

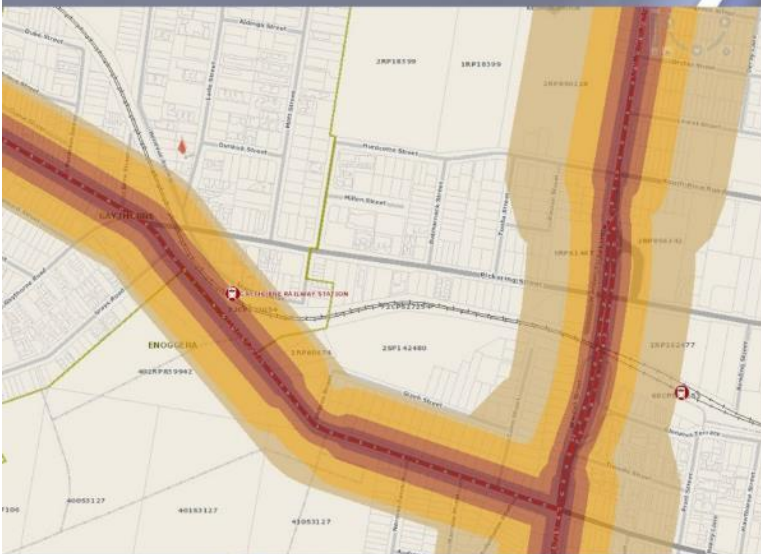
PLANS AND DOCUMENTS
referred to in the
DEVELOPMENT APPROVAL

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REPORT FOR Tam Dang Planning *on behalf of* Hamel (QLD) Pty Ltd

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Signed



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Contents

Executive Summary	4
Conclusions	4
Recommendations	4
1. Introduction.....	5
2. Measurement of Ambient Noise Levels	8
2.1 Measurement Procedures.....	8
2.2 Measurement Results	9
3. Noise Criteria and Limits	11
3.1 Brisbane City Council City Plan 2014.....	11
3.2 Environmental Protection (Noise) Policy 2008	12
3.3 Air Conditioning - Noise Emissions – EPA 1994.....	12
4. Noise Impact Assessment.....	13
4.1 Noise Sources	13
4.2 Sensitive Receivers	14
4.3 Acoustic Fencing.....	16
4.4 Summary of Assessment Criteria	17
4.5 Assessment of Potential Noise Emissions	18
4.5.1 Vehicle Movements	18
4.5.2 Delivery Activities	19
4.5.3 ‘Slamming’ Car Doors.....	20
4.5.4 Vocal Activity	21
4.5.5 Drive-Thru Intercom	22
4.5.6 Air Conditioning / Mechanical Plant	23
4.6 Recommended Acoustic Canopy.....	23
Appendix A: Plans.....	26
Appendix B: Environmental Noise Model.....	29
Appendix C: Glossary	35

Executive Summary

This Report is in response to a request from Tam Dang Planning for a noise impact assessment report for a proposed drive-thru restaurant at 1304 Old Cleveland Road, Carindale (Lot 1 on RP168799). The site is located within a LDR Low density residential zone, and is within the designated *Transport Noise Corridor* for Old Cleveland Road. The aim of this report is to assess the potential noise impacts from expected activity onto neighbouring sensitive uses. Assessment has been conducted with regard to the following policy documents and standards:

- *Brisbane City Council Cityplan 2014 – Centre or Mixed Use Code*
- *Brisbane City Council Cityplan 2014 – Noise Impact Assessment Planning Scheme Policy*
- *Environmental Protection Act 1994*
- *Environmental Protection (Noise) Policy 2008*
- *Australian Standard AS1055:1 – Acoustics: Description and measurement of environmental noise*

Conclusions

It is concluded that:

- Noise from customer activity and ‘slamming’ car doors is forecast to meet criteria at all receivers during all periods.
- Noise from truck deliveries is forecast to meet criteria at all receivers during the daytime and evening periods.
- Subject to the construction of an acoustic canopy and fence as presented in **Section 4.6**, noise from vehicle movements and intercom activity are forecast to meet criteria at all receivers during all periods.
- The specific type and siting of mechanical plant has not been determined at this stage. The relevant criteria are considered to be readily achievable through appropriate plant selection and siting, although detailed noise assessment can be conducted – if required – at the Building Approval stage.
- Subject to the considerations and recommendations of this report, it is the opinion of this consultancy that expected activities at the site can comply with the requirements of Brisbane City Council, and be otherwise compliant with relevant regulatory obligations.

