

**Noise Impact Assessment
Stage 2 Works
Health & Well Being Development
Vincentia Marketplace
8 Moona Creek Road
Vincentia NSW**

August 2021

**Prepared for Home Co Pty Ltd
Report No. 21-2610-R1**

Building Acoustics-Council/EPA Submissions-Modelling-Compliance-Certification

REVERB ACOUSTICS PTY LTD
ABN 26 142 127 768 ACN 142 127 768
PO Box 252 BELMONT NSW 2280
Telephone: (02) 4947 9980
email: sbradyreverb@gmail.com

TABLE OF CONTENTS

1. INTRODUCTION	3
2. TECHNICAL REFERENCE / DOCUMENTS	3
3. DESCRIPTION OF PROPOSAL	4
4. EXISTING ACOUSTIC ENVIRONMENT	5
5. CRITERIA	6
6. METHODOLOGY	10
7. ANALYSIS	11
8. SUMMARY OF RECOMMENDED NOISE CONTROL	21
9. CONCLUSION	25
APPENDIX A	
DEFINITION OF ACOUSTIC TERMS	26

COMMERCIAL IN CONFIDENCE

In order to protect the integrity and proper use of this document, it may be copied in full providing it is complete and securely bound. Consider separate pages of this report in contravention of copyright laws.

1 INTRODUCTION

Reverb Acoustics has been commissioned to conduct a noise impact assessment for the Stage 2 Health & Well Being Development at Vincentia Marketplace. The purpose of this assessment is to theoretically determine the noise impact operation of the site will have on nearby residential receivers. The assessment considers site activities (vehicle movements, light industrial activities, mechanical plant, customers, etc).

The assessment was requested by Home Co Pty Ltd to form part of and in support of a Development Application to Shoalhaven City Council (SCC) and to ensure any noise control measures are incorporated into the design of the centre.

2 TECHNICAL REFERENCE / DOCUMENTS

NSW Environment Protection Authority (2017). *Noise Policy for Industry*

NSW Environment Protection Authority (2011). *NSW Road Noise Policy*

NSW Roads and Traffic Authority (2001). *Environmental Noise Management Manual*

Association of Australian Acoustic Consultant's (2013) *Technical Guideline. Child Care Centre Noise Assessment.*

Colston Budd Rogers & Kafes Pty Ltd (April 2021). *Traffic Report for Proposed Stage 2 Development, Vincentia Marketplace.*

Reverb Acoustics Pty Ltd (September 2018). *Noise Impact Assessment. Section 4.55(2) Application. Modification of Dock Hours. Vincentia District Centre. 8 Moona Creek Road, Vincentia, NSW.*

Heggies Pty Ltd (1 October 2008). *Vincentia District Centre. Noise Impact Assessment*

Planning Assessment Commission (18 November 2013). *Modifications to the Design of Stage 1, Vincentia District Centre (Mod 5).*

Planning Assessment Commission (30 August 2013). *Statement of Commitment & Conditions of Consent – Mod 5 – updated 30 August 2013.*

Development Approval Proposed Site Plan supplied by Buchan Pty Ltd, Rev H, dated 11 August 2021. Note that variations from the design supplied to us may affect the acoustic recommendations.

A Glossary of commonly used acoustical terms is presented in Appendix A to aid the reader in understanding the Report.

COMMERCIAL IN CONFIDENCE

In order to protect the integrity and proper use of this document, it may be copied in full providing it is complete and securely bound. Consider separate pages of this report in contravention of copyright laws.

3 DESCRIPTION OF PROPOSAL

Home Co Pty Ltd seeks development consent for a Health & Well Being Development at 8 Moona Creek Road, Vincentia. Proposed modifications includes a child care centre, TK Maxx, Pet Store/Vet, Gym, Health Services facility and Radiology, together with parking for staff and customers.

Loading docks to each tenancy will be located along the west facade. Operating hours for the docks will be restricted to 7am-10pm for larger trucks and 5am-10pm for smaller trucks <10 tonne TARE.

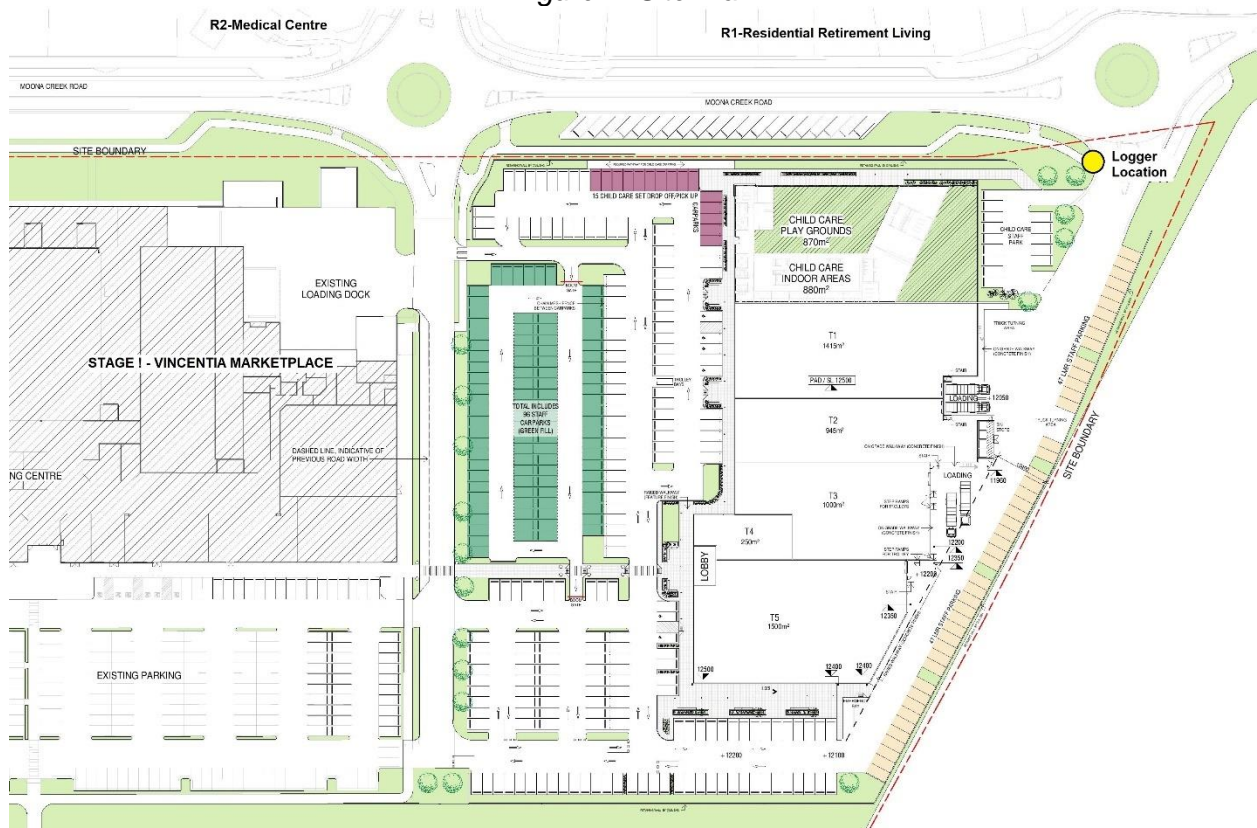
Proposed trading hours are as follows:

Childcare:	6.30am-7pm Monday to Friday & 8am 6pm Saturday to Sunday
Shop/Restricted Retail	8am-7pm Monday to Friday and 9am 5pm Saturday to Sunday
Pet Store & Vet	8am-7pm Monday to Friday and 9am 5pm Saturday to Sunday
Gym	24 hours Monday to Sunday
Radiology	8am-6pm Monday to Friday and 9am 5pm Saturday to Sunday
Health Services Facility	24 hours Monday to Sunday

Potential noise sources that may impact upon nearby residential neighbours include vehicles entering leaving and manoeuvring on the site, loading/unloading of equipment, mechanical plant, light industrial (workshop) activities, amplified music associated with the gym, and children in outdoor play areas. Other noise sources include general site noise such as garbage collection.

