.

Glazing for the building has been designed to achieve internal noise levels in accordance with the requirements outlined in the AS/NZS 2107:2016 *'Acoustics – Recommended design sound levels and reverberation times for building interiors'*.The proposed glazing is presented in Section 6.2.

The increase in noise due to the predicted traffic generation from the proposed development scheme is expected to comply with the traffic noise criteria established within the Road Noise Policy.

The maximum sound power levels presented in this report show that the day, evening and night noise criteria are based off the project noise trigger noise levels established in Section 5.2.2. Should the plant sound power levels exceed the levels presented in this report additional noise mitigation measures will be required. These measures will be developed and implemented during the design stages of the project.

Even though no assessment can be considered as being thorough enough to preclude all potential environmental impacts, having given regard to the above listed conclusions, it is the finding of this assessment that the development application should not be refused on the grounds of excessive noise generation, as it can comply with all applicable regulations.

The information presented in this report shall be reviewed if any modifications to the features of the development specified in this report occur, including and not restricted to selection of air-conditioning units, layout of equipment, modifications to the building and introduction of any additional noise sources.

APPENDIX A Glossary of Acoustic Terms

NOISE	
Acceptable Noise Level:	The acceptable LAeq noise level from industrial sources, recommended by the EPA (Table 2.1, INP). Note that this noise level refers to all industrial sources at the receiver location, and not only noise due to a specific project under consideration.
Adverse Weather:	Weather conditions that affect noise (wind and temperature inversions) that occur at a particular site for a significant period of time. The previous conditions are for wind occurring more than 30% of the time in any assessment period in any season and/or for temperature inversions occurring more than 30% of the nights in winter).
Acoustic Barrier:	Solid walls or partitions, solid fences, earth mounds, earth berms, buildings, etc. used to reduce noise.
Ambient Noise:	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment Period:	The period in a day over which assessments are made.
Assessment Location	The position at which noise measurements are undertaken or estimated.
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, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level.
Decibel [dB]:	The units of sound pressure level.
dB(A):	A-weighted decibels. Noise measured using the A filter.
Extraneous Noise:	Noise resulting from activities that are not typical of the area. Atypical activities include construction, and traffic generated by holidays period and by special events such as concert or sporting events. Normal daily traffic is not considered to be extraneous.
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. Frequency or pitch can be measured on a scale in units of Hertz (Hz).
Impulsive Noise:	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.
Intermittent Noise:	Level that drops to the background noise level several times during the period of observation.

LAmax	The maximum A-weighted sound pressure level measured over a period.
LAmin	The minimum A-weighted sound pressure level measured over a period.
LA1	The A-weighted sound pressure level that is exceeded for 1% of the time for which the sound is measured.
LA10	The A-weighted sound pressure level that is exceeded for 10% of the time for which the sound is measured.
LA90	The A-weighted 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	The A-weighted "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
LAeqT	The constant A-weighted sound which has the same energy as the fluctuating sound of the traffic, averaged over time T.
Reflection:	Sound wave changed in direction of propagation due to a solid object met on its path.
R-w:	The Sound Insulation Rating R-w is a measure of the noise reduction performance of the partition.
SEL:	Sound Exposure Level 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 Absorption:	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound Level Meter:	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound Pressure Level:	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound Power Level:	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise:	Containing a prominent frequency and characterised by a definite pitch.

APPENDIX B Mechanical Services Options

Figure 4: Option 1, One AHU and in-ceiling FCUs is supplying each space

Figure 5: Option 2, 3 AHUs supplying fresh air to each space