Recommendations

It is recommended that:

- Truck deliveries be limited to the hours of 7am to 10pm.
- An acoustic canopy and fence be constructed over the order station, as presented in **Section 4.6**.
- Mechanical plant be selected, sited and – if necessary – screened to not exceed 45 dB(A) at nearby sensitive uses. Detailed plant noise calculations can be conducted at the Building Approval stage once specific equipment selection and installation can be determined.

1. Introduction

This Report is in response to a request from Tam Dang Planning for a noise impact assessment report for a proposed drive-thru restaurant at 1304 Old Cleveland Road, Carindale (Lot 1 on RP168799). The site is located within a LDR Low density residential zone, and is within the designated *Transport Noise Corridor* for Old Cleveland Road. The aim of this report is to assess the potential noise impacts from expected activity onto neighbouring sensitive uses (detailed in **Section 4**). Assessment has been conducted with regard to the following policy documents and standards:

- *Brisbane City Council Cityplan 2014 – Centre or Mixed Use Code*
- *Brisbane City Council Cityplan 2014 – Noise Impact Assessment Planning Scheme Policy*
- *Environmental Protection Act 1994*
- *Environmental Protection (Noise) Policy 2008*
- *Australian Standard AS1055:1 – Acoustics: Description and measurement of environmental noise*

Nominal 24hr operation has been assumed. The development site and locale are presented in the following **plates** and **photos**. Development plans are presented in **Appendix A**, while terms and definitions used in this Report are found in **Appendix C**.

Plate 1: Showing the development site and locale (source: Google; Queensland Government)



Plate 2: Showing the site within a LDR Low density residential zone (Source: BCC)

Property Address	
1304 Old Cleveland Rd Carindale 4152	
Parcel Details	
Lot No and Plan: Lot 1 on RP1163/99	IRBc Area*: 1249 m2
Full Property Holding: Y&A property, boundary detail report 1 on RP1163/99	Ward: CHANDLER
PDc- Maps GRND Reference: Map 29	* Refer 76111 31 Index
City Plan 2014 Zones	
Zone Name	Description
LDR Low density residential	The purpose of the Low density residential zone code is to provide for predominantly dwelling houses supported by community uses and small scale services and facilities that cater for local residents. Refer to Part 6 in the City Plan 2014 and the Exclusion .

Plate 3: Showing the development layout (source: Google; Queensland Government, client)



Plate 4: Showing (in part) the approved plans for the adjacent aged care centre (source: Google, BCC)



2. Measurement of Ambient Noise Levels

2.1 Measurement Procedures

In order to assess the potential impact of noise from all sources of noise in the locale, an ambient noise survey was conducted on-site. The environmental noise logger was installed at a location 1.5m from the western boundary, and 3m from the northern boundary. The microphone was at a height of 1.4m and is considered free-field. Levels measured at this location are considered representative of existing background levels at the most sensitive residential interface. The location is referred to as ML1 in this report, and is presented below.

Plate 5: Showing location ML1



Photo 1: Showing location ML1 (source: NMS)



The operation of the sound level measuring equipment was field calibrated before and after each measurement session, and no significant drift from the reference signal was observed. All instrumentation used in this assessment holds a current calibration certificate from a certified NATA calibration laboratory. The following instruments were used to measure the ambient noise levels-

- 1 x Rion NL-21 type 2 environmental noise logger
- 1 x Quest CA-22 calibrator

2.2 Measurement Results

Ambient sound pressure levels were measured generally in accordance with Australian Standard AS1055.1:1997 - *Acoustics-Description and measurement of environmental noise - Part 1: General procedures*. Ambient noise levels were recorded at 15 minute intervals between the 3rd and the 10th of October 2017. Levels are presented graphically in **Figure 1** below, and in tabular format in **Table 1** following

