H.Corp National Pty Ltd

71 Park Ave Kingwoods

Acoustic and Railway Vibration DA Assessment

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1 Introduction

The following report has been prepared by Acouras Consultancy on behalf of H.Corp National Pty Ltd to assess the potential for noise impact associated with the 71 Park Ave Kingwoods. The residential development will include:

- Two (2) basement carpark.
- Childcare centre on lower ground level.
- Residential apartment on lower ground to level 3.
- Communal space on level 3 and roof top.

The proposed residential development is surrounded by existing residential buildings. Traffic noise along the Park Ave, to a lesser extent the Great Western Highway and railway noise contributes to the surrounding ambient noise levels. The site location is shown in Figure 1.

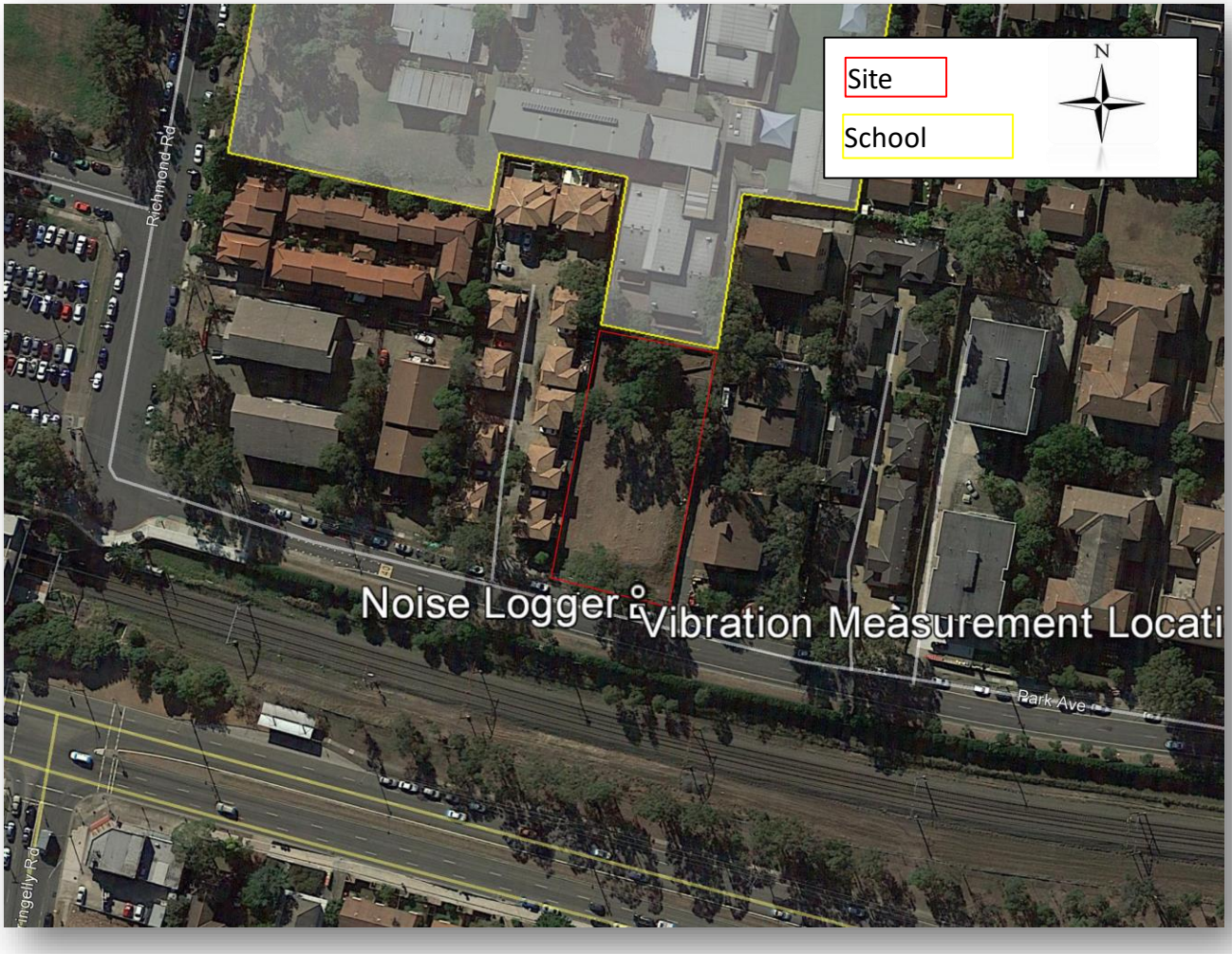

Figure 1 – Site Location, Nearest Residents and Noise Logger Position

2 Noise Criteria

The following standards and guidelines are applicable to this project:

- Penrith City Council: Development Control Plan (2014) Part C12.
- NSW Department of Planning "Development Near Rail Corridors and Busy Roads".
- NCC/BCA Part F5.
- NSW EPA "Noise Guide for Local Government" (NGLG).
- NSW EPA "Interim Construction Noise Guideline" (ICNG).
- DEC/EPA's guideline "Assessing vibration: a technical guideline"
- Association of Australian Acoustical Consultants (AAAC) "Guideline for Child Care Centre Acoustic Assessment" (September 2010).
- Australian standard AS/NZS 2107-2000: Acoustics – Recommended design sound levels and reverberation times for building interiors.
- Australian standard AS 1055.1-1997: Acoustics – Description and measurement of environmental noise - General procedures.