This assessment includes measurement of the existing acoustic environment at the site over several days to provide baseline data and enable establishment of noise assessment criteria. Plans supplied by Buchan Pty Ltd show the layout of the site and the location of nearby land uses. Nearest residential receivers identified during our site visits are shown on Figure 1.

Figure 1: Site Plan



REVERB ACOUSTICS

4 EXISTING ACOUSTIC ENVIRONMENT

A background noise level survey was conducted using a Class 1, Svan 977 environmental noise logging monitor, installed on the south side of Moona Creek Road, approximately 15 metres from the near lane of traffic (see Figure 1). The selected location is representative of the acoustic environment in the receiver area and is considered an acceptable location for determination of the background noise in accordance with Appendix B of the NSW Environment Protection Authority's (EPA's) – Noise Policy for Industry (NPfI).

Noise levels were continuously monitored from 17 June to 24 June 2018, to determine the existing background and ambient noise levels for the area. The instrument was programmed to accumulate environmental noise data continuously and store results in internal memory. The data were then analysed to determine 15 minute Leq and statistical noise levels using dedicated software supplied with the instrument. The instrument was calibrated with a Brüel and Kjaer 4230 sound level calibrator producing 94dB at 1kHz before and after the monitoring period, as part of the instrument's programming and downloading procedure, and showed an error less than 0.5dB.

Measured road traffic noise levels at the site are shown in Table 1 while Table 2 shows a summary of our noise survey, including the Assessment Background Levels (ABL's), for the day, evening and night periods. From these ABL's the Rating Background Level (RBL) has been calculated, according to the procedures described in the EPA's NPI and by following the procedures and guidelines detailed in Australian Standard AS1055-1997, "Acoustics - Description and Measurement of Environmental Noise, Part 1 General Procedures". A complete set of logger results is not shown, but available on request.

Table 1: Measured Traffic Noise Levels – Moona Creek Road

Descriptor	Noise Level dB(A)	Time Interval
Leq,1hr (day)	59.4	07:00 to 22:00
Leq,1hr (night)	54.4	22:00 to 07:00
Leq,8hr	51.7	22:00 to 06:00
Leq,9hr	52.2	22:00 to 07:00
Leq,15hr	56.0	07:00 to 22:00
Leq,24hr	54.4	06:00 to 06:00

Table 2: Summary of Noise Logger Results, dB(A)

Time Period	Background L90			Ambient Leq		
	Day 7am-6pm	Evening 6pm-10pm	Night 10pm-7am	Day 7am-6pm	Evening 6pm-10pm	Night 10pm-7am
17-18 June	42.7	36.4	33.3	52.1	46.4	46.2
18-19 June	46.3	41.1	39.2	63.0	53.6	58.4
19-20 June	46.0	39.0	33.3	59.3	54.1	50.7
20-21 June	42.2	40.2	36.1	49.3	45.5	41.8
21-22 June	35.5	43.4	38.1	48.2	48.1	43.8
22-23 June	37.4	41.9	35.9	49.1	47.8	42.3
23-24 June	38.0	40.1	33.5	46.1	47.6	39.9
24-25 June	40.9	-	-	46.8	-	-
RBL	42	40	36	--	--	--
LAeq	--	--	--	57	50	52
RBL (5am-7am) = 37dB(A),L90				Leq (5am-7am) = 54dB(A),L90		

A summary of the measured noise environment at the site appears in Table 3, taken from our logger results. The measured noise levels are typical for residential areas near a busy road and commercial district.

Table 3: Existing Source Noise levels

Time Period	Leq		Lmax		L10		L90	
	Range	Average	Range	Average	Range	Average	Range	Average
Day	37-73	50	53-98	69	40-78	51	34-53	44
Evening	40-61	48	49-88	65	43-65	49	36-48	42
Night	35-67	44	42-98	59	36-65	46	32-49	39
5am-7am	38-67	47	47-96	63	40-64	48	36-48	41

5 CRITERIA

5.1 Road Traffic Noise – Impact on Neighbours

The Roads and Maritime Services (RMS) base their assessment criteria on those outlined by EPA. Reference to Page 160 of the Environmental Noise Management Manual released in December 2001, indicates that noise reduction measures for new and existing developments should endeavour to meet the noise level targets set out in the EPA's Environmental Criteria for Road Traffic Noise (ECRTN). The ECRTN has been superseded by the NSW Road Noise Policy (RNP) which contains a number of criteria applied to a variety of road categories (freeway, arterial, sub-arterial and local roads) and situations (new, upgraded roads and new developments affected by road traffic). Table 4 shows the relevant categories, taken from Table 3 of the RNP:

Table 4: - Extract from Table 3 of RNP Showing Relevant Criteria.

Road Category	Day	Night
Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments.	60 LAeq,15hr (external)	55 LAeq,9hr (external)
Existing residences affected by additional traffic on existing local roads generated by land use developments.	55 LAeq,1hr (external)	50 LAeq,1hr (external)

Road categories are defined in the RNP are as follows:

- Freeway/arterial Support major regional and inter-regional traffic movement. Freeways and motorways usually feature strict access control via grade separated interchanges.
- Sub-arterial Provide connection between arterial roads and local roads. May provide a support role to arterial roads during peak periods. May have been designed as local streets but can serve major traffic generators or non-local traffic functions. Previously designated as “collector” roads in ECRTN.
- Local Road Provide vehicular access to abutting property and surrounding streets. Provide a network for the movement of pedestrians and cyclists, and enable social interaction in a neighbourhood. Should connect, where practicable, only to sub-arterial roads.

Based on the above definitions, Moona Creek Road is classified as a sub-arterial road.

5.2 Site Activities/Mechanical Plant Noise – Impact on Neighbours

Noise from industrial noise sources scheduled under the Protection of Environment Operations Act is assessed using the EPA’s NPfI. However, local Councils and Government Departments may also apply the criteria for land use planning, compliance and complaints management. The NPfI specifies two separate criteria designed to ensure existing and future developments meet environmental noise objectives. The first limits intrusive noise to 5dB(A) above the background noise level and the other is based on the total industrial noise in an area in relation to the noise levels from the development to be assessed. Project Noise Trigger Levels are established for new developments by applying both criteria to the situation and adopting the more stringent of the two.

The existing L(A)eq for the receiver areas is dominated by traffic on nearby roads, and commercial/light industrial activity during the day, evening and night. Reference to Table 2.2 of the NPfI shows that all receiver areas are classified as urban. The Project Amenity Level is derived by subtracting 5dB(A) from the recommended amenity level shown in Table 2.2. A further +3dB(A) adjustment is required to standardise the time periods to LAeq,15 minute. The adjustments are carried out as follows:

Recommended Amenity Noise Level (Table 2.2) – 5dB(A) +3dB(A)

In high traffic areas where the existing traffic noise levels are 10dB or more above the recommended amenity level, the Amenity Level is derived by subtracting 15dB(A) from the existing traffic noise level.

Table 5 below specifies the applicable project intrusiveness and amenity noise trigger levels for the proposed redevelopment.

Table 5: - Base Noise Level Objectives

Period	Intrusiveness Criteria	Amenity Criteria
Day	47 (42+5)	58 (60-5+3)
Evening	45 (40+5)	48 (50-5+3)
Night	41 (36+5)	43 (45-5+3)
Shoulder (5am-7am)	42 (37+5) ¹	43 (45-5+3)
Receiver Type: Urban (See EPA’s NPfI - Table 2.2)		

1. Shoulder Period: the lowest 10th percentile of LAF90,15min dB measurements for the equivalent of one week’s worth of valid data taken over the shoulder period (that is, all days included in a single data set of shoulder periods (see Section A3 of the EPA’s NPfI).

Project specific noise levels, determined as the more stringent of the intrusiveness criteria and the amenity / high traffic criteria, are as follows:

Day **47dB LAeq,15 Minute** 7am to 6pm Mon to Sat or 8am to 6pm Sun and Pub Hol.
 Evening **45dB LAeq,15 Minute** 6pm to 10pm
 Night **41dB LAeq,15 Minute** 10pm to 7am Mon to Sat or 10pm to 8am Sun and Pub Hol.
 Shoulder **42dB LAeq,15 Minute** 5am to 7am.

NOTE: Section 2.6 of the NPfI states that assessment should be to the most affected point on or within the residential property boundary, or if that is more than 30m from the residence, at the most affected point within 30m of the residence.

5.3 Maximum Noise Level Event Assessment - Sleep Arousal Impact on Neighbours

Section 2.5 of EPA's NPfl requires a detailed maximum noise level event assessment to be undertaken where the subject development/premises night-time noise levels exceed the following:

- LAeq (15 minute) 40dB(A) or the prevailing RBL plus 5dB whichever is greater, and/or
- LAFmax 52dB(A) or the prevailing RBL plus 15dB, whichever is greater.

The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the RBL, and the number of times this happens during the night.

5.4 Child Care Centre

5.4.1 Impact from Child Care on Neighbours

OUTDOOR PLAY AREAS:

The Association of Australian Acoustic Consultants' (AAAC's) document, *Technical Guideline. Child Care Centre Noise Assessment*, specifies the following limits for impacts from outdoor play areas, at residential locations:

Up to 2 Hours (total) per day:

The Leq,15 minute noise level emitted from the outdoor play area shall not exceed the background noise level by more than 10dB at the assessment location. Based on a measured background noise level for day of 42dB(A),L90 the criterion is set at **52dB(A) ,Leq 15 minute**.

More than 2 Hours per day:

The Leq,15 minute noise level emitted from the outdoor play area shall not exceed the background noise level by more than 5dB at the assessment location. Based on the measured background noise level for day of 42dB(A),L90 the criterion is set at **47dB(A) ,Leq 15 minute**.

INDOOR PLAY AREAS, MECHANICAL PLANT, PICK-UP & DROP-OFF OF CHILDREN:

The AAAC's document, *Technical Guideline. Child Care Centre Noise Assessment*, specifies the following limits for impacts from indoor play areas, mechanical plant and pick-up drop-off of children, at residential locations:

The Leq,15 minute noise level emitted from the cumulative noise impact of children playing indoors, mechanical plant and traffic on the site shall not exceed the background noise level by more than 5dB at the assessment location. Based on a measured background noise levels, assessment criteria are as follows:

Day	47dB LAeq,15 Minute	7am-6pm.
Shoulder	42dB LAeq,15 Minute	6.30am to 7am.
	45dB LAeq,15 Minute	6pm to 7pm.

5.4.2 Impact on Child Care from Road Traffic / Commercial Activity

The AAAC's document, *Technical Guideline. Child Care Centre Noise Assessment*, states the following:

- For proposals that are located within 60 metres of an arterial road or railway line a noise assessment should be submitted with the development application.
- The noise level LAeq,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 **55dB(A)**.
- The noise level LAeq,1hr from road, rail traffic or industry at any location within the indoor play or sleeping areas during the hours when the Centre is operating shall not exceed **40dB(A)**.

5.5 Noise Impact Between Adjoining Tenancies

The design criteria are set according to the use of adjoining rooms and the likely sources of noise within them. Published sound insulation performance in terms of Rw/STC ratings relate to partitions tested in ideal laboratory conditions or opinions based on such measurements. We therefore recommend selecting partitions with a laboratory Rw rating 3-4dB higher than required, to compensate for loss of performance through installation on-site.

There are differing classes of speech privacy which depend on speech level, absorption and background noise level in the adjoining room, and the sound insulation of the common partitions. The background noise level is typically generated by air-flow over grilles or diffusers in offices and by conversation and general people movements in corridors and reception areas.

Criteria for the assessment of quasi-steady-state noise sources, are sourced from AS/NZS 2107-2016 "*Acoustics-Recommended Design Sound Levels and Reverberation Times for Building Interiors*" and are detailed below.

Room Type	dBA
<i>SHOP BUILDINGS</i>	
Shopping malls	<55
Specialty shops	<45
Supermarkets	<55

The aim of this assessment is to ensure that the allowable noise levels shown above are not (theoretically) exceeded within any habitable room of adjoining tenancies.

The transmission of noise within a building can occur in two ways, namely, air-borne noise and structure-borne noise. Air-borne sounds can be considerably attenuated by intervening enclosures i.e. walls, floors, ceilings, screens, etc. Control of structure-borne noise is more difficult as it causes vibration of the building structure and is readily transmitted to adjoining areas with little attenuation. Therefore, structure-borne noise needs to be suppressed at the source by provision of isolation mountings and hangers, anti-vibration pads, resilient flooring, etc.

Just as the terms air-borne and structure-borne define the origin of sound, so direct or indirect defines the method of transmission of noise to the receiving room. The direct sound, whether air-borne or structure-borne, is that which impinges directly on the surface of the intervening partition between the source and receiver and is radiated from the source directly to the receiver. Indirect or flanking sound is that component of the source which reaches the receiving room by way of open or inadequate windows, doors, ceiling plenums or ventilation ducts. Increasing the Weighted Sound Reduction Index (Rw) of the dividing partition will have little effect if the acoustic energy of the indirect field dominates. The weaker insulating path is always the critical one.

6 METHODOLOGY

6.1 Road Traffic Noise

Due to the non-continuous nature of traffic flow to and from the site, noise generated by traffic associated with the development, on public roads, is assessed using the EPA approved US Environment Protection Agency's Intermittent Traffic Noise guidelines.

Equation 1 outlines the mathematical formula used in calculating the $L_{eq,T}$ noise level for intermittent traffic noise.

Equation 1:

$$L_{eq,T} = L_b + 10 \log \left[1 + \frac{ND}{T} \left(\frac{10^{(L_{max} - L_b) / 10} - 1}{2.3} - \frac{(L_{max} - L_b)}{10} \right) \right]$$

Where L_b background noise level (dB(A)) L_{MAX} is vehicle noise (dB(A))
 T is the time for each group of vehicles (min) N is number of vehicle trips
 D is duration of noise of each vehicle (min)

Typical vehicle noise levels were sourced from our library of technical data, while background noise levels are those described in Section 4. The L_{max} vehicle noise levels used in Equation 1 are the maximum predicted noise levels produced at the facade of the residence by vehicles entering and departing the site.

6.2 Site Noise

Future noise sources on the site cannot be measured at this time, consequently typical noise levels from similar developments have been sourced from manufacturers' data and/or our library of technical data. This library has been accumulated from measurements taken in many similar situations on other sites, and allows theoretical predictions of future noise impacts at each receiver and recommendations concerning noise control measures to be incorporated in the design of the site.

The sound power level of each activity was determined according to the procedures described in AS IEC 61672-2004 as appropriate, and theoretically propagated to nearby receivers. Due to the non-continuous nature of activities, duration adjustments are determined using the following in-house mathematical formula. Where noise impacts above the criteria are identified, suitable noise control measures are implemented and reassessed to demonstrate satisfactory received noise levels in the residential area.

Equation 2:

$$L_{eq,T} = L_w - 10 \log (2 \pi r^2) + 10 \log \frac{(D \times N)}{T}$$

Where L_w is sound power level of source (dB(A)) N is number of events
 R distance to receiver (m) T is total assessment period (sec)
 D is duration of noise for each event (sec)

7 ANALYSIS

7.1 Received Noise Levels - Road Traffic

Traffic due to the proposal travelling on nearby public roads is assessed separate to site noise and is subject to the criteria described in Section 5.1 of this report. Trucks and vehicles will approach and depart the site from either direction along Moona Creek Road. The Traffic report suggests that Stage 2 of the development will produce 200 vehicle movements during peak periods. We have assumed that 120 vehicle movements may occur during normal periods. Significantly less vehicle movements are expected during the early morning 5am-7am period, with perhaps 40-50 vehicle movements each hour. Based on the above, projected traffic numbers for Stage 2 are shown below:

Table 6: Traffic Numbers

DAY 7am-10pm			SHOULDER 5am-7am		
Light	Heavy	TOTAL	Light	Heavy	TOTAL
1900	30	1930	100	-	100

Truck noise varies from one machine to another, with more modern larger trucks consistently producing a sound power in the range 98dB(A) to 104dB(A) at full power. This assessment assumes a typical large truck sound power of 100dB(A), as full engine power is not typically required to approach and depart the site at low speed.

Cars typically produce an average sound power of 92dB(A), however wide variations are noted particularly with smaller modern cars and larger V8 or diesel powered vehicles. Our calculations present the worst case for the situation, as the noise produced by a typical car accelerating at full power is used to determine the received noise level. In reality, many people will not leave the site at full acceleration but will depart more sedately. The following Table shows calculations to determine received traffic noise levels at typical residential receivers along Moona Creek Road for peak day and shoulder periods.

Table 7: Traffic Noise Calculations Moona Creek Road - dB(A)Leq (T)

Traffic and Receiver	DAY 7am-10pm		Shoulder 5am-7am	
	Cars	Trucks	Cars	Trucks
Vehicle Type	Cars	Trucks	Cars	Trucks
Movements per hour	1900	30	100	-
Vehicle Sound Power	92	100	92	100
Received Noise Level, Lmax	60.5	68.5	60.5	68.5
Average Distance to Rec, m	15	15	15	15
Received Noise Level	49.6	41.4	45.6	-
Total Received	50.3		45.6	
Criteria	60dB(A),Leq 1hr		55dB(A),Leq 1hr	
Impact	0		0	

The above Table shows the noise impact from traffic movements associated with Stage 2 are predicted to compliant with the criteria at all residential receivers and considered acceptable.

7.2 Noise Impact - Child Care Centre

7.2.1 Road Traffic (Impact from Passing Traffic on Child Care)

Shown below is a sample calculation detailing the procedure followed in order to calculate required glazing for the 3-5 Years Playroom on the north side of the building. The traffic noise level at the outer face of the glazing is calculated as follows,

Table 8: Sample Calculation - Traffic Impact at Playroom Glazing

Propagation calculation	dB(A)	Octave band Sound Pressure Levels, dB(A)							
		63	125	250	500	1k	2k	4k	8k
Facade traffic noise, Leq ¹	60	40	47	49	53	55	51	45	38
Arch shielding/Directivity ²		-3	-3	-3	-3	-3	-3	-3	-3
Distance Correction ³		0	0	0	0	0	0	0	0
Traffic noise at window	57	37	44	46	50	52	48	42	35

1. Projected to the year 2021. 2. Intervening structures, angle of view 135°. 3. Adjustments to correct distance.

As the criterion for the Playroom is 40dB(A), see Section 5.4.2, the required traffic noise reduction is $TNR = 57 - 40 = 17\text{dB(A)}$. The traffic noise attenuation, TNA , required of the glazing is calculated according to the equation given in Clause 3.4.2.6 of AS 3671,

$$TNA = TNR + 10\log_{10}[(S/S_f) \times 3/h \times 2T_{60} \times C] \quad \text{equation 1}$$

where

- S = Surface area of glazing = 8m^2
- S_f = Surface area of floor = 40m^2
- h = Ceiling height, assumed to be 2.7m
- T_{60} = Reverberation time, s
- C = No. of components = 4 (glazing, walls, roof)

Assuming that the room is acoustically average (neither too 'live' nor too 'dead') equation 9.26 in *Noise and Vibration Control*, L.L. Beranek, 1971, gives a reverberation time of 0.46s. Consequently, the value of 0.5s was used in equation 1.

Using the values listed above gives

$$TNA = 21\text{dB(A)} \quad \text{for the glazing}$$

Substituting this value into the equation given in Clause 3.4.3.1 of AS3671 gives

$$Rw = TNA + 6 \approx 27.$$

Published sound insulation performance in terms of Rw or STC ratings relate to partitions tested in ideal laboratory conditions or opinions based on such measurements. Field conditions (eg. flanking paths, penetrations, air leaks etc) caused by lack of supervision of workmanship or inadequate attention to detail at design/specification stage can reduce the Rw rating. For this reason, we recommend selecting partition systems with a laboratory Rw rating 1-2dB higher than required on site. In respect to the above, the sliding door in the play room must have a tested $Rw29$ rating. Based on the above, thicker clear float glass or laminated glass will be required. See Section 8 for required construction. In situations where acoustic fences are positioned at the perimeter of the outdoor area, glazing requirements may also be reduced. (see Section 8)

Average traffic noise levels in the outdoor areas are approximately 60dB(A), which exceeds the criteria by 5dB(A). To reduce noise levels to an acceptable level, an acoustic fence will be required at the perimeter of the outdoor area. Theoretical calculations reveal the fence must be 1200mm above FGL along the north edge of the outdoor area. See Section 8 for detailed construction.

7.2.2 External Noise Sources (Impact on Child Care)

The following Tables show sample calculations to predict received noise levels from activities/equipment associated with the proposed development on the child care indoor areas and Outdoor Play Area.

**Table 9: Received Noise – External Noise Sources, dB(A),Leq
 Propagated to Outdoor Play Area**

Activity	Truck S1	Fork Lift R2	Training R3	Truck/Van R4	Cars R5
Lw dB(A)	102	100	74	90	86
Ave Dist to rec (m)	100	80	60	100	20
Duration of event	30 sec	5 min	15 min	30 sec	10 sec
No. of events	2	2	1	5	10
Barrier loss/Dir ¹	0	0	2	2	0
Rec dB(A),Leq	42	52	28	32	42
Combined	52				
Criteria (external)	55dB(A),Leq				
Impact	0				

1. Intervening structures, etc.

**Table 10: Received Noise – External Noise Sources, dB(A),Leq
 Propagated Within Playrooms**

Activity	Cars Site Carpark	Cars R3 Carpark	Training Activities R3	Cars R4 Carpark	Workshop Activities R5
Lw dB(A)	102	100	74	90	86
Ave Dist to rec (m)	100	80	60	100	20
Duration of event	30 sec	5 min	15 min	30 sec	10 sec
No. of events	2	2	1	5	10
Barrier loss/Dir ¹	0	0	2	2	0
Loss thru window	10	10	10	10	10
Rec dB(A),Leq	32	42	18	22	32
Combined	42				
Criteria (internal)	40dB(A),Leq				
Impact	2				

1. Intervening structures, etc.

The above Tables show that noise levels from external noise sources impacting on the child care centre will be acceptable providing acoustic fences are erected at the perimeter of the outdoor area and acoustic windows installed in sensitive areas. See Section 8 for construction details.

7.2.3 Outdoor Play Areas (Impact from Centre on Neighbours)

We understand that a total of 126 children may be at the centre. Based on Sound Power Levels (Lw's) detailed in the AAAC's document "*Technical Guideline. Child Care Centre Noise Assessment*", the following noise levels apply for children in the outdoor area:

Number of Children	Age Group	Lw 10 Children dB(A)	Total Lw Children dB(A)
24	0-1 years	77-80	81-84
24	1-2 years	77-80	81-84
28	2-3 years	83-87	87-91
50	3-5 years	84-90	91-97

Technical papers submitted to the Proceedings of Acoustics in relation to child care centres in NSW revealed that noise levels from children in outdoor play areas reduced by up to 9dB(A) when averaged over a 15 minute assessment period. This equates to an average noise level of 82dB(A),Leq for the outdoor play areas.

To create our acoustic model, we have assumed a worst-case situation where all children are using the outdoor areas at the same time. The sources were placed randomly over the available areas and the resulting sound pressure level was propagated to nearest residences using an equation¹ giving the sound field due to an incoherent plane radiator. The following Table shows calculations to predict the noise impact at nearest residential boundaries. Allowances have been made for boundary fences at residences, where applicable.

Table 11: Noise Impact from Children in Outdoor Area, dB(A),Leq. Propagated to Nearest Residences

Location/Activity	Outdoor Play Areas/Residential Receivers
	R1
Average Lw dB(A)	82
Barrier loss ¹	5
Ave Dist to bdry (m)	25
Received	41
Criteria (day)	47
Impact	0

1. Fence at perimeter of outdoor areas.

As can be seen by the results in the above Table, noise from children in the outdoor play area is predicted to be compliant with the criteria at nearest residential receivers, providing fences are erected at the perimeter of the outdoor areas. Higher noise received levels will be experienced if greater numbers of children are in the play area. We therefore recommend considering applying administrative noise control to ensure compliance with the criterion, i.e. smaller groups using the outdoor area. Implementation of the above strategy will result in a further 3-4dB(A) reduction in noise. See Section 8 for detailed acoustic recommendations.

¹ Equation (5.104), DA Bies and CH Hansen, *Engineering Noise Control*, E & FN Spon, 1996.

7.3 Noise Impact - Gym

7.3.1 Incidental Music (Impact on Neighbours)

No fitness classes requiring amplified music accompaniment are permitted. Only background (incidental) music will be played to provide a more appealing atmosphere for clients and staff. The most significant noise paths are doors that face towards nearest residences. The following Tables show calculations to predict noise from incidental music, propagated through the roller doors to nearest residential boundaries (R1). Calculations assume all roller doors will be closed prior to 7am and may be open after this time.

**Table 12: Calculated SPL Incidental Music Prior to 7am
 Thru Closed Roller Doors - Propagated to Nearest Residences (R1) dB(A),L10**

Item	dB(A)	Octave Band Centre Frequency, Hz								
		31.5	63	125	250	500	1k	2k	4k	8k
SPL at doors ¹	75	28	43	55	65	70	71	66	65	50
TL doors/Dir ²		-5	-6	-7	-9	-11	-14	-17	-21	-23
Area Gain		+12	+12	+12	+12	+12	+12	+12	+12	+12
SPL at receiver	27	-	2	12	20	23	21	13	8	-
Crit (5am-7am)	41	27	28	30	31	35	36	30	28	26
Impact	0	0	0	0	0	0	0	0	0	0

1. Background music. 2. Transmission loss doors, plus directivity. Assumes roller door closed.

**Table 13: Calculated SPL Incidental Music After 7am
 Thru Open Roller Doors - Propagated to Nearest Residences (R1) dB(A),L10**

Item	dB(A)	Octave Band Centre Frequency, Hz								
		31.5	63	125	250	500	1k	2k	4k	8k
SPL at doors ¹	75	28	43	55	65	70	71	66	65	50
TL doors/Dir ²		-3	-2	-2	-2	-2	-1	-1	-1	-1
Area Gain		+12	+12	+12	+12	+12	+12	+12	+12	+12
SPL at receiver	38	-	5	17	27	32	34	29	28	13
Crit (after 7am)	47	33	34	36	37	41	42	36	34	32
Impact	0	0	0	0	0	0	0	0	0	0

1. Background music. 2. Transmission loss doors, plus directivity. Assumes roller door only open approx. 2.5m.

Theoretical results in the above Tables show that noise emissions from incidental music will be compliant with the overall LAB (and therefore Council) criteria at the nearest residential boundaries to the north (R1). Compliance with the criteria at these nearest residences ensures compliance at more remote locations.

Our theoretical calculations reveal that incidental music will produce noise <30dB(A) at nearest residences prior to 7am, which is an order of magnitude lower than other assessed noise sources and will therefore be inaudible. Compliance with the criteria is however, dependent on the specified limit being set for music output. Use of incidental music is considered acceptable, subject to the noise control recommendations detailed in Section 8.

7.3.2 Dropping Weights/Instructor Training (Impact on Neighbours)

Clients dropping weights on the floor (impact), together with trainers instructing clients (raised speech) has the potential to create unacceptable noise levels at nearest residences. The following Tables show calculations to predict the combined noise impact, from these activities at the nearest residences north of the site (R1). Calculations assume all roller doors will be closed prior to 7am and may be open after this time.

**Table 14: Calculated SPL Centre Activities Prior to 7am
 Thru Closed Roller Doors - Propagated North to Nearest Residences (R1) dB(A),Leq**

Item	dB(A)	Octave Band Centre Frequency, Hz								
		31.5	63	125	250	500	1k	2k	4k	8k
Lw activities ¹	84	42	52	64	77	81	76	75	62	48
Dir/Barrier loss		-5	-6	-7	-9	-11	-14	-17	-21	-23
Area Gain		+12	+12	+12	+12	+12	+12	+12	+12	+12
SPL at rec	28	-	2	12	23	24	17	13	-	-
Crit (5am-7am)	41									
Impact	0									

1. Dropping weights, trainer instruction.

**Table 15: Calculated SPL Centre Activities After 7am
 Thru Open Roller Doors - Propagated North to Nearest Residences (R1) dB(A),Leq**

Item	dB(A)	Octave Band Centre Frequency, Hz								
		31.5	63	125	250	500	1k	2k	4k	8k
Lw activities ¹	84	42	52	64	77	81	76	75	62	48
Dir/Barrier loss		-3	-2	-2	-2	-2	-1	-1	-1	-1
Area Gain		+12	+12	+12	+12	+12	+12	+12	+12	+12
SPL at rec	36	-	4	16	29	32	29	28	15	1
Crit (after 7am)	41									
Impact	0									

1. Dropping weights, trainer instruction.

As can be seen by the above results, noise from dropping weights and trainer instruction is predicted to be compliant with the criteria at nearest residential boundaries. Noise levels, while compliant, may still produce unacceptable levels of noise when weights are dropped on hard surfaces. For this reason, we recommend that weights are used over rubber gym flooring in the free weights area. See Section 8 for further acoustic recommendations and strategies.

A proposed gym may provide access to members over the full 24 hour period, with access provided via a PIN code or tag sign in when unstaffed. No classes are permitted during the night period from 10pm-5am.

7.4 Received Noise – Deliveries

Future tenants at the site will require regular deliveries to replenish stock, distribute finished products, etc. The proposed site layout necessitates all deliveries via the roundabout off Moona Creek Road and the internal access road along the west site boundary. Noise sources associated with deliveries include trucks entering the site via the designated entrance, parking the truck, loading and unloading. A worst-case situation for loading dock activities has been assessed for a 15 minute assessment period as follows:

Day/Evening Deliveries

- Up to 3 trucks enter the site and travel along the driveway and then reverse into position at the dock.
- The truck engines are turned off once in position.
- Each trucks are unloaded continuously for approximately 10 minutes, by fork lift and manual means.

Table 16 shows calculation of received noise levels from loading dock activities, propagated to nearest residential receivers in Bluebell Street. All calculations are based on distances scaled from plans supplied by Hunter Pro Pty Ltd and through physical measurement during our site visits.

Table 16: Received Noise –Day/Evening Large Truck Deliveries, dB(A),Leq (15 min) Propagated to Nearest Residential Boundaries in Moona Creek Road R1

Activity	Truck Enter	Truck Reverse	Unloading Activities	Truck Leave
Lw dB(A)	98	100	78	98
Ave Dist to rec (m)	60	80	90	60
Duration of event	10 sec	20 sec	10 min	10 sec
No. of events	3	3	3	3
Rec dB(A),Leq	37	39	29	38
Combined	43			
Criterion (Day/even))	47dB(A),Leq / 45dB(A),Leq			
Impact	0/0			

Early Morning Deliveries 5am-7am

Table 17: Received Noise –5am-7am Van Small Truck Deliveries, dB(A),max Propagated to Nearest Residential Boundaries in Moona Creek Road R1

Activity	Van Enter	Van Reverse	Dock Activities	Van Leave
Lw dB(A)	92	94	78	92
Nearest Dist to rec (m)	40	60	60	40
Rec dB(A),max	50	47	42	50
Criteria (5am-7am)	52dB(A),Lmax			
Impact	0	0	0	0

As can be seen by the above results, deliveries to site during the day, evening and early morning shoulder period (5am-7am) are expected to be compliant with the criteria at nearest residences.

7.5 Received Noise Levels – Staff and Customer Vehicles

Vehicles entering, leaving and manoeuvring in the carpark have the potential to cause disturbance to nearby residents. The greatest impact will occur during peak periods when the centre is open, and the carpark may be full. Based on peak hourly traffic data (i.e. 200 movements/hour) up to 50 vehicle movements may occur during a 15 minute assessment period. The following Table shows calculations of noise from carpark activities, propagated to the nearest residential boundaries north of the site across Moona Creek Road (R1).

**Table 18: Received Noise – Carpark Activities (Peak Day)
 Propagated North to Nearest Residential Boundaries (R1)**

Activity	Vehicle Enter/Leave	Vehicle N End CP	Car Reverse N End CP	Vehicle S End CP	Car Reverse S End CP
Lw dB(A)	80	80	78	80	78
Ave Dist to rec (m)	80	80	80	140	140
Duration of event	20 sec	20 sec	15 sec	20 sec	15 sec
Barrier Loss/dir ¹	0	2	2	4	4
No. of events	50	30	30	20	20
Rec dB(A),Leq	34	30	27	22	18
Combined	37				
Crit (day/evening)	47dB(A),Leq(15 min) / 45dB(A),Leq(15 min)				
Impact	0 / 0				

1. Intervening structures/orientation.

The following Table shows results of calculations to predict the impact at each receiver, and accompanying notes detailing necessary modifications to achieve compliance.

Table 19: Calculated SPL, Carpark Activities - Propagated to Nearest Receivers

Receiver Loc'n	Received Noise (Day/Even/Shoulder)					Noise Control Required
	Period	dB(A),Leq	Crit	dB(A),Lm	Crit	
Residences North R1	Day	37	47	-	N/A	No
	Evening	37	45	-	N/A	"
	Shoulder	33	42	46	52	"

The above results show that noise from vehicle movements in the carpark will be compliant with the criteria at all nearby receivers for normal and peak periods during the day, evening and shoulder periods.

7.6 Received Noise Levels – Veterinary Surgery/Pet Store

A theoretical assessment of barking dogs in the proposed veterinary surgery/pet store was carried out to predict the noise level at the nearest residences. Inspection of the supplied plans has identified the glazing, and entry doors to be the potential noise paths of concern. Other surfaces have not been considered, as adjoining sections of the building form a noise buffer to nearby residences. This assessment focuses on noise transmission through the above building elements and the resulting impact at the nearest receivers.

Noise levels produced by barking dogs, were previously measured at veterinary surgeries in the Hunter Valley and Central Coast. Generally, only one dog will be in the treatment area at any one time, owners will accompany dogs in waiting rooms, and dogs in recovery areas will typically be heavily sedated awaiting surgery, consequently these areas will be quiet for the majority of the time. However, on occasion barking may occur in the hospital ward, particularly during overnight stays, and this worst-case situation has been assessed. Similarly dogs are restrained and controlled by owners in Pet Stores.

Measurements were taken with a Svan 912AE Sound and Vibration Analyser. The instrument is Type 1 accuracy, in accordance with the requirements of AS1259, and has the capability to measure steady, fluctuating, intermittent and/or impulsive sound, and to compute and display percentile noise levels for the measuring period. A calibration signal was used to align the instrument train prior to measuring and checked at the conclusion. Difference in the two measurements was less than 0.5dB. Each measurement was taken over a representative time period to include all aspects of noise, including short periods of barking. Barking generally produced a brief burst of noise, therefore our measurements were taken for a similarly brief time period to ensure the results were not influenced by long periods of inactivity.

The Sound Power Level, Lw dB(A), of a mix of small and large dogs barking at feeding time is shown in Table 20. Up to 3-4 dogs may bark at the same time, therefore, these sources were placed in Wards in typical fibreglass holding modules, and noise produced from barking theoretically propagated to the nearest residences taking into account reverberant field loss to internal surfaces and transmission loss through each building element.

Table 20: Lw, Dogs Barking

Octave Band Centre Frequency, Hz								
dB(A)	63	125	250	500	1k	2k	4k	8k
109	82	86	89	104	106	100	90	79

From consideration of the known dimensions and orientation of each building component, the sound pressure level immediately outside was propagated to the nearest receivers using an equation. giving the sound field due to an incoherent plane radiator.

Tables 21 shows sample calculations to predict the noise from barking dogs propagated through the west doors and glazing and the resulting impact at the nearest residential boundaries (R1).

Table 21: Calculated SPL, North to R1 - Propagated through West Doors/Glazing

Item	dB(A)	Octave Band Centre Frequency, Hz							
		63	125	250	500	1k	2k	4k	8k
Source Lw (dogs x3)	109	82	86	89	104	106	100	90	79
TL ¹ windows/doors		17	19	22	25	30	25	32	33
SPL at receiver	36	21	22	22	33	30	28	9	-
Criteria (night)	41								
Impact	0								

¹ Glazing 5-6 mm clear float/roller door.

Theoretical results in the above Table show that noise emissions from barking dogs in the veterinary surgery/Pet Store will be compliant with the EPA (and therefore Council) criteria at nearest residences, subject to acoustic modifications detailed in Section 8.

7.7 Received Noise Levels – Mechanical Plant

It is expected that each tenancy will require some form of mechanical plant for ventilation. Council is responsible for the approval and control of noise emission from premises within Council boundaries. Council prefers the background noise level of the area to be maintained, although, in certain circumstances may permit the noise level in question to exceed the prevailing background noise level by 5dB(A), providing the sound is bland and free from impulsive and/or tonal components. Mechanical plant regularly produces noise containing significant tonal components, we have therefore applied a 5dB(A) penalty as a precautionary measure. This equates to planning levels detailed in Section 5.2, when measured at the boundary of the nearest residential neighbour.

As the exact type of mechanical plant is not known for each tenancy at this stage, this assessment is based on a plant layout taken from similar developments. We understand the majority of plant will be located on the roof or at ground level for each tenancy. Nearest plant items may be 50 metres from nearest residences. We have conducted theoretical calculations to determine limiting noise emission levels for anticipated plant items. No acoustic treatment or barriers will be required for plant items compliant with the limits specified below:

	<i>L_w, dB(A)</i>	<i>SPL at 1m dB(A)</i>
Exhaust plant	76	82
Air con/refrig Plant	72	78

Any plant item that produces noise in excess of the limits specified above will require acoustic modifications to be incorporated into the design. See Section 8 for noise control recommendations.

7.8 Noise/Vibration Transmission to Adjoining Tenancies

The adjoining partitions between the child care, veterinary surgery, gym and adjoining tenancies must attenuate at least 35dB(A) (250-500Hz) to provide an acceptable noise environment in adjoining tenancies. To put results into context, an impact of 35 implies that the partition must be capable of attenuating 45dB (i.e. 80dB(A) – 45 = 35).

To calculate the *R_w* (airborne) rating of the partition wall noted above, we have used Marshall Day's Insul Predictive Program (used by over many acoustic consultancies worldwide and has proved a reliable tool for accurately predicting the acoustic performance of complex building systems). To provide a measure of conservatism, we recommend that the common wall, i.e. between the child care/gym and retail tenancies should be designed to achieve a minimum *R_w*50 rating, which can be achieved by the following construction:

Option 1:

- 2 x 13mm fire rated or sound rated Pb.
- 64-92mm Steel studs
- Cavity insulation
- 1 x 13mm fire rated or sound rated Pb.

Option 2:

- 110mm brick or concrete.
- 30-40mm furring channel.
- Cavity insulation
- 1 x 13mm Pb.

Other construction options are acceptable, subject to review by us. See Section 8 for floor covering recommendations to ensure structure-borne noise transmission does not become an issue (i.e. from impact of weights).

8 SUMMARY OF RECOMMENDED NOISE CONTROL

8.1 Child Care Centre

8.1.1 Acoustic fences 1200mm above FGL must be erected at the perimeter of the outdoor play areas. Acceptable forms of construction include Colorbond, lapped and capped timber, Hebel Powerpanel, Plexiglass, etc. No significant gaps should remain in the fence to allow the passage of sound below the recommended height. Other construction options are available if desired, providing the fence or wall is impervious and of equivalent or greater surface mass than the above construction options.

8.1.2 Similar calculations to those in Section 7.2.2 were performed for all building elements. From these calculations, a schedule of required glazing has been compiled, shown below. The glazing systems, sighted in the following Table, are presented as a guide for the supplier:

Glazing Systems:
 Type A: Standard glazing. No acoustic requirement.
 Type B: Single-glaze 5-8mm clear float glass.
 Type C: Single glaze laminated or VLam Hush glass

Note: The typical glazing shown in the following Table should be used as a guide only. The supplier of the window/door must be able to provide evidence from a registered laboratory that the complete system will achieve the specified Rw performance, i.e. do not simply install our recommended glass in a standard window frame.

Table 22: Glazing Schedule

Location	Required Rw Compliance Requirement	Typical Glazing System. Not for Specification
Staff Room	27	Type B or C
Planning/Offices/Parent	30	Type C
Play Rooms	29	Type C
Meeting/Planning	30	Type C
Entry/Reception	-	No acoustic requirement
Amenities/Kitchen	-	No acoustic requirement

8.1.3 In the unlikely event that complaints should arise from children playing, crying, etc, in the indoor play rooms, we recommend closing external windows facing towards the residence. Consideration should be given to installing ceiling fans to provide additional ventilation.

8.1.4 Administrative noise control must be implemented for the outdoor play area. We suggest each age group should be allocated a roster for usage of the outdoor area.

8.1.5 For both staff and visitors, some form of education campaign is required to ensure satisfactory noise levels at nearby residences. For staff, the education can be part of in-service training, while for visitors reminders may be included in "Centre Newsletters" and reinforced with erection of appropriate signage.

8.2 Gym

8.2.1 Gym 24 hour access is acceptable.

8.2.2 No amplified music or PA System is permitted in any section of the centre.

8.2.3 Background (incidental) music and "Classes on Demand" are permitted. Output must be limited to 75dB(A) at a distance of 3m from each speaker. Once this level is achieved, corresponding references should be assigned to the sound system controls.

8.2.4 All roller doors, access doors and windows must remain shut prior to 7am.

8.2.5 No training activities are permitted in the carpark. Prior to 7am.

8.2.6 After 7am the roller doors may remain open during classes. In the unlikely event of complaint, closing external doors should be the first course of action.

8.2.7 Multi machines, power racks or similar must not be bolted to common walls between adjoining tenancies unless resiliently mounted to prevent structure-borne noise transmission.

8.2.8 A resilient flooring system is to be installed in all areas where free-weights may be used. The following options are available:

Option 1:

- Lay 40m Regupol Everoll or Shockpad Underlay to entire gym active area.
- Lay 8mm Regupol Composite Flooring above Underlay.

Option 2:

- Install 15mm thick compressed rubber flooring to entire active gym area.
- Store 40-50mm thick gymnastic mats (say 2400mm x 1200mm dimensions) in an easily accessible location to be used as an overlay when required, i.e. when using free weights, kettlebells, etc.
- Details of selected mats are to be forwarded to the acoustic consultant for approval prior to purchase.

Figure 2: Examples of Typical Additional Matting Overlay.



Comparable systems may be used subject to review by Reverb Acoustics.

8.3 Veterinary Surgery/Pet Store

8.3.1 Acoustic windows are required in Wards and other areas where dogs may left be unattended. The windows must achieve a minimum Rw30 rating. Typical construction consists of single-glaze laminate or Vlam Hush windows with acoustic seals at sliders. Acoustic test data for window suites must be provided upon request.

8.3.2 All animals entering the building must be restrained and accompanied by owners. Signs are to be erected in conspicuous locations reminding customers to control barking dogs.

8.3.3 A designated "isolation kennel" must be allocated for dogs kept overnight that may persistently bark.

8.4 Tenancy Trading Hours /Loading Dock Operating Hours

8.4.1 Operating hours for the docks are to be restricted to the following:

Trucks >10 tonne TARE	7am-10pm Monday to Saturday & 8am-10pm Sunday
Trucks <10 tonne TARE	5am-10pm Monday to Sunday

8.4.2 The following proposed trading hours are acceptable:

Childcare:	6.30am-7pm Monday to Friday & 8am 6pm Saturday to Sunday
Shop/Restricted Retail	8am-7pm Monday to Friday and 9am 5pm Saturday to Sunday
Pet Store & Vet	8am-7pm Monday to Friday and 9am 5pm Saturday to Sunday
Gym	24 hours Monday to Sunday
Radiology	8am-6pm Monday to Friday and 9am 5pm Saturday to Sunday
Health Services Facility	24 hours Monday to Sunday

8.4.3 Waste disposal bins are to be located in shielded areas, ideally behind walls or buildings, to reduce impacts during collection. We strongly recommend that waste collection be restricted to weekdays 7.00am to 6.00pm.

8.5 Mechanical Plant

8.5.1 No acoustic treatment is required for air conditioning/refrigeration or exhaust plant that satisfies the following noise emission limits:

	<i>L_w, dB(A)</i>	<i>SPL at 1m dB(A)</i>
Exhaust plant	76	82
Air con/refrig Plant	72	78

8.5.2 If noise emissions from exhaust plant exceed the limits shown in Item 8.5.1, acoustic barriers must be constructed to enclose the fan discharge. Barriers must fully enclose at least three sides towards any residence. In our experience, a more efficient and structurally secure barrier is one that encloses all four sides. The barrier must extend at least 600mm above and below the fan centre and/or the discharge outlet and must be no further than 1200mm from the edges of the exhaust. Barrier construction should consist of either Acoustisorb panels (available through Modular Walls) or an outer layer of one sheet of 12mm fibre cement sheeting (Villaboard, Hardiflex), or 19mm marine plywood. The inside (plant side) is to be lined with an absorbent foam to reduce reverberant sound (fibrous infills are not recommended as they will deteriorate if wet), Note that variations to barrier construction or alternate materials are not permitted without approval from the acoustical consultant. Barrier construction is based solely on acoustic issues. Visual, wind load issues must be considered and designed by appropriately qualified engineers.

REVERB ACOUSTICS

8.5.3 If noise emissions from individual items of air conditioning or refrigeration plant exceed the limits shown in Item 8.5.1, acoustic barriers must be constructed along 3 sides towards any residences. Barriers are to be 300mm above the top of the highest plant item. Barrier construction should consist of *either* Acoustisorb panels (available through Modular Walls) *or* an outer layer of one sheet of 12mm fibre cement sheeting (Villaboard, Hardiflex), or 19mm marine plywood. The inside (plant side) is to be lined with an absorbent foam to reduce reverberant sound (fibrous infills are not recommended as they will deteriorate if wet).

8.5.4 The contractor responsible for supplying and installing mechanical plant must provide evidence that installed plant meets this noise emission limit, or that noise control included with the plant is effective in reducing the sound level to the specified limit. Once the plant layout has been finalised, details should be forwarded to the acoustic consultant for approval.

8.6 Future Occupants to Tenancies

8.6.1 Given the variability of future occupancies at the site, it is not possible to specify acoustic controls on a case-to-case basis. For example, a mechanical workshop would need to address noise emission from machinery and exhaust equipment, while no significant noise is expected from a computer repair outlet. In addition, the tenure of small business is usually dynamic dependent upon the success or otherwise of the occupant. For this reason, each business, which has the potential to create excessive noise, should submit a separate noise impact assessment to Council as part of the Development Application process.

Table 23: Future Business Type Checklist

Business Type	Day Operation	Evening/Night Operation
	Acoustic Report Required Yes/No	Acoustic Report Required Yes/No
Mechanical W'shop. Sheetmetal W'shop. Tyre W'shop.	Yes	Yes
Timber Joinery. Smash Repairs	Yes	Yes
Self-Storage	No	N/A
Place of Assembly. Place of Public Worship.	Yes	Yes
Retail Outlet. Showroom. (computer, office supplies, etc)	No	N/A
Office	No	No
Liquor Outlet	No	Yes
Car Detailing. Car Wash	No	Yes
Take Away Outlet	No	Yes
Bulky Goods.	No	N/A

NOTE: Council may at their discretion request preparation of an acoustic assessment for any noise generating business not noted in the Table.

9 CONCLUSION

A noise impact assessment for Stage 2 works at Vincentia Marketplace, has been completed, resulting in noise control recommendations summarised in Section 8 of this Report. The site is suitable for the intended purpose providing recommendations outlined in this report are incorporated into the design. With these or equivalent measures in place, noise from the site will be either within the criterion or generally below the existing background noise level in the area for the majority of the time.

With relatively constant traffic on nearby roads, and the abundance of nearby commercial and industrial development, noise generated by the proposed site will be audible at times but not intrusive at any nearby residence. As the character and amplitude of activities associated with the site will be similar to those already impacting the area, it will be less intrusive than an unfamiliar introduced source and should be acceptable to residents.

Providing the recommendations presented in this report are implemented noise emissions from operation of the site will not have any long term adverse impact upon the acoustical amenity of nearby residents. We therefore see no acoustic reason why the proposal should be denied.

Steve Brady M.A.S.A. A.A.A.S.
Principal Consultant

APPENDIX A

Definition of Acoustic Terms

Definition of Acoustic Terms

Term	Definition
dB(A)	A unit of measurement in decibels (A), of sound pressure level which has its frequency characteristics modified by a filter ("A-weighted") so as to more closely approximate the frequency response of the human ear.
ABL	<i>Assessment Background Level</i> – A single figure representing each individual assessment period (day, evening, night). Determined as the L90 of the L90's for each separate period.
RBL	<i>Rating Background Level</i> – The overall single figure background level for each assessment period (day, evening, night) over the entire monitoring period.
Leq	Equivalent Continuous Noise Level - which, lasting for as long as a given noise event has the same amount of acoustic energy as the given event.
L90	The noise level which is equalled or exceeded for 90% of the measurement period. An indicator of the mean minimum noise level, and is used in Australia as the descriptor for background or ambient noise (usually in dBA).
L10	The noise level which is equalled or exceeded for 10% of the measurement period. L ₁₀ is an indicator of the mean maximum noise level, and was previously used in Australia as the descriptor for intrusive noise (usually in dBA).