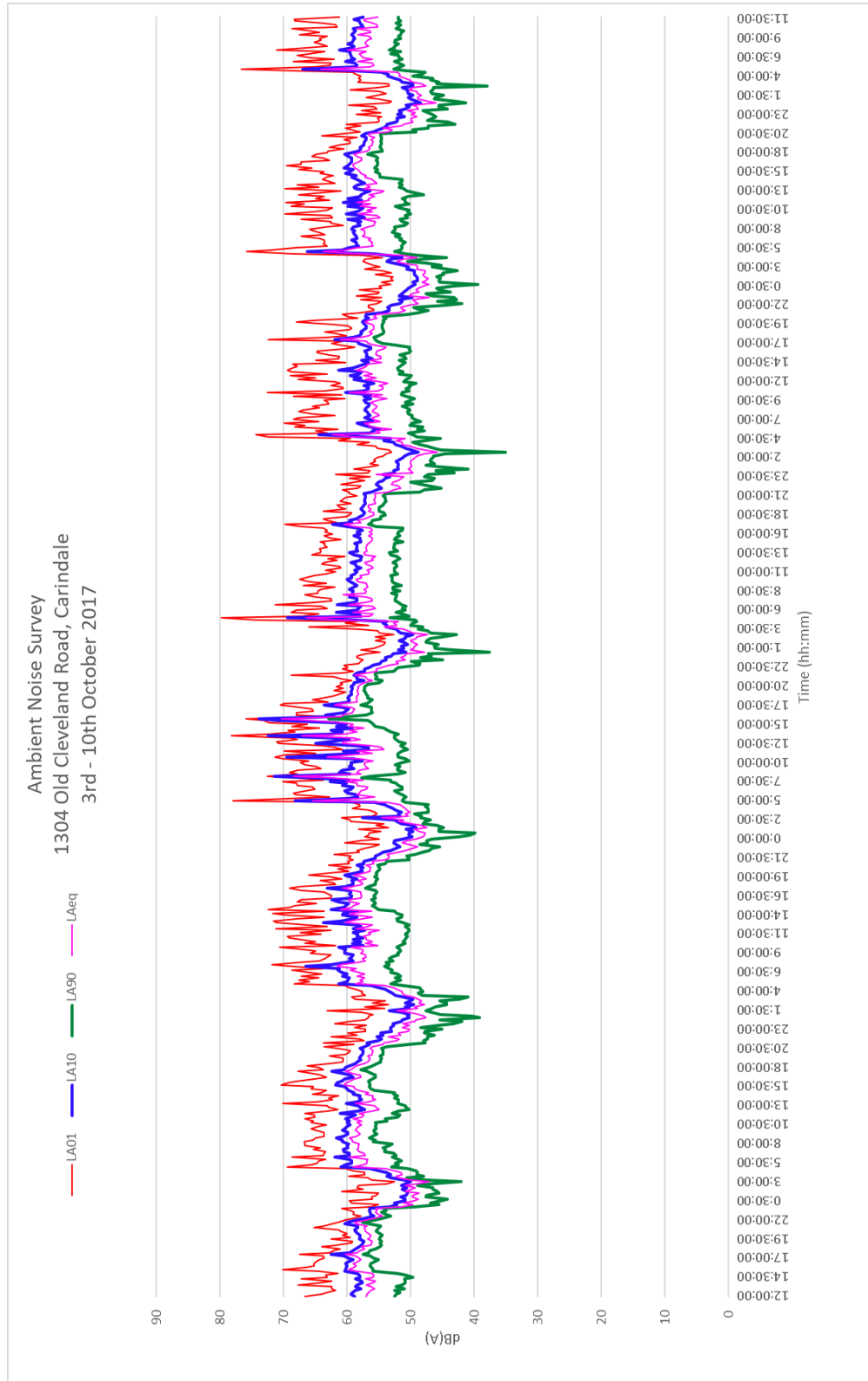


Figure 1: Ambient noise levels measured at ML1, 3rd – 10th October 2017. Levels are in dB(A), free-field.

Table 1: Average ambient noise levels measured at ML1, 3rd – 10th October 2017. Levels are in dB(A), free-field.