2.1 Internal Noise Levels

For road traffic noise, the DCP does not provide specific a guideline to implement. However, the NSW Department of Planning recommends Clause 102 (road) of the SEPP (Infrastructure) which requires that if the development is for the purpose of a building for residential use, the following L_{Aeq} levels are not exceeded.

Table 1— Development near Rail Corridors and Busy Roads – Interim Guideline

Residential Space	Internal Noise Criteria
in any bedroom in the building	35dB(A) at any time 10pm–7am
anywhere else in the building (other than a garage, kitchen, bathroom or hallway)	40dB(A) at any time

Mitigation measures are based on having windows and external doors closed. If internal noise levels with windows or doors open exceed the criteria by more than 10dBA, the design of the ventilation for these rooms should be such that occupants can leave windows closed, if they so desire, and also to meet the ventilation requirements of the Building Code of Australia.

The AS/NZS 2107–2000 outlines the acceptable internal noise levels such that a satisfactory acoustic environment within non-residential spaces in new buildings.

2.2 Childcare Centre Internal Noise

For the childcare centre on the ground floor of Building G, Australian Acoustical Consultants (AAAC) "Guideline for Child Care Centre Acoustic Assessment" (September 2010) recommends the following criteria for noise intrusion from traffic, rail and industry.

> *The noise level $L_{eq,1hr}$ from road, rail traffic or industry at any location within the outdoor play or activity area during the hours when the Centre is operating shall not exceed 55 dB(A). The noise level $L_{eq,1hr}$ from road, rail traffic or industry at any location within the indoor play or sleeping areas of the Centre during the hours when the centre is operating shall not exceed 40 dB(A).*

Also, AS/NZS 2107–2000 outlines the acceptable internal noise levels within occupied spaces in new and existing buildings. Table 2 presents the recommended internal design noise levels for the various spaces in a childcare centre.

Table 2— Recommended Internal Design Noise Levels (AS/NZS 2107)

Type of occupancy/activity	Recommended design sound level, L_{eq} in dB(A)	
	Satisfactory	Maximum
Reception and lobbies	45	50
Staff common rooms	40	45
Toilets	45	55

2.3 Railway Vibration Criteria

The proposed development is located within 60m of the nearest railway corridor, therefore vibration levels such as the intermittent vibration emitted by trains should be assessed in accordance with the criteria given in the EPA/DECC "Assessing Vibration: a technical guideline (2006)". Human comfort is normally assessed with reference to the above British Standard or Australian Standard AS 2670.2 1990. When assessing intermittent vibration, the vibration dose value (VDV) is used to determine the vibration energy received over the daytime and night-time periods. Acceptable values of vibration dose are presented in Table 3.

Table 3 – Acceptable vibration dose values for intermittent vibration ($m/s^{1.75}$)

Location	Daytime (7.00 am to 10.00 pm)		Night-time (10.00 pm to 7.00 am)	
	Preferred value	Maximum value	Preferred value	Maximum value
Residence	0.20	0.40	0.13	0.26

2.4 Sound Insulation Requirement (Part F5 NCC/BCA)

For sound transmission and insulation between sole occupancy units (SOU) within the same development, walls and floors to be constructed in accordance with requirements of Part F5 of the Building Code of Australia (BCA). Sound insulation requirements are summarised in Table 4.

Table 4 - NCC Part F5 Requirements (Class 2 or 3)

Building Element	Minimum NCC Part F5 Requirements
Sound Insulation Rating of Walls (Class 2 or 3)	
Walls between separate sole occupancy units.	Rw + Ctr 50 (airborne)
Walls between wet areas (bathrooms, sanitary compartment, laundry or kitchen) and a habitable room (other than kitchen) in adjoining apartments.	Rw + Ctr 50 (airborne) & of discontinuous construction
Walls between sole occupancy unit and stairway, public corridors, public lobby or the like or parts of a different classification.	Rw 50 (airborne)
Walls between a plant room or lift shaft and a sole occupancy unit.	Rw 50 (airborne) & of discontinuous construction
Sound Insulation Rating of Floors (Class 2 or 3)	
Floors between sole occupancy units or between a sole occupancy unit and plant room, lift shaft, stairway, public corridor, public lobby or the like.	Rw + Ctr 50 (airborne) & Ln,w + CI < 62 (impact)
Apartment Entry Doors (Class 2 or 3)	
A door incorporated in a wall that separates a sole-occupancy unit from a stairway, public corridor, public lobby or the like.	Rw 30 (airborne)
Services (Class 2, 3 or 9c)	
If a storm water pipe, a duct, soil, waste or water supply pipe including a duct or pipe that is located in a wall or floor cavity serves or passes through more than one sole occupancy unit must be separated:	
if the adjacent room is a habitable room (other than a kitchen); or	Rw + Ctr 40
if the room is a kitchen or non-habitable room	Rw + Ctr 25

Construction Deemed to Satisfy

The forms of construction must be installed as follows:

(a) Masonry—Units must be laid with all joints filled solid, including those between the masonry and any adjoining construction.

(b) Concrete slabs—Joints between concrete slabs or panels and any adjoining construction must be filled solid.

(c) Sheeting materials—

(i) if one layer is required on both sides of a wall, it must be fastened to the studs with joints staggered on opposite sides; and

(ii) if two layers are required, the second layer must be fastened over the first layer so that the joints do not coincide with those of the first layer; and

(iii) joints between sheets or between sheets and any adjoining construction must be taped and filled solid.

(d) Timber or steel-framed construction—perimeter framing members must be securely fixed to the adjoining structure and—

(i) bedded in resilient compound; or

(ii) the joints must be caulked so that there are no voids between the framing members and the adjoining structure.

(e) Services—

(i) Services must not be chased into concrete or masonry elements.

(ii) A door or panel required to have a certain Rw + Ctr that provides access to a duct, pipe or other service must—

(A) not open into any habitable room (other than a kitchen); and

(B) be firmly fixed so as to overlap the frame or rebate of the frame by not less than 10 mm, be fitted with a sealing gasket along all edges and be constructed of—

(aa) wood, particleboard or blockboard not less than 33 mm thick; or

(bb) compressed fibre reinforced cement sheeting not less than 9Â mm thick; or

(cc) other suitable material with a mass per unit area not less than 24.4 kg/m^2

(iii) A water supply pipe must—

(A) only be installed in the cavity of discontinuous construction; and

(B) in the case of a pipe that serves only one sole-occupancy unit, not be fixed to the wall leaf on the side adjoining any other sole-occupancy unit and have a clearance not less than 10 mm to the other wall leaf.

(iv) Electrical outlets must be offset from each other—

(A) in masonry walling, not less than 100 mm; and

(B) in timber or steel framed walling, not less than 300 mm.

2.5 Construction Noise Criteria

The NSW EPA "Interim Construction Noise Guideline" (ICNG) provides guidance on noise limits from construction sites. Table 5 is an extract from the EPA guideline. When assessing short-term construction works, best management practices should be implemented to reduce any impact as far as practically possible.

Table 5 – Noise at Residences Using Quantitative Assessment

Time of Day	Management Level $L_{Aeq\ (15min)}$*	How to Apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	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, 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.

* Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5m above ground level. If the property boundary is more than 30m 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.

2.6 Construction Vibration Criteria

The DEC/EPA's guideline "Assessing vibration: a technical guideline" is based on the "BS 6472–1992: Evaluation of human exposure to vibration in buildings (1–80 Hz)" which presents preferred and maximum vibration values for use in assessing human responses to vibration. Vibration and its associated effects are usually classified as follows:

- **Continuous** vibration continues uninterrupted for a defined period (usually throughout daytime and/or night-time).
- **Impulsive** vibration is a rapid build up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping). It can also consist of a sudden application of several cycles at approximately the same amplitude, providing that the duration is short, typically less than 2 seconds.
- **Intermittent** vibration can be defined as interrupted periods of continuous (e.g. a drill) or repeated periods of impulsive vibration (e.g. a pile driver), or continuous vibration that varies significantly in magnitude.

Higher levels of vibration are generated during excavation and piling operations, which are intermittent and are assessed using the Vibration Dose Value (VDV). The VDV criteria for a range of receiver types are stated in Table 6 below.

Table 6—Acceptable Vibration Dose Values for Intermittent Vibration (m/s $^{1.75}$)

Location	Daytime[1]		Night-time[1]	
	Preferred Value	Maximum Value	Preferred Value	Maximum Value
Critical Areas	0.10	0.20	0.10	0.20
Residence	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

[1] Daytime is 7.00 am to 10.00 pm and night-time is 10.00 pm to 7.00 am.

Guidance for acceptable vibration at the foundation of buildings to limit cosmetic damage or nearby buildings is given in the British Standard "BS 7385 (1993): Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground-borne vibration". It is recommended that vibration from construction activities should be limited to the values given in Table 7 below.

Table 7—BS 7385 Construction vibration criteria for buildings, PPV mm/s

Construction	Limits for Transient Vibration	
	4 – 15 Hz	>15 Hz
Heavy or reinforced	50 mm/s	
Light (e.g. normal dwellings)	15 mm/s at 4 Hz rising to 20 mm/s at 15 Hz	20 mm/s at 15 Hz rising to 50 mm/s for 40 Hz and above

Typically, it would be expected that no cosmetic damage would occur provided intermittent vibration levels do not exceed 15mm/s at low frequencies rising to 20mm/s at 15Hz and 50mm/s at 40Hz and above.

2.7 Noise Survey and Project Specific Limits

An unattended noise survey was carried out at the site to measure the background and ambient noise levels. Nose monitoring was conducted between Thursday 19th to Wednesday 25th January 2015. The monitor was positioned as shown in Figure 1. Measurements were conducted using the following equipment:

- SVAN 958A Type 1 Real time Analyser/Noise Logger. Serial No. 36624.
- SVAN SV30A Type 1 Sound Level Calibrator. Serial No. 31830.

Noise monitoring was conducted in general accordance with Australian standard AS 1055.1-1997: Acoustics-Description and measurement of environmental noise-General procedures. The noise analyser was calibrated immediately before and after measurements were taken with no discernible differences between these two recorded levels. The sound analyser is Type 1 and complies with Australian standard AS1259.2: 1990.

During the monitoring period any adverse weather condition have been excluded. The noise logger results are presented in Appendix C.

2.7.1 Traffic Noise Levels

Table 8 presents a summary of the measured ambient noise level and traffic noise impacting the development.

Table 8 – Measured Ambient and Traffic Noise and Levels, dBA

Location	Period	Average L_{eq}	Highest L_{eq} 1hr
Park Ave	Day (07:00-22:00)	56	63
	Night (22:00-07:00)	53	58

2.7.2 Railway Noise Levels

To assess the noise impact from rail vehicle movements both day and night period, attended measurements were take of at least 20 pass-bys. The following formula has been applied to determine the $L_{Aeq(T)}$ for each period as shown in Table 9.

$$L_{Aeq(T)} = 10\log_{10}\frac{1}{T}\sum_{i=1}^{N}\left(n_i \times 10^{\left(\frac{LAE_i}{10}\right)}\right)$$

Table 9 – Railway Vehicle Noise and Levels, dBA

Period	Average	Highest
Day (07:00-22:00)	$L_{eq(15hr)}$ 58	L_{eq1hr} 60
Night (22:00-07:00)	$L_{eq(9hr)}$ 52	L_{eq1hr} 53

2.7.3 Project Noise Limits

Table 10 presents a summary of the measured background noise level and the allowable intrusive noise limit for this project in accordance with the EPA NGLG. For the purpose of the assessment, the background noise level has been determined using the RBL in accordance with the method given in the EPA INP.

Table 10—Noise Survey Summary and Project Limits, dBA

Time Period	Existing Noise Levels		DCP Noise Limits, L_{eq}
	$L_{eq\ (period)}$	RBL	
Day	56	46	51
Evening	55	46	51
Night	53	37	42

During detailed design stage, the design and selection of the mechanical equipment required to service the proposed development will be required to achieve the DCP noise limits as presented in the table above.

2.7.4 Children Activity Noise Limits (AAAC)

Penrith City Council DCP does not have any specific guide for controlling noise emission from children activity and from the operation of mechanical equipment that is associated with this type of development. Also, the EPA Noise Guide for Local Government (NGLG) and the Industrial Noise Policy (INP) does not provide an objective noise goal in assessing the intrusive impact from children activity to nearby residential receivers.

Therefore, to provide an objective assessment of the proposed childcare centre the Association of Australian Acoustical Consultants (AAAC) "Guideline for Child Care Centre Acoustic Assessment" (September 2010) as a best practice method to determine the intrusive noise levels. The AAAC guideline recommends that outdoor play be assessed as follows:

- Up to 2 hours (total) per day - The L_{eq} 15 min noise level emitted from the outdoor play area shall not exceed the background noise level by more than 10 dB at the assessment location.
- More than 2 hours per day - The L_{eq} 15 min noise level emitted from the outdoor play area shall not exceed the background noise level by more than 5 dB at the assessment location.

The assessment location is defined as the most affected point on or within any residential receiver property boundary. Examples of this location may be:

- 1.5 m above ground level;
- On a balcony at 1.5 m above floor level;
- Outside a window on the ground or higher floors.

For the purpose of the assessment, the background noise level RBL has been determined based on the average noise level recorded during the expected play time periods. Table 11 presents a summary of the measured background noise level and the allowable intrusive noise limit for this project from children activity noise.

Table 11—Children Activity Noise Limits, dBA (AAAC)

Location	Time Period	Existing Noise Levels			AAAC Noise Limits, $L_{eq\ (15min)}$[2]
		$L_{eq\ (period)}$	$L_{90\ (period)}$	RBL	
Residential	Day (07:00-18:00)	56	48	46	51
	Evening (18:00-22:00)	55	47	46	51
	Night (22:07:00)	53	41	37	N/A

At this stage of the DA assessment, the proposed future tenant and operational activities of the childcare centre have not been finalised. Following the DA approval of the future tenant for the centre is to provide a separated detailed assessment of all activities to the be undertake to ensure compliance with the AAAC noise limits as given in Table 11.

[2] More than 2 hours per day - not exceed the background noise level by more than 5 dB.

2.7.5 EPA's Construction Noise Management Level

Table 12 presents a summary of the measured background noise level and the noise management level for this project in accordance with EPA's ICNG.

Table 12 — EPA ICNG Noise Limits, dBA

Receiver	Time Period	Existing Noise Levels		Management Level
		$L_{eq\ (period)}$	RBL	$L_{Aeq\ (15min)}$
Residential	Mon-Fri: 07.00-18.00	56	46	56
	Sat: 08.00-13.00	56	47	57
Classrooms at schools and other educational institutions	When in use	-	-	45

3 Assessment and Recommendations

3.1 Façade Glazing Requirements

Acoustic glazing for the apartments are given in Table 13 are required to reduce noise impact on the internal occupants and should result in noise levels within such units in accordance with the Department of Planning Noise Guidelines.

Table 13 – Schedule of Window and Glazing (R_w)

Level	Apt No.	Space	Glazing Thickness	Minimum R_w (Glazing+Frame)
LG	G01 to G04	Living & Bed	6.38mm laminated	30
	Childcare centre	All	10.38mm laminated	32
UG	U01, U02, U05 to U11	Living & Bed	6.38mm laminated	30
	U03	Living	6.38mm laminated	30
		Bed 1 (ensuite)	6.38mm laminated	30
		Bed 2 (south)	10.38mm laminated	32
	U04	Living	6.38mm laminated	30
		Bed 1	10.38mm laminated	32
1	101, 102, 105 to 111	Living & Bed	6.38mm laminated	30
	103	Living	6.38mm laminated	30
		Bed 1 (ensuite)	6.38mm laminated	30
		Bed 2 (south)	10.38mm laminated	32
	104	Living	6.38mm laminated	30
		Bed 1 & 2	10.38mm laminated	32
2	201, 202, 205 to 211	Living & Bed	6.38mm laminated	30
	203	Living	6.38mm laminated	30
		Bed 1 (ensuite)	6.38mm laminated	30
		Bed 2 (south)	10.38mm laminated	32
	204	Living	6.38mm laminated	30
		Bed 1 & 2	10.38mm laminated	32
3	301 to 308	Living & Bedroom	6.38mm laminated	30

All other non-habitable spaces, such as bathrooms and laundries require minimum 6mm monolithic glass (Rw 28). All Windows/doors should be well sealed (air tight) when closed with good acoustic seals around the top and bottom sliders. Mohair seals are not considered to be acoustic seals.

3.2 Building Façade Construction

To provide sufficient acoustic attention of noise, the general external construction of the proposed building would need to be constructed as detailed in Table 14.

Table 14 – External Façade Construction (R_w)

Building Element	Proposed Construction	Minimum R_w
External Wall	Masonry or cavity brick	45
Roof and ceiling	Concrete with a plasterboard cavity ceiling	45

3.3 External Noise Levels

The following are the predicted external noise levels at the various external locations based on the traffic and railway noise survey conducted at the site. Table 15 summaries the results.

Table 15—Predicted External Noise Levels, dBA

Space	Location/Façade	Predicted External Noise Level, L_{eq} dBA
Balcony	South	60-63
	East & West	51-54
	North	46
Childcare Centre Outdoor Playarea	Ground-West	53[3]
	Roof	51[3]
Communal Open Space	Ground-East	53
	Roof	50

[3] AAAC recommends a noise level $L_{eq,1hr}$ within the outdoor area not to exceed 55 dB(A).

3.4 Mechanical Services

At the DA stage of the design, there are no specific equipment selection of the mechanical ventilation systems for proposed development. The following sections details our review of the mechanical system based on the developments knowledge of similar projects.

In assessing the operation of the carpark exhaust ventilation system, the following assumptions and general recommendation are recommended:

- Exhaust and supply fans operate with a VSD and CO sensor.
- It is recommended that during the night-time (10pm-7am) for the operation speed of the fan not exceed 50% of the maximum speed.
- Exhaust and supply fans could have acoustic attenuators and air ducts can be internally lined with 50/25mm acoustic insulation.
- All mechanical plant equipment are to be located in enclosed plantrooms located in the basement.

It is recommended that during the Construction Certificate design stage, a detailed acoustic assessment is conducted to ensure compliance with the project noise limits.

3.5 Railway Vibration Measurement Results

On-site measurements were conducted on 19th and on 25th January 2017 to determine the tactile vibration amplitude due to train pass-bys. Measurements of at least 20 train-pass-by events and background levels were recorded. From the measured vibration levels, the eVDV in Table 16 indicates a low probability of adverse comment during the daytime or night time. The measured vibration levels are below the base vibration curve for residential development during the day and night, as shown in Figure 2 and unlikely that there will be complaints. Based on these results, there is no further requirement to treat the rail vibration impacts.

Table 16 – eVDV of Ground Vibration Measurements of Rail Pass-by

Time	eVDV	Adverse Comment
Day	0.003	Low probability
Night	0.002	Low probability

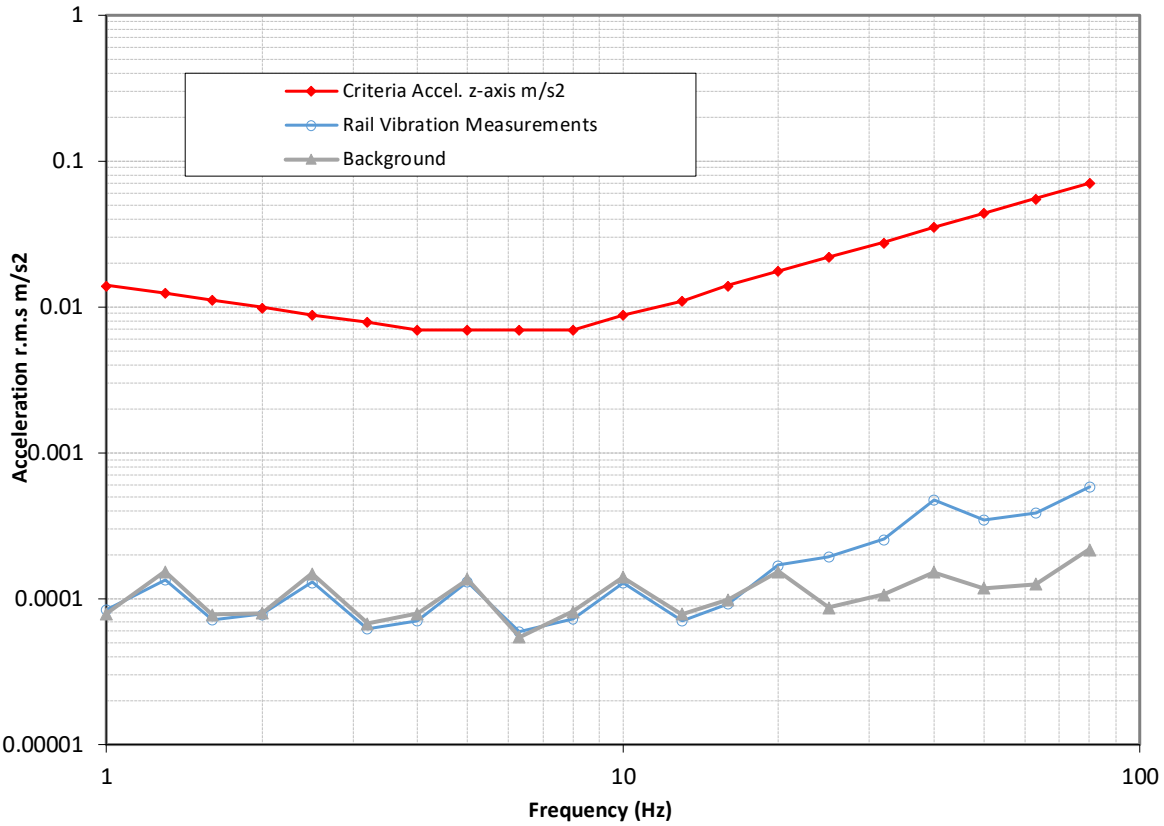

Figure 2 –Railway Train Vibration RMS Acceleration (Z-Axis)

3.6 Childcare Centre Noise Management

It is assumed that the proposed childcare centre intends to operate Monday to Friday between 7.30am to 6.00pm, to accommodate a total of ninety (90) children. The centre will be closed on Public Holidays. At this stage, operational activities of the childcare centre have not been finalised and following DA approval a separate detailed assessment of all activities is to be undertaken

Typical sound power of children activity noise is based on the AAAC's "Guideline for Child Care Centre Acoustic Assessment" (September 2010) as given in Table 17. The mid-level of the sound power levels given in Table 17 have been extrapolated for the proposed number of children in the playscape. This is considered the worst case scenario.

Table 17—Typical Sound Power Levels from Children (Source: AAAC)

Description	Sound Power Level
10 Children aged 0-2 years	77-80
10 Children aged 2-3 years	83-87
10 Children aged 3-6 years	84-90

To manage noise from the centre, the following are the recommended managerial practices to be implemented:

- Outdoor activities are limited and generally comprises approximately an hour in the morning and again in the afternoon. All activities are educational and supervised.
- For the outdoor area on the ground floor, the space is to be used only for children between the age of 0-2 years and be limited to no more than 5 children at any one time.
- Restricted outdoor activity before 9:00am and after 5.00pm.
- Restricting the noisier games/activities to the roof outdoor area only. The outdoor sessions are based on supervised learning activities and designed to be educational.
- Pre-recorded music played in the centre has not been included in these predictions. However, if any pre-recorded music is played in the indoors activity rooms, it is recommended that all doors and windows closed.
- Staff are to be properly trained and instructed in controlling the level of noise emissions from the external play activity areas. For example, staff should:
    - Not shout and to speak to children and to each other at a normal conversation noise level.
    - Remind parents who are talking too loudly while outdoors and request that they be mindful of the neighbours.
    - Pacify crying and over excited children, if necessary taking them indoors where necessary to ensure that the neighbours are not unduly impacted.

- Appropriate signage shall be placed within the premises to remind staff and parents to respect the rights of neighbours to quiet enjoyment.
- The childcare centre operator is to maintain a complaints register to record any noise complaints received by neighbours. Such complaints will be thoroughly investigated and where such complaints are justified, appropriate measures will be put in place to ensure that the offence is not repeated.
- Neighbours should be able to refer complaints directly to management by calling the telephone number posted on the outside of the premises.

3.7 Construction Noise and Vibration Assessment

3.7.1 Construction Activity

The following sections are an assessment of the demolition, excavation and construction work and the potential noise at receiver locations. At this stage, there is no detail on the expected construction schedule and equipment to be operated and a more detailed assessment is to be conducted prior to commencement on site once a contractor has been appointed.

The following is based on knowledge from the developer and previous experience. Proposed hours of construction, and the delivery of materials will be restricted to the following times:

- Monday to Friday: 7 am to 6 pm.
- Saturday 8 am to 1 pm.
- No work on Sunday and Public Holidays.

The demolition and construction work will broadly consist of four (4) major phases:

- Phase 1-Demolition: Initial clearing, demolition and removal of waste from the site.
- Phase 2-Excavation: Includes bulk excavation, substructure and retailing walls.
- Phase 3-Building Construction: Main structure, façade and internal finishes.

3.7.2 Management of Construction Noise

In order to manage the noise from the construction activities the following work practices and procedures are to be considered:

- Adherence to the recommended preferred hours for construction and deliveries. Truck drivers are to be informed of site access routes, acceptable delivery hours and minimising extended periods of engine idling.
- When selecting equipment ensure where feasible and reasonable it has the most effective mufflers, enclosures and low-noise tool bits and blades. Always seek the manufacturer's advice before making modifications to plant to reduce noise.
- If diesel generates are located with 40m of the nearest residence, the generator is to be

located within the site shielded by the hoarding. Refer to Table 18 for the expected noise reduction.

- Locate the use of noisy plant, cherry pickers, forklifts, and mobile cranes away from boundary of noise-sensitive receivers where possible.
- Turn off plant that is not being used.
- Table 18 is an excerpt from Appendix E 'Noise Sources, remedies and their effectiveness' Australian Standard 2436:2010, presenting possible noise reductions from various control mechanisms.

Table 18 – Relative Effectiveness of Various forms of Noise Control[4]

Control by	Noise Reduction Possible in Practice, dB(A)
Distance	Approximately 6 for each doubling of distance
Screening	Normally 5 to 10, maximum 15
Enclosure	Normally 15 to 25, maximum 50
Silencing	Normally 5 to 10, maximum 20

3.7.3 Management of Construction Vibration

Vibration levels due to construction activities are very difficult to predict due to variations in ground and structural conditions. The construction of this development is unlikely to require the operation of rock-breakers, jack-hammering and piling due to the nature of the soil.

In all cases, where the vibration levels are found to exceed the relevant criteria, alternative construction methods should be considered to reduce the impact. This may include the following strategies:

- Prior to start of construction work and after the construction activities, prepare a dilapidation report on the state of the adjacent existing buildings.
- During the construction, consider the following procedure to minimise the impact of construction vibration:
    - Use smaller equipment - This will reduce the level of impact, but will need longer duration. The number of smaller equipment can be increased to compensate for the longer duration.
    - Allowance for respites - When human comfort levels are exceeded, breaking up the longer exposure periods to allow for rest will reduce the degree of impact.

[4] Australian Standard 2436:2010

3.8 Delivery and Waste Collection Vehicles

For all delivery vehicles and privately operated waste collection vehicles used for the community centre and restaurant/café, Part 4.3.3 of EPA Noise Guide for Local Government it is recommends the following time restrictions:

- Before 8.00 am or after 8.00 pm on any Saturday, Sunday or public holiday.
- Before 7.00 am or after 8.00 pm on any other day.

This excludes residential motor vehicles entering of existing the premises.

Additional management controls of the delivery and rubbish collection vehicles to minimise noise impact to the units on ground floor could include:

- Using up-to-date equipment that uses 'quieter' technology such as low-noise bin lifters.
- Maintaining rubbish trucks and braking materials to minimise or eliminate noise such as squeaky brakes.
- Educating drivers and collectors to be careful and to implement quiet work practices.
- Setting more appropriate times for the rubbish collection.

4 Conclusion

An acoustic assessment of the proposed development has been carried out in accordance with the requirements of Penrith City Council DCP.

An environmental noise survey of the site has been conducted and the noise limiting criteria for mechanical plant/equipment noise emission has been determined based on the EPA NGLG. The limits are presented in Table 10.

Construction for glazing, external walls and the roof/ceiling systems have been provided to achieve the internal noise criteria and are detailed in Section 3.1 and Section 3.2 based on the impact of road, rail and aircraft noise.

An assessment of railway vibration levels has been conducted accordance with the Department of Planning guidelines and EPA criteria. Section 3.5 details the assessment and results indicate there is a “low probability” of impact.

At this stage of the DA assessment, the proposed future tenant and operational activities of the childcare centre have not been finalised. Following the DA approval of the future tenant for the centre is to provide a separated detailed assessment of all activities to the be undertake to ensure compliance with the AAAC noise limits as given in Table 11.

Noise management level for construction activity noise and construction vibration limits has been determined based on the on the EPA ICNG and DEC/EPA’s “Assessing vibration: a technical guideline”. General guidelines for the management of noise and vibration from the site is outlined in Section 3.7.2 and Section 3.7.3 . It is recommended that a more detailed assessment is to be conducted prior to commencement on site once a contractor has been appointed.

Providing the recommendations in this report are implemented, the noise from the proposed development is predicted to comply with acoustic requirements of the Penrith City Council DCP, Department of Planning (SEEP), BCA Part F5 and relevant Australian standards.

Appendix A – Acoustic Terminology

Decibel, dB: A dimensionless unit which denotes the ratio between two quantities that are proportional to power, energy or intensity. One of these quantities is a designated reference by which all other quantities of identical units are divided. The sound pressure level in decibels is equal to 10 times the logarithm (to the base 10) of the ratio between the pressure squared divided by the reference pressure squared. The reference pressure used in acoustics is 20 micro Pascals.

A-WEIGHTING: A measure of sound pressure level designed to reflect the response of the human ear, which does not respond equally to all frequencies. To describe sound in a manner representative of the human ear's response it is necessary to reduce the effects of the low and high frequencies with respect to medium frequencies. The resultant sound level is said to be A-weighted, and the units are in decibels (dBA). The A-weighted sound level is also called the noise level.

Sound Pressure Level, L p (dB), of a sound: 20 times the logarithm to the base 10 of the ratio of the r.m.s. sound pressure to the reference sound pressure of 20 micro Pascals. Sound pressure level is measured using a microphone and a sound level meter, and varies with distance from the source and the environment.

Ambient Noise/Sound: All noise level present in a given environment, usually being a composite of sounds from many sources far and near. Traffic, HVAC, masking sound or even low-level background music can contribute to ambient level of noise or sound.

Percentile Level - L 90 , L 10 , etc: A statistical measurement giving the sound pressure level which is exceeded for the given percentile of an observation period, e.g. L 90 is the level which is exceeded for 90% of a measurement period. L 90 is commonly referred to as the "background" sound level.

Background Noise (L 90): The sum total of all unwanted residual noise generated from all direct and reflected sound sources in a space that can represent an interface to, or interfere with good listening and speech intelligibility.

Rating Background Level – RBL: Method for determining the existing background noise level which involves calculating the tenth percentile from the L A90 measurements. This value gives the Assessment Background Noise Level (ABL). Rating Background Level is the median of the overall ABL.

L AEQ,T : Equivalent continuous A-weighted sound pressure level. The value of the A-weighted sound pressure level of a continuous steady sound that, within a measurement time interval T, has the same A-weighted sound energy as the actual time-varying sound.

Appendix B – Architectural Drawings

This assessment was based on the following architectural drawings provided by Urban Link.

Drawing	Issue	Date	Description
DA-009	E	07.05.2018	Site Plan
DA-010	E	07.05.2018	Basement 2 Plan
DA-011	E	07.05.2018	Basement 1 Plan
DA-012	E	07.05.2018	Ground Floor Plan
DA-013	E	07.05.2018	Level 1 Plan
DA-014	E	07.05.2018	Level 2 Plan
DA-015	E	07.05.2018	Level 3 Plan
DA-016	E	07.05.2018	Level 4 Plan
DA-017	E	07.05.2018	Level 5 Plan
DA-021	D	24.05.2018	South Elevation
DA-022	D	24.05.2018	East Elevation
DA-023	D	24.05.2018	West Elevation
DA-024	D	24.05.2018	North Elevation

Appendix C – Noise Logger Results