

**Noise Impact Assessment
Lochinvar Shopping Village
Proposed Lot 1001
Cnr. Springfield Drive &
Robert Road
Lochinvar NSW**

December 2022

**Prepared for GWH Build Pty Ltd
Report No. 22-2804-R2**

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

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SECTION 1

Introduction

1.1 INTRODUCTION

Reverb Acoustics has been commissioned to conduct a noise impact assessment for the proposed Lochinvar Shopping Village, Proposed Lot 1001, corner Springfield Drive and Robert Road, Lochinvar. The proposal will include initial bulk earthworks and construction of a supermarket, specialty shops, a tavern, loading dock and on-grade carparking.

This assessment considers noise impacts from mechanical plant (refrigeration, air conditioning, exhaust), loading dock activities (including unloading, truck movements, etc), customer vehicles entering and leaving the premises and manoeuvring on the site, and patron activity in outdoor areas. Other noise sources include garbage collection, trolley return and general site noise. We understand that at this stage the Tavern will not be seeking an entertainment license, therefore assessment of amplified entertainment has not been undertaken.

The assessment was requested by GWH Build Pty Ltd in support of and to accompany a Development Application to Maitland City Council (MCC) and to ensure any noise control measures required for the site are incorporated during the design stages.

1.2 TECHNICAL REFERENCE / DOCUMENTS

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

NSW Environment Protection Authority (1999). *Environmental Criteria for Road Traffic Noise*

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

Office of Environment and Heritage (2011). *NSW Road Noise Policy*.

NSW Environment Protection Authority (1994). *Environmental Noise Control Manual*

Department of Environment and Climate Change NSW (2010). *Noise Guide for Local Government*.

Plans supplied by our client, dated 2 & 23 November 2022. 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.

SECTION 2

Existing Acoustic Environment Assessment Criteria

2.1 CRITERIA

2.1.1 Road Traffic Noise

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 3 shows the relevant categories, taken from Table 3 of the RNP:

Table 1: - 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, adjoining roads are classified as sub-arterial roads.

2.1.2 Site Activities / Mechanical Plant

Since background noise levels are expected to significantly change in the future due to ongoing development, assessment criteria will be based on protecting noise amenity in preference to controlling intrusiveness, in accordance with the requirements of the NSW Environment Protection Authority’s (EPA’s) Noise Policy for Industry (NPfI). Project amenity noise levels are determined in accordance with the requirements of Section 2.4 of the NPfI. The existing L(A)eq for the receiver areas will be classified as suburban as development. 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)

Table 2: - Amenity Noise levels

Period	Amenity Criteria
Day	53 (55-5+3)
Evening	43 (45-5+3)
Night	38 (40-5+3)
Receiver Type: Suburban (See EPA's NPfl - Table 2.1)	

Project Noise Trigger Levels are as follows:

Day **53dB LAeq,15 Minute** 7am to 6pm Mon to Sat or 8am to 6pm Sun and Pub Hol.
 Evening **43dB LAeq,15 Minute** 6pm to 10pm
 Night **38dB LAeq,15 Minute** 10pm to 7am Mon to Sat or 10pm to 8am Sun and Pub Hol.

2.1.3 Tavern Operation

Reproduced below are the LA10 Noise Conditions adopted for assessment purposes (see EPA's Noise Guide for Local Government):

"The LA10 noise level emitted from the licensed premises shall not exceed the background noise level in any Octave Band Centre Frequency (31.5Hz - 8kHz inclusive) by more than 5dB between 07:00 am and 12:00 midnight at the boundary of any affected residence.

The LA10 noise level emitted from the licensed premises shall not exceed the background noise level in any Octave Band Centre Frequency (31.5Hz - 8kHz inclusive) between 12:00 midnight and 07:00 am at the boundary of any affected residence.

Notwithstanding compliance with the above, the noise from the licensed premises shall not be audible within any habitable room in any residential premises between the hours of 12:00 midnight and 07:00 am."

To ensure the requirements of the LA10 criteria are satisfied, we have adopted a planning level, in the adjacent residential area before midnight of **43dB(A),L10** being 5dB(A) above the measured background noise level in the area between 6pm and midnight.

Clauses relating to limits after midnight do not apply, as the Tavern will be closed.

For the purposes of this condition, the LA10 can be taken as the average maximum deflection of the noise emission from the licensed premises.

Alternate criteria that may apply are those taken from the EPA's NPfl, which considers noise from industrial noise sources scheduled under the Protection of Environment Operations Act. Since the premises is licensed and the LA10 criteria are more stringent in this case, we have adopted criteria shown in Table 3 for assessment purposes.

Table 3: Noise Planning Level, L(A)10 – 6pm-12am

Octave Band Centre Frequency, Hz									
dB(A)	31.5	63	125	250	500	1k	2k	4k	8k
43	26	32	35	38	37	35	32	28	23

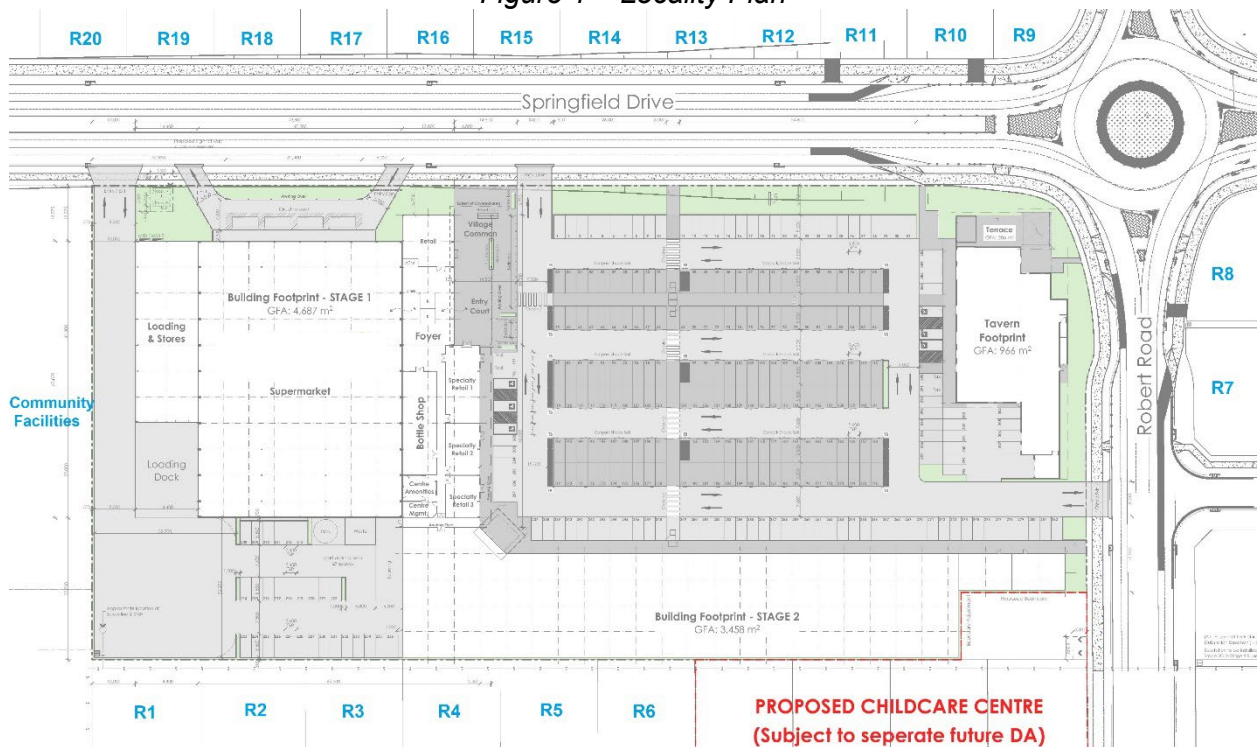
2.1.4 Maximum Noise Level Event Assessment - Sleep Arousal

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.

Figure 1 – Locality Plan



SECTION 3

Noise Impact Assessment Site Operation

3.1 PROJECT DESCRIPTION

GWH Pty Ltd Limited seeks Development Consent to construct the proposed Lochinvar Shopping Village, Proposed Lot 1001, corner Springfield Drive and Robert Road, Lochinvar. The proposal will include initial bulk earthworks and construction of a supermarket, specialty shops, a tavern, loading dock and on-grade carparking. A child care centre will also be constructed at the south east corner of the site, subject to a separate Application.

This assessment considers noise impacts from mechanical plant (refrigeration, air conditioning, exhaust), loading dock activities (including unloading, truck movements, etc), and customer vehicles entering and leaving the premises and manoeuvring on the site, and patron activity in outdoor areas. Other noise sources include garbage collection, trolley return and general site noise.

The following trading and operating hours are proposed:

Supermarket	7am-12am	Monday to Sunday
Specialty Shops (General)	8am-10pm	Monday to Sunday
Specialty Shops (Food & Drink)	7am – 12am Internal Areas	Monday to Saturday
	7am – 10pm Alfresco Areas	Monday to Saturday
	8am – 10pm Internal Areas	Sunday
	8am – 10pm Alfresco Areas	Sunday
Loading Dock	7am-10pm	Monday to Sunday

NOTE: No amplified entertainment is proposed for the Tavern or Food & Drink tenancies alfresco or indoor areas, although background "incidental" music is expected.

This assessment will focus on the noise impact at nearest existing and future receivers and it should be acknowledged that compliance with criteria at these locations will ensure satisfactory results at more remote locations. Plans supplied by our client show the layout of the site and the location of nearby land uses.

3.2 METHODOLOGY

3.2.1 Road Traffic

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 Leq,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 2.1. The Lmax 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.

3.2.2 Mechanical Plant

Proposed mechanical plant details have been sourced from a Design Kit Specification, and based on typical layouts for similar sized developments, with the majority of plant located on dedicated roof-top plant decks or within the mezzanine plant rooms. As the exact type of mechanical plant has not been finalised at this stage, this assessment is based on sound levels sourced from our library of technical data.

The sound power of anticipated plant is propagated to nearest receivers taking into account sound intensity losses due to spherical spreading, acoustic barriers, etc. Additional minor losses such as molecular absorption, directivity and ground absorption have been ignored in the calculations. As a result, predicted received noise levels are expected to slightly overstate actual received levels and thus provide a measure of conservatism. Comparison of the predicted noise levels produced by the plant and the allowable level are then compared to give the noise impact at the receiver.

3.2.3 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))
 R distance to receiver (m)
 D is duration of noise for each event (sec)

N is number of events
 T is total assessment period (sec)

3.2.4 Tavern Alfresco Areas

Reverb Acoustics has completed a detailed analysis of patron noise levels under various situations in licensed premises with the following findings:

Table 4: Noise Levels from Various Types of Occupied Areas within Licensed Premises

Situation/Location	Noise Rating	Typical Noise Levels # dB(A),L10	Comments
Auditorium courtyard <i>Breakout for patrons during functions</i>	1	85+	During functions up to 1/3 of patrons may occupy outdoor area. Monitoring recommended.
General courtyard <i>Servicing lounge areas, public bars, etc</i>	2	80	Patrons may remain in area for extended periods. Monitoring recommended.
Outdoor dining <i>Seating outdoors</i>	3	75-80	Patrons generally quiet, although may remain for extended periods and produce higher noise levels.
Bistros Internal eating area	4	75	Continuous conversation typical at self-service areas.
Restaurant <i>Internal eating area with open doorway</i>	5	70	Generally quiet. Only low level conversation. Patrons typically vacate area once meal completed.
Club Gaming area <i>Poker machine, TAB areas</i>	6	65-70	Patrons typically quiet. Rarely talk. Some noise from machines, TV's, monitors, etc.
Gaming courtyard <i>Smokers breakout</i>	7	<70	Patrons typically quiet. Rarely talk. Anxious to return to gaming area.

Typical noise level at inside surfaces.

Outdoor Dining Terrace – Noise Rating 3

- Seated only, i.e. 80dB(A).

Children's Outdoor Play Area – Noise Rating 3-4

Generally, children will only be in the Outdoor Play Area during the day and early evening, while parents are having a meal, etc, i.e. 75dB(A).

Cafe Terrace – Noise Rating 3-4

- Seated only, 70dB(A).

Alfresco Gaming – Noise Rating 7

- Seated only, 65dB(A).

The above events have been measured by Reverb Acoustics at various licensed premises under worst-case situations. Calculations to determine the Sound Pressure Level (SPL) at the inside surfaces of each area were carried out using Equation 2.

The combined sound pressure level (SPL) at the receiver is then compared to the criteria. Where noise impacts above the criteria are identified, suitable noise control measures are implemented and reassessed to demonstrate satisfactory received noise levels.

Note that assessment of short term events, such as shouted speech has also been assessed against the EPA's Sleep Arousal Criterion.

3.3 ANALYSIS AND DISCUSSION

3.3.1 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 2.1.1 of this Report. All delivery trucks will access the loading dock via the dedicated Springfield Drive entry/exit at the north west corner of the development and reverse into position at the dock. Once unloaded the trucks will drive out of the dock and exit the site. Customer’s vehicles will access the carpark via dedicated entry/exit off both Springfield Drive and Robert Road.

Delivery Trucks

The anticipated frequency of service deliveries and waste collection is summarised below, taken from counts for similar supermarket developments:

Supermarket

1 grocery/day	1 meat/day	1 frozen/day
1 dairy & milk/day	1 bread/day (van)	2 misc/day (van)
1 paper bails/week	1 refuse/week	1 fat & bone/week

Misc: 5/day (van/smaller trucks)

Anticipated total maximum 10 trucks/day (20 movements)

Specialty Retail/Tavern

4-5 vans or trucks/day (8-10 movements)

Truck noise varies from one machine to another, with more modern larger trucks consistently producing a sound power in the range 100dB(A) to 106dB(A) at full power. This assessment assumes a typical large truck sound power of 104dB(A), as full engine power is not typically required to approach and depart the site at low speed.

Customers Vehicles

Previous studies for similar size developments indicate that the site will generate up to 250 vehicle movements/hr during peak day periods (7am-10pm). A 25% reduction would be typical during normal periods. Significantly less vehicle movements are expected during the night shoulder period (10pm-12am), with perhaps 100 vehicle movements/hr, coinciding with closure of the Tavern.

Vehicle Type	Traffic Generation	
	Day (7am-10pm)	Shoulder Periods
Trucks	30/day or 4/hour	2/hr
Cars	2900/day or 250/hr	100/hr

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 adjoining roads for peak day and night periods.

Table 5: Traffic Noise Calculations - dB(A)Leq (T)

Traffic and Receiver	Peak Day		Peak Shoulder	
	Cars	Trucks	Cars	Trucks
Vehicle Type				
Movements per hour	2900	30	200	4
Vehicle Sound Power	92	104	92	104
Received Noise Level, Lmax	61	73	59	73
Average Distance to Rec, m	15	15	15	15
Received Noise Level	51.5	45.4	48.6	45.4
Total Received	52.4		50.3	
Criteria	60dB(A), Leq 15hr		55dB(A), Leq 9hr	
Impact	0		0	

The above Table shows the noise impact from traffic movements associated with the development are predicted to compliant with the criteria during day and shoulder period (6am-7am) at all residential receivers and is considered acceptable.

3.3.2 Received Noise Levels - Loading Dock/Deliveries

As part of the proposal, a loading dock will be located along the west boundary. Main sources of noise from loading docks are trucks entering the site and reversing into position, the truck refrigeration unit (supermarket trucks only), unloading of produce, and the compactor. Typical noise levels from loading dock activities, which were used in this assessment, have been measured at existing shopping centres in Sydney, Newcastle and the NSW South and North Coasts. A worst-case situation for loading dock activities has been assessed for a 15-minute period, as follows:

- A refrigerated truck enters off Springfield Drive reverses into the supermarket dock.
- The truck engine is turned off, although the refrigeration unit remains running.
- Workers continuously unload the refrigerated truck parked at the supermarket dock.
- A second rigid truck enters off Springfield Drive reverses into the specialty dock.
- Workers continuously unload the rigid truck parked at the specialty dock.
- The rigid truck drives out of the dock along and exits the site onto Springfield Drive.
- A compactor is operating intermittently in the dock area.

NOTE: A refrigerated truck takes longer than 15 minutes to unload.

Table 6: Modelling Parameters:

Item	Lw, dB(A)	Acoustic Centre (m)	Comments
Refrigerated Truck (driving)	102-106	0.5, 1.5, 2.7, 2.7	Tyres, Engine, Exhaust
Refrigerated Truck (reversing)	102	0.5, 1.5, 2.7, 2.7	Tyres, Engine/Reverse Alarm, Exhaust
Truck Refrig Unit	86	2.7	Operates continuously
Rigid Truck (driving)	96-98	0.5, 1.5, 2.7	Tyres, Engine, Exhaust
Rigid Truck (reversing)	98	0.5, 1.5, 2.7, 2.7	Tyres, Engine/Reverse Alarm, Exhaust
Unload Dock	78	2.0	Gas Fork lift/pallet jack
Compactor	82	2.0	Located s'market dock

The following Table shows calculations to predict received noise levels from loading dock activities, propagated to nearest residential receivers south of the site (R1). All calculations are based on distances scaled from plans supplied by our client.

**Table 7: Received Noise – Loading Dock Activities – NO NOISE CONTROL
 Propagated South to Nearest Residential Bdry's (R1)**

Item/Activity	Lw dB(A)	Ave Dist Rec (m)	Duration (sec)	No. of Events	Barrier Loss/Dir	Received dB(A)
Refrig truck enter	106	70	10	1	6	36
Refrig truck reverse	102	20	25	1	2	49
Refrig unit running	86	30	900	1	4	43
Unload refrig truck	78	50	900	1	6	30
Rigid truck enter	98	70	10	1	6	28
Rigid truck reverse	96	25	15	1	2	40
Unload rigid truck	78	50	600	1	6	28
Rigid truck leave	98	50	10	1	4	31
Compactor running	82	45	300	1	4	31
Combined						50
Crit (D/E)						53/43
Impact						0/7

As can be seen by the results in the above Table, noise emissions from operation of the loading dock are predicted to exceed the criteria by up to 7dB(A) during the evening. Higher exceedances would occur if the dock operated after 10pm. Various options of noise control were investigated with the following options considered to be the most effective and economical.

- Restrict dock operating hour to 7am-10pm.
- Erect 2500mm high acoustic fence along the south site boundary between the loading dock and residences R1 and R2.

Table 8 shows further calculations to predict received noise levels from loading dock activities, propagated to nearest residential receivers south of the site (R1), with the above noise control in place.

**Table 8: Received Noise – Loading Dock Activities – NOISE CONTROL
 Propagated South to Nearest Residential Bdry's (R1)**

Item/Activity	Lw dB(A)	Ave Dist Rec (m)	Duration (sec)	No. of Events	Barrier Loss/Dir	Received dB(A)
Refrig truck enter	106	70	10	1	12	30
Refrig truck reverse	102	20	25	1	10	41
Refrig unit running	86	30	900	1	12	35
Unload refrig truck	78	50	900	1	16	20
Rigid truck enter	98	70	10	1	12	22
Rigid truck reverse	96	25	15	1	10	32
Unload rigid truck	78	50	600	1	18	16
Rigid truck leave	98	50	10	1	10	25
Compactor running	82	45	300	1	12	23
Combined						42
Crit (D/E)						53/43
Impact						0/0

As can be seen by the results in the above Table, noise emissions from operation of the loading dock are predicted to be compliant with the criteria during proposed operating hours (i.e. 7am-10pm) providing noise control modifications detailed in Section 4 are implemented.

3.3.3 Received Noise Levels – Vehicle Movements

Vehicles entering, leaving and manoeuvring on the site have the potential to cause disturbance to nearby residents. All cars will access the carparks via dedicated entry/exit off both Springfield Drive and Robert Road, with the exception of staff vehicles that will use the loading dock access road. The greatest impact will occur during peak periods when the centre is open and the carpark may be full. Based on typical peak traffic data up to 90 vehicle movements may occur during a 15 minute assessment period. Significantly less movements are expected during the 10pm-12am Shoulder Period with perhaps 50 vehicle movements when the Tavern closes.

The following Table shows calculations of noise from site vehicles, propagated to the nearest residential boundaries north of the site (R15).

**Table 9: Received Noise – Vehicle Movements (Peak Day)
 Propagated North to Nearest Residential Boundaries (R15)**

Item/Activity	Lw dB(A)	Ave Dist Rec (m)	Duration (sec)	No. of Events	Barrier Loss/Dir	Received dB(A)
Cars E/L Springfield Dv E	82	30	5	50	2	36
Cars E/L Robert Rd	82	120	5	40	6	20
Cars E/L Springfield Dv W	82	50	5	10	3	23
Cars Drive Main Carpark	76	60	30	60	4	3
Cars Drive Tavern Carpark	76	120	30	30	6	20
Cars Drive Staff Carpark	76	100	30	10	24	-
Cars Rev Main Carpark	78	60	20	30	4	26
Cars Rev Tavern Carpark	78	120	20	15	6	18
Cars Rev Staff Carpark	78	100	20	5	24	-
Combined						37
Crit (D/E/S)						53/43/40
Impact						0/0/0

Table 10 below shows results of calculations to predict the impact at each receiver, and accompanying notes detailing necessary modifications to achieve compliance.

Table 10: Calculated SPL, Site Vehicles - Propagated to Nearest Receivers

Receiver Loc'n	Received Noise (Day/Even/Shoulder)					Compliant YES/NO
	Period	dB(A),Leq	Crit	dB(A),Lm	Crit	
Residences S R1-R3	Day	39	53	-	N/A	YES
	Evening	39	43	-	N/A	"
	10pm-12am	37	40	44	52	"
Residences S R4-R6	Day	37	53	-	N/A	"
	Evening	37	43	-	N/A	"
	10pm-12am	34	40	40	52	"
Residences E R7-R8	Day	36	53	-	N/A	"
	Evening	36	43	-	N/A	"
	10pm-12am	35	40	42	52	"
Residences N R9-R13	Day	34	53	-	N/A	"
	Evening	34	43	-	N/A	"
	10pm-12am	31	40	41	52	"
Residences N R14-R17	Day	38	53	-	N/A	"
	Evening	38	43	-	N/A	"
	10pm-12am	36	40	44	52	"
Residences N R18-R20	Day	36	53	-	N/A	"
	Evening	36	43	-	N/A	"
	10pm-12am	34	40	43	52	"

The above results show that noise created by activities associated with the carparks (vehicles, customers) will be compliant with the criteria at all nearby receivers for normal and peak periods during the day, evening and shoulder periods. Compliance with the Sleep Arousal Criterion is also predicted at nearest residential receivers. See Section 4 for details of required noise control.

3.3.4 Received Noise Levels - Substation Kiosk

As no information is available concerning the exact type of substation kiosk equipment (transformers, cooling operation, fans, etc), a limiting sound pressure level (SPL) has been specified at 3 metres from the surface of the kiosk, as shown in the following Table.

Table 11: Maximum Allowable SPL 3 metres from Kiosk – dB(A),Leq

Night Planning Level	38dB(A),Leq #
Maximum Plant Noise Level (SPL) at 3 metres	52

3dB(A) penalty applied to account for cumulative impact from all plant associated with the site.

3.3.5 Received Noise Levels - Mechanical Plant

The development will require air conditioning plant to ventilate habitable spaces and refrigeration plant for cool rooms/cold storage, while exhaust may be required for some specialty shops. This assessment is based on a typical supermarket Design Kit Specification. For assessment purposes we have assumed the majority of mechanical plant will be located on the dedicated roof-top plant deck, with some individual plant items located on the roof above specialty shops. The anticipated number and location of noise generating items associated with the development are shown below. Note that a detailed assessment of the noise impacts from all mechanical plant will be required once locations and selections have been finalised.

Location	Plant Item
Supermarket Deck	Refrigeration condensers (x3) Air conditioning condensers(x3)
Plant Room	Exhaust/Supply Air Fan (x2) Air conditioning condensers(x3) Temp racks (x3) Heat pump (x1)
Specialty Shops Deck	Air conditioning condensers (x2) Exhaust (x1)
Tavern	Air conditioning condensers (x2) Exhaust (x1) Refrigeration condensers (x2)

The following Table shows sample calculations to predict noise from anticipated mechanical plant on the supermarket roof-top plant, propagated south to nearest residential boundaries.

**Table 12: Calculated SPL, Roof-Top Plant
 Propagated to Nearest Residential Boundaries**

Item	dB(A)	Octave Band Centre Frequency, Hz							
		63	125	250	500	1k	2k	4k	8k
Combined Lw plant	92	63	79	81	83	84	88	83	74
Barrier loss ¹		7	8	9	11	14	17	21	23
SPL at Receiver	35	12	27	28	28	26	27	18	7
Criteria (night)	38								
Impact	-								

1. Acoustic barrier at perimeter of plant deck.

As can be seen by the results in Table 12, noise emissions from roof-top plant are predicted to be compliant with the night criterion of 38dB(A),Leq at nearest residences, subject to construction details shown in Section 4. As previously stated, detailed assessment of the noise impacts from all mechanical plant associated with the development will be required once locations and selections have been finalised. In the interim, general acoustic recommendations and noise emission limits are detailed in Section 4.

3.3.6 Received Noise Levels – Tavern Outdoor Terraces

Table 13 shows results of calculations to predict the noise impact from activities associated with the Outdoor Dining Terrace, propagated to the nearest residential boundaries north of the site (R9-R11).

**Table 13: Noise Impact, Outdoor Dining Terrace
 Propagated North to Nearest Residential Boundaries (R9-R11) dB(A),L10**

Item	dB(A)	Octave Band Centre Frequency, Hz								
		31.5	63	125	250	500	1k	2k	4k	8k
SPL at perimeter	80	16	33	69	71	74	75	71	62	54
Barrier loss ¹		5	5	5	4	3	1	0	0	0
SPL at rec	36	-	-	22	25	29	32	29	20	12
Crit (before 12am)	43	26	32	35	38	37	35	32	28	23
Impact	-	-	-	-	-	-	-	-	-	-

1. Acoustic barrier 900mm above FGL at Terrace perimeter.

The above Table shows that noise from patrons in the Tavern Outdoor Dining Terrace are predicted to be compliant with the overall LA10 criteria.

Tables 14 and 15 show summaries of calculations to predict the combined noise impact from all Tavern Outdoor areas (i.e. Outdoor Dining, Children’s Outdoor play, Café Terrace, Alfresco Gaming), propagated to nearest residences.

**Table 14: Combined Noise Impact – All Outdoor Areas
 Propagated to Nearest Receivers, dB(A),L10**

Noise Path	dB(A)	Octave Band Centre Frequency, Hz								
		31.5	63	125	250	500	1k	2k	4k	8k
R7-R8 Res’s N	28	-	-	17	19	22	23	19	10	2
R9-R11 Res’s N	37	-	-	24	26	30	33	30	21	13
Crit (before 12am)	43	26	32	35	38	37	35	32	28	23

**Table 15: SPL Patrons in Outdoor Areas – Short Term Noise Events
 Propagated to Nearest Residences dB(A),Lmax**

Location	R1-R6	R7-R8	R9-R11	R12-R20
Outdoor Terraces	<20	42	47	<45
Crit. (10pm-12am)	52dB(A),Lmax			

Theoretical results in the above Tables show that the combined noise impact from patrons in outdoor areas will be compliant with the LA10 and EPA criteria at nearest residential receivers, subject to acoustic modifications detailed in Section 4.

3.3.7 Cumulative Noise Impact – Site Activities/Equipment

The cumulative noise impact from all activities associated with the site must be considered to confirm compliance. Peak periods during the day, evening, and shoulder periods are considered the time periods of most concern. The acoustic sum of all noise generating items expected to operate at the site, propagated to nearest residential receivers, is shown in the following Tables.

Table 16: Cumulative Noise Impact - Propagated to Nearest Receivers (Day/Evening)

Receiver/Item	Loading Dock	Site Vehicles	Mech Plant	Tavern Terraces	Sum
R1-R3 Res's S	42	39	35	<30	43
R4-R6 Res's S	41	37	37	<30	43
R7-R8 Res's E	<30	36	38	28	40
R9-R13 Res's N	<30	34	37	37	39
R14-R17 Res's N	<30	38	35	<30	40
R18-R20 Res's N	<30	36	35	<30	39

Criteria: Day=53dB(A),Leq Evening=43dB(A),Leq Night=38dB(A),Leq 10pm-12am=40dB(A)

Table 17: Cumulative Noise Impact - Propagated to Nearest Receivers (10pm-12am)

Receiver/Item	Loading Dock	Site Vehicles	Mech Plant	Tavern Terraces	Sum
R1-R3 Res's S	-	37	35	<30	39
R4-R6 Res's S	-	34	37	<30	39
R7-R8 Res's E	-	35	38	28	40
R9-R13 Res's N	-	31	37	37	38
R14-R17 Res's N	-	36	35	<30	39
R18-R20 Res's N	-	34	35	<30	38

Criteria: Day=53dB(A),Leq Evening=43dB(A),Leq Night=38dB(A),Leq 10pm-12am=40dB(A)

As can be seen by the above results, the cumulative noise impact from activities associated with operation of the development are predicted to be compliant with the criteria at all nearby receivers during all assessed time periods. It is highly unlikely that all activities will occur at the same time (i.e. maximum vehicle traffic, loading dock delivery, etc), therefore lower than predicted noise levels are expected in residential areas, providing noise control modifications detailed in Section 4 are incorporated into the design.

Collectively, with up to 3 or 4 other sources operating simultaneously on occasion over various parts of the site, the acoustic sum could be as high as 75dB(A),Leq. This overall sum is at least 10dB below significant sources noted above, therefore they will not contribute or raise the sound level at nearby receivers.

SECTION 4

Summary of Recommended Noise Control

4 NOISE CONTROL RECOMMENDATIONS

4.1 Site Operations

4.1.1 The following trading and operating hours are acceptable:

Supermarket	7am-12am	Monday to Sunday
Specialty Shops (General)	8am-10pm	Monday to Sunday
Specialty Shops (Food & Drink)	7am – 12am Internal Areas	Monday to Saturday
	7am – 10pm Alfresco Areas	Monday to Saturday
	8am – 10pm Internal Areas	Sunday
	8am – 10pm Alfresco Areas	Sunday
Loading Dock	7am-10pm	Monday to Sunday

4.1.2 We strongly recommend that waste collection be restricted to dock operating hours.

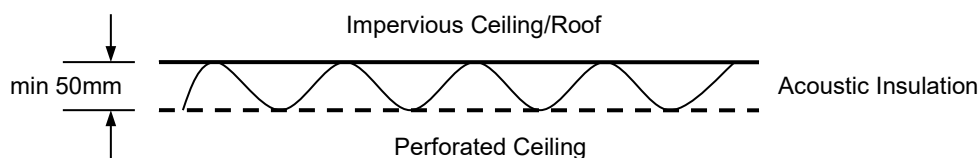
4.1.3 Given the variability of the proposed specialty shops it is not possible to specify exact acoustic controls on a case-to-case basis. For example, a café or butcher may require exhaust or refrigeration plant, while no significant noise is expected from a newsagent. In addition, the tenancy of retail outlets is usually dynamic dependent upon the success or otherwise of the occupant. For this reason, the onus is upon the tenant to ensure noise emission is kept to a minimum. Future tenants should be assessed on a case to case basis and required to submit their own Noise Impact Assessment to Council, if noise generating activities are anticipated.

4.1.4 No amplified entertainment is proposed for the Tavern or Specialty Food & Drink tenancies alfresco or indoor areas, although background "incidental" music is expected. A limiting SPL of **70dB(A),L_{max}** is to be set at a distance of 3 metres from the speakers. Once this output limit is achieved, corresponding references should be assigned to the sound system controls and should only be accessed by responsible staff familiar with the system settings.

4.2 Loading Dock

4.2.2 The entire loading dock areas are to be treated to absorb reflected sound. We recommend the underside of the ceilings be treated to absorb reflected noise. See Figure 2 for detail. Available options include a perforated metal ceiling to the underside, i.e. Luxalon, Renhurst, or similar, minimum 10-15% open area, backed with R2 fibreglass or S2 polyester insulation. Alternatively, a perforated plasterboard or perforated FC sheet ceiling may be installed with cavity insulation. If the insulation is exposed to the weather, hosing, washing, etc, we recommend using a water resistant acrylic blanket (available through the supplier of the perforated metal ceiling).

Figure 2: Absorbent Ceiling Detail to Entire Loading Dock Area



4.2.3 Trucks visiting the dock must not congregate outside the dock area or park on streets. Deliveries should be co-ordinated with management to ensure trucks are able to enter the dock immediately when arriving at the site.

4.3 Acoustic fence

4.3.1 An acoustic fence 2500mm above FGL is to be erected along the south site boundary between the loading docks and residences R1-R6. An acoustic fence is one which is impervious from the ground to the recommended height, and is typically constructed from lapped and capped timber, Hebel Powerpanel, masonry, or a combination of the above. 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.

4.4 Mechanical Plant

4.4.1 As part of Construction Certificate documentation a detailed assessment of the noise impacts from all mechanical plant associated with the development will be required once locations and selections have been finalised.

4.4.2 No noise control will need to be incorporated into the design of proposed mechanical plant if the following maximum allowable limits are not exceeded (also see Item 4.3.3):

Location	Plant Item	Maximum Allowable Noise level	
		SPL @ 3m	Lw
Supermarket Deck & Plant Room	Refrig condenser	N/A – See Item 4.4.3	
	Air con condenser	"	
	Exhaust/Supply Air Fan	"	
	Temp racks	"	
	Heat pump	"	
Specialty/Commercial Roof	Air con condensers	55	72
	Refrig condensers	55	72
	Exhaust discharge	53	70
Tavern Roof/Service Yard	Air con condensers	59	76
	Refrig condensers	59	76
	Exhaust discharge	57	74

4.4.3 Acoustic barriers will be required at the perimeter of the supermarket roof-top plant deck. Barriers must be minimum 300mm above the top of the highest plant item. Absorbent panel options include the following:

- Acoustisorb Panels (available thru Modular Walls)
- CFG Acoustic+ Panels (available thru Con-Form Group)
- Alternate option approved by Reverb Acoustics

Final acoustic barrier heights and locations will be determined as part of the CC documentation, recommended in Item 4.4.1 above.

Acoustic barriers must continue at least 300mm below the top of the plant deck.

NOTE 1: All barrier heights are above top of plant, not height above plant deck

NOTE 2: Any supply/exhaust fans in plant room roof/walls must not produce an SPL >65dB(A) at 1 metre (includes combined noise from fans and plant equipment). Acoustically rated ducts/louvres must be installed at plant room side of fan for any roof opening.

NOTE 3: Should impervious acoustic barriers create ventilation problems for the plant deck, we recommend installing acoustic louvres. The louvres must have the following insertion loss values (typically Fantech SBL1, Nap Silentflo 300S Line or Robertson Type 7010):

Required Insertion Loss Values for Plant deck Acoustic Barriers – dB

	Octave Band Centre Frequency, Hz							
	63	125	250	500	1k	2k	4k	8k
NR	10	12	15	19	20	18	18	14
STL	4	6	9	13	14	12	12	8

4.4.4 Noise emissions from the substation kiosk must not exceed a sound pressure level of 52dB(A),Leq at a distance of 3 metres. Where plant intended to be installed on the site produces noise in excess of specified levels, noise control will be required to ensure satisfactory noise emissions.

4.4.5 Acoustic louvres are required in the walls of the plant room above the loading dock, in preference to standard ventilation louvres. The louvres must have the following insertion loss values (typically Fantech SBL1, Nap Silentflo 300S Line or Robertson Type 7010):

Required Insertion Loss Values for Plant Room Louvres – dB

	Octave Band Centre Frequency, Hz							
	63	125	250	500	1k	2k	4k	8k
NR	10	12	15	19	20	18	18	14
STL	4	6	9	13	14	12	12	8

4.4.6 Any roof-top exhaust plant that is not located on the supermarket plant deck that produces an SPL above the limits specified in Item 4.4.2 must have acoustic barriers constructed at 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. The barrier must be no closer than 500mm and no further than 1200mm from the edges of the exhaust. Barrier construction should consist of Acoustisorb panels or similar construction detailed previously for deck barriers. Barrier construction is based solely on acoustic issues. Visual, wind load issues must be considered and designed by appropriately qualified engineers.

4.4.7 Any roof-top air conditioning or refrigeration plant that is not located on the supermarket plant deck that produces an SPL above the limits specified in Item 4.4.2 must have acoustic barriers constructed between the plant and residences. Barriers must fully enclose at least three sides towards any residence. The barrier must be no further than 1200mm from the edges of the plant. Barrier construction should consist of Acoustisorb panels or similar construction detailed previously for deck barriers. Barrier construction is based solely on acoustic issues. Visual, wind load issues must be considered and designed by appropriately qualified engineers.

4.4.8 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.

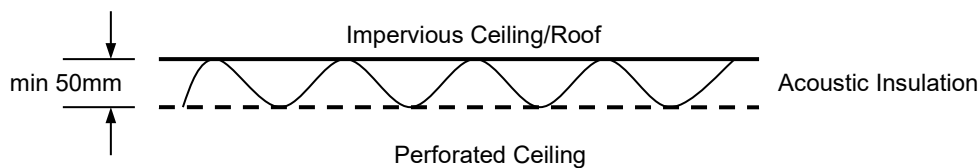
4.4.9 Once the plant layout has been finalised, details should be forwarded to the acoustic consultant for approval. Revision of the plant layout may result in modified acoustic requirements.

4.5 Tavern Outdoor Terraces

4.5.1 No PA system or amplified entertainment is permitted in outdoor areas. Emergency announcements are excluded from this requirement.

4.5.2 External ceiling/roof must have an absorbent underside to reduce reflected sound. We recommend a perforated metal ceiling to the underside of the roof/ceiling, i.e. Luxalon, Renhurst, or similar, minimum, 15% open area, backed with R2/S2 fibreglass or polyester insulation. Alternatively, a perforated plasterboard or perforated FC sheet ceiling may be installed with cavity insulation. If the insulation is exposed to the weather, hosing, etc, we recommend using a water resistant acrylic blanket.

Figure 2: Absorbent Ceiling Detail to Outdoor Areas



4.5.3 Acoustic barriers are required at the following locations. Note that all acoustic barrier heights are the total height from FFL to the top of the barrier:

<i>Location</i>	<i>Height Above FFL (mm)</i>
Outdoor Dining Terrace	900
Kids Play Area	1200
Café Terrace	NIL
Alfresco Gaming	NIL

No significant gaps are permitted in the barriers to allow the passage of sound below the recommended height. Acceptable forms of construction include masonry, safety glass, stud wall lined both sides with 9mm FC sheeting, or materials of equivalent surface mass. A gap of say 50-75mm is permitted at floor level to allow cleaning, hosing, etc.

4.5.4 All doors and windows leading from First Floor Function Room 2 to the associated Outdoor

The above noise control recommendations are not necessarily the only options available, but are expected to be the most cost-effective and practical with the information currently to hand. Alternative options can be considered providing they result in the same or lower received noise levels at any nearby residence.

SECTION 5

Conclusion

5.1 CONCLUSION

A noise impact assessment for the proposed Lochinvar Shopping Village, Proposed Lot 1001, corner Springfield Drive and Robert Road, Lochinvar, has been completed, resulting in noise control recommendations summarised in Section 4 of this Report. This assessment has shown that 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 criteria or generally below the existing background noise level in the area for the majority of the time.

Noise generated by the 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, considering the economic and social benefit to the local community as a whole.

Providing the recommendations presented in this report are implemented, operation of the new development 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).