Day	Date	Period	L ₀₁	L ₁₀	L ₉₀	L _{eq}
Tuesday	3 rd / 10 th October	7:00am – 6:00pm	68.1	59.1	52.9	57.4
		6:00pm – 10:00pm	63.8	58.5	55.3	57.2
		10:00pm – 7:00am	66.9	53.4	47.3	54.0
Wednesday	4 th October	7:00am – 6:00pm	67.4	59.9	54.4	58.2
		6:00pm – 10:00pm	64.2	57.6	53.2	56.3
		10:00pm – 7:00am	64.6	54.8	49.7	54.3
Thursday	5 th October	7:00am – 6:00pm	71.2	60.0	53.0	58.4
		6:00pm – 10:00pm	63.6	58.0	54.2	56.7
		10:00pm – 7:00am	66.6	54.1	47.3	53.7
Friday	6 th October	7:00am – 6:00pm	72.4	62.0	53.8	61.4
		6:00pm – 10:00pm	64.7	59.1	56.3	58.0
		10:00pm – 7:00am	67.3	54.0	47.8	54.8
Saturday	7 th October	7:00am – 6:00pm	66.7	58.8	52.7	57.2
		6:00pm – 10:00pm	62.7	57.3	53.6	55.8
		10:00pm – 7:00am	68.4	54.8	48.4	55.8
Sunday	8 th October	7:00am – 6:00pm	68.9	57.7	51.3	56.3
		6:00pm – 10:00pm	64.4	56.4	52.7	55.4
		10:00pm – 7:00am	67.5	53.8	46.9	54.2
Monday	9 th October	7:00am – 6:00pm	68.5	58.8	52.4	57.1
		6:00pm – 10:00pm	63.1	56.7	52.4	55.6
		10:00pm – 7:00am	66.2	53.0	46.8	54.0
Arithmetic Average		Day	69	59	53	58
		Evening	64	58	54	56
		Night	67	54	48	54

The levels presented above include measured noise from all sources in the locale, including road traffic, wildlife, meteorology and aged care activity.

The Rating Background Levels (RBL) at ML1 have been calculated in accordance with the BCC Noise Impact Assessment Planning Scheme Policy, and are presented in **Table 2** below.

Table 2: Rating Background Levels (RBL) at ML1.

Location	Day (7am – 6pm)	Evening (6pm – 10pm)	Night (10pm – 7am)
ML1	51	52	44

3. Noise Criteria and Limits

3.1 Brisbane City Council City Plan 2014

The City Plan 2014 Centre or Mixed Use Code provides guidance to assess the suitability of proposed centre use activities, and is summarized (in part) in **Tables 3 and 4** below. Proposed uses do not include significant amplified music or other identified sources of low-frequency noise emissions, and the low-frequency noise emission criteria have therefore not been assessed.

Table 3: Centre or Mixed Use Code (in part)

Performance Outcome		Acceptable Outcome			
<p>PO1 Development:</p> <p>a) has hours of operation which are controlled so that the use does not detrimentally impact on the amenity of adjoining residents;</p> <p>b) where not located in a Special entertainment precinct identified in a neighbourhood plan, does not result in noise emissions that exceed the noise (planning) criteria in Table 9.3.3.F low frequency noise criteria in Table 9.3.3.3.G and night-time noise criteria in Table 9.3.3.3.H in a sensitive zone or a nearby sensitive use.</p> <p>Note—A noise impact assessment report prepared in accordance with the Noise impact assessment planning scheme policy can assist in demonstrating achievement of this performance outcome</p>		<p>AO1.1 Development:</p> <p>(c) for any other use:</p> <p>(iii) where in any other zone:</p> <p>(A) has hours of operation, including for deliveries, which are limited to 6am to 8pm; or</p> <p>(B) does not generate noise which is clearly audible and disturbing in a dwelling or other sensitive use;</p>			
		<p>AO1.2 Development ensures mechanical plant or equipment is acoustically screened from an adjoining sensitive use.</p> <p>Note—Mechanical plant includes generators, motors, compressors and pumps e.g. air-conditioning, refrigeration or cold room motors</p>			
Additional criteria for development if for a food and drink outlet					
<p>PO6 Development mitigates impacts on residential amenity in or adjoining the building through:</p> <p>(a) providing an outdoor dining area that is appropriately located;</p> <p>(b) ensuring external dining and entertainment areas are visually and acoustically screened from an adjoining dwelling.</p>		<p>AO6 Development provides for external dining or entertainment areas to be:</p> <p>(a) located in or directly adjacent to the public realm;</p> <p>(b) visually and acoustically screened from an adjoining dwelling.</p>			
		Table 9.3.3.3.F—Noise (planning) criteria			
Criteria location	Intrusive noise criteria		Acoustic amenity criteria		
	<p>Day, evening and night $L_{Aeq,adj,T}$ are not greater than the RBL plus the value in this column for the relevant criteria location, where T equals:</p> <ul style="list-style-type: none"> • day – 11hr • evening – 4hr • night – 9hr 		<p>Day, evening and night $L_{Aeq,adj,T}$ are not greater than the values in the columns below for the relevant criteria location, where T equals:</p> <ul style="list-style-type: none"> • day – 11hr • evening – 4hr • night – 9hr 		
			Day	Evening	Night
Emerging community zone boundary	5dB(A)		55dB(A)	50dB(A)	45dB(A)

Table 4: Centre or Mixed Use Code (in part, *continued*)

Table 9.3.3.3.H—Night-time noise criteria			
Criteria location	Where the existing $L_{Aeq,9hr\ night}$ at the criteria location is:	Average of the highest 15 single L_{Amax} events over a given night (10pm–7am) period is not greater than the following values at the relevant criteria location	The absolute highest single L_{Amax} event over a given night (10pm–7am) period is not greater than the following values at the relevant criteria location
At the zone boundary of a • Emerging community zone	< 45 dB(A)	50 dB(A)	55 dB(A)
	45- 60 dB(A)	$L_{Aeq,9hr\ night} + 5\ dB(A)$	$L_{Aeq,9hr\ night} + 10\ dB(A)$
	>60 dB(A)	65 dB(A)	70 dB(A)

3.2 Environmental Protection (Noise) Policy 2008

The *Environmental Protection (Noise) Policy 2008* establishes acoustic quality objectives (AQO) to protect or enhance stated environmental values. The environmental values to be enhanced or protected under the policy are the qualities of the acoustic environment that are conducive to protecting the health and biodiversity of ecosystems; and the qualities of the acoustic environment that are conducive to human health and well-being, including ensuring a suitable acoustic environment for individual's to sleep, study and learn, to be involved in recreation including relaxation and conversation; and the qualities of the acoustic environment that are conducive to protecting the amenity of the community. The AQO do not differentiate between sleeping areas, living areas and work areas.

It is noted that Brisbane City Council (BCC) provides noise emission assessment criteria, which take precedence over the AQO. It is therefore concluded that the policy objectives of the *Environmental Protection (Noise) Policy 2008* can be met through application of Council's noise emission policies.

3.3 Air Conditioning - Noise Emissions – EPA 1994

It is expected that the development will include some form of air conditioning, although the specific model and siting of plant has not been determined at this stage. Noise emission requirements are set out under the *Environmental Protection Act 1994*; in that Act noise from air conditioning must not exceed the following noise levels when measured as the LA_{90} dB(A) level over a period of 15 minutes at an affected building:

- Between 10pm and 7am: 3 dB(A) above the background level
- From 7am to 10pm: 5 dB(A) above the background level

With reference to the Rating Background Levels at ML1, the above criteria are less stringent than the BCC Acoustic Amenity Criteria (assuming continuous operation). As the EPA noise requirements represent an ongoing obligation under State legislation, it is recommended that air conditioning equipment be selected, sited and maintained to achieve the relevant criteria at all times. Detailed assessment of air conditioning noise emissions can be conducted – if required – at the Building Approval stage once the specific equipment and installation can be determined.

4. Noise Impact Assessment

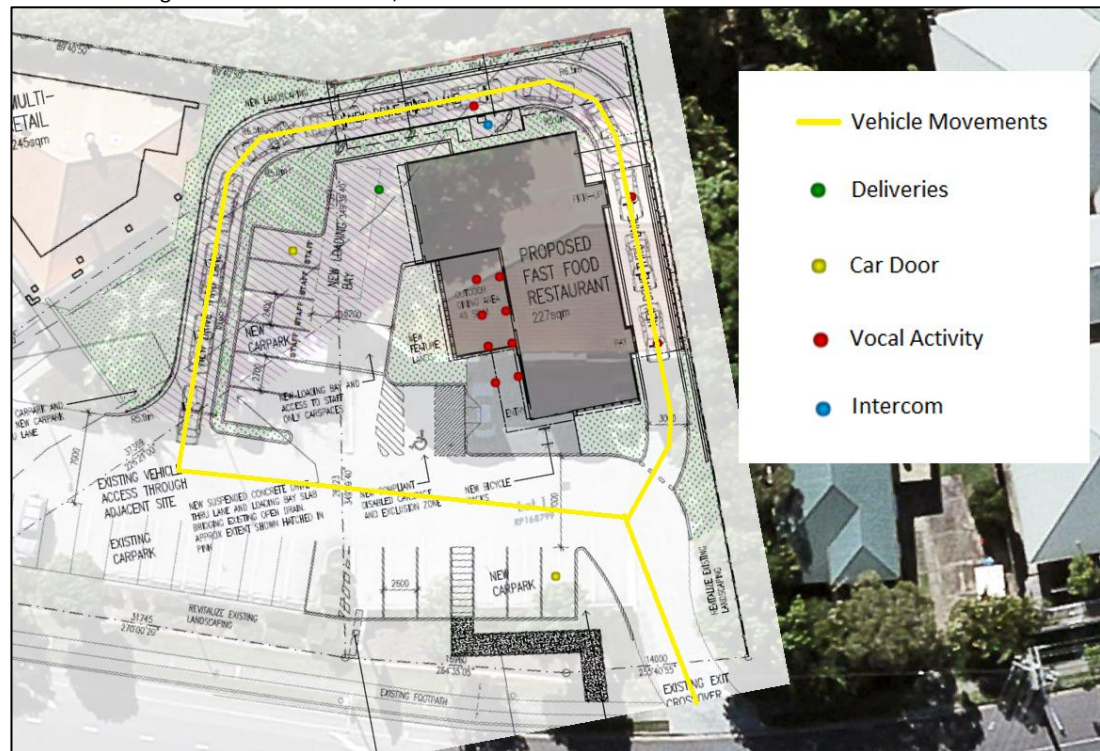
4.1 Noise Sources

Seven distinct sources of potentially intrusive noise emissions have been identified from expected activities at the proposed drive-thru restaurant:

- Vehicle movements through the carpark and drive-thru, represented by the L_{eq} descriptor
- Delivery activities at the loading bay, represented by the L_{eq} descriptor
- ‘Slamming’ car doors at the car park area, represented by the L_{max} descriptor
- Vocal activity at the outdoor area, order station and service windows, represented by the L_{eq} descriptor
- Amplified vocal activity at the order station, represented by the L_{eq} and L_{max} descriptors
- Air conditioning / mechanical plant, represented by the L_{eq} and L_{90} descriptors

Potential noise emissions from these sources have been forecast to existing and future sensitive uses with the environmental noise model presented in **Appendix B**. Noise source locations, as modelled, are presented in **Plate 6** below.

Plate 6: Showing noise source locations, as modelled



It is noted that the outdoor dining area shown on the western side of the building will be screened by the building envelope from existing and future sensitive uses to the east and to the north. It is therefore concluded that the outdoor dining area is appropriately located, and is acoustically screened from nearby sensitive uses in accordance with **PO6** of the Brisbane City Plane 2014 – Centre or Mixed Use Code.

4.2 Sensitive Receivers

The development site is adjacent to residential, commercial, aged care and child care uses, as presented in **Plate 7** below. Due to the intervening Old Cleveland Road, a source of road traffic noise, negligible noise impacts are expected upon dwellings on the southern side of the road, which have therefore not been considered.

Plate 7: Showing existing land uses on neighbouring properties.



It is noted that a substantial expansion to the aged care centre to the north and the east of the site has been approved (Council ref. A003505136). It is assumed that this redevelopment will be completed in the 2027 (10 year) design horizon, and the present assessment has been conducted to include new sensitive receivers in this future scenario. In particular, new accommodation suites are to be constructed to the immediate north, overlooking the development site.

Additionally, the neighbouring residential dwelling to the east is to be demolished for outdoor recreation use (although this location is generally commensurate with private outdoor space at the existing dwelling).

Noise emissions have been calculated to the most affected suites on Level 3 (representing the highest and most exposed locations), as well as to the outdoor recreation area, and to the existing child care centre. The most affected sensitive receivers are referred to as R1-R7 in this report, and are presented in **Table 5 and Plate 8** below.

Table 5: Showing sensitive receivers R1-R7

Receiver	Description	Receiver Height (RL)	Easting (UTM)	Southing (UTM)
R1	Child care play area	9.5m	511516.06	6957991.34
R2	Lounge / dining balcony	15.5m	511540.10	6957980.09
R3	Suite 16	15.5m	511549.26	6957981.32
R4	Suite 10	15.5m	511561.36	6957983.33
R5	Suite 9	15.5m	511572.44	6957984.45
R6	Suite 2	15.5m	511584.08	6957982.86
R7	Outdoor recreation area	7.5m	511569.02	6957953.19

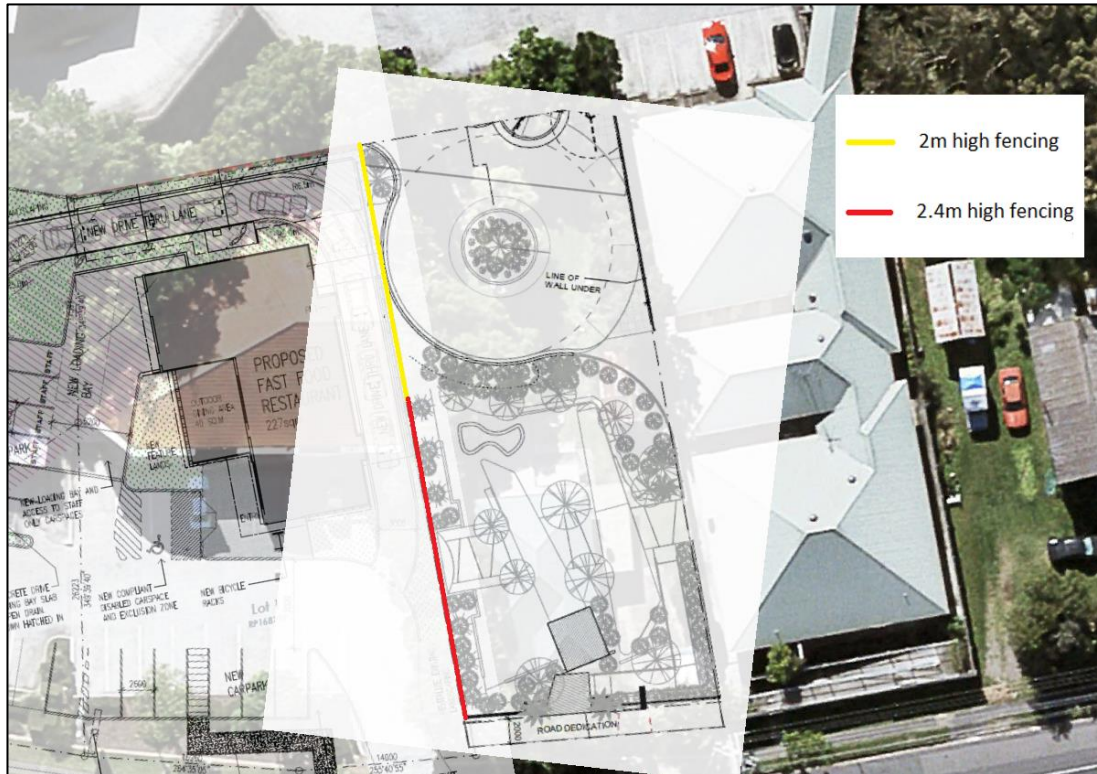
Plate 8: Showing sensitive receivers R1-R7



4.3 Acoustic Fencing

The development plans show that the 2m high acoustic fencing along the eastern boundary is to be retained. It is further noted that 2.4m high screening has been Conditioned for the southern section of the eastern boundary as part of the Development Approval for the expansion of the adjacent aged care centre (Council ref. A003505136). The extent of this fencing is shown in the approved noise assessment report for the aged care centre expansion (MWA report no. Carindale 12-093, dated 12th November 2012). Noise emission forecasts therefore include screening (where applicable) from these barriers, as presented in **Plate 9** below.

Plate 9: Showing existing and future acoustic fencing, as modelled



4.4 Summary of Assessment Criteria

The applicable noise emissions criteria are presented in **Table 6** below. The EPP 1994 and BCC Intrusive noise criteria are referenced to the Rating Background Levels at ML1, which have been calculated from the ambient noise survey in accordance with the BCC Noise Impact Assessment Planning Scheme Policy. The BCC Night-time noise criteria have been calculated with reference to the measured $L_{Aeq,9hr}$ at ML1 and presented in **Section 2.2**. The 'design criteria' refer to the most stringent of applicable criteria

Table 6: Summary of applicable noise emission criteria. Levels are in dB(A).

	Descriptor	Day	Evening	Night
Rating Background Level at ML1	L_{90}	51	52	44
Intrusive Noise Criteria (RBL + 5)	$L_{eq,adj,T}$	56	57	49
Acoustic Amenity Criteria	$L_{eq,adj,T}$	55	50	45
EPA 1994 ($L_{90} + 5$ 7am-10pm; $L_{90} + 3$ 10pm-7am)	L_{90}	56	55	47
Existing $L_{eq,9hr}$	$L_{eq,10pm-7am}$	-	-	54
Night-Time Noise Criteria ($L_{eq,9hr} + 5$)	$L_{max, average 15}$	-	-	59
Night-Time Noise Criteria ($L_{eq,9hr} + 10$)	$L_{max, single event}$	-	-	64
Design Noise Criteria	$L_{eq,adj,T} / L_{90}$	55	50	45
Design Noise Criteria	L_{max}	-	-	59

4.5 Assessment of Potential Noise Emissions

4.5.1 Vehicle Movements

Vehicle movements have been modelled as a moving line source, assuming a 1.5m source height and an average speed of 25 km/hr. Calculations assume a sound power level (SWL) of 90 dB(A), in line with the design range maximum for car activity¹. It is noted that under the BCC Noise Impact Assessment Planning Scheme Policy, assessment to L_{max} criteria specifically excludes noise from vehicle passes-by.

With reference to the traffic impact report for the proposed development (BMC Traffic report no. BMC18022, dated 5th September 2017), peak drive-thru activity of 122 trips/hr are expected. As a 'worst-case' assumption, calculations are based upon average movements of 85% of peak (amounting to 104 trips/hr) over the full assessment periods. Significant periods of relative inactivity are typically expected (particularly during the night period), and calculations are therefore considered to be conservative.

Vehicle movement noise emission forecasts are presented in **Table 7** below, along with the design noise criteria. The adjacent outdoor recreation area and child care centre are expected to only be in use during the daytime (7am – 6pm) period, and evening/night criteria has therefore not been assessed at these locations. Further details of the environmental noise model are presented in **Appendix B**.

Table 7: Noise emissions forecasts – vehicle movements. Levels are in dB(A) $L_{eq,adj,T}$. Exceedances highlighted

Receiver	Forecast	Design Noise Criteria			Assessment
		Day	Evening	Night	
R1	40	55	-	-	Pass
R2	49	55	50	45	+4 night
R3	49	55	50	45	+4 night
R4	47	55	50	45	+2 night
R5	45	55	50	45	Pass
R6	43	55	50	45	Pass
R7	51	55	-	-	Pass

As shown above, noise emissions from vehicle movements are forecast to meet criteria at all receivers during the daytime period, and in minor (2 – 4 dB(A)) exceedance of the night criteria at future aged care suites. To screen these future sensitive receivers from noise emissions, it is recommended that an acoustic canopy be constructed over part of the drive-thru area. This canopy is discussed in **Section 4.6**, and is predicted to achieve substantially more noise reduction than required to meet criteria. It is therefore concluded that – subject to construction of an acoustic canopy as discussed in **Section 4.6** – noise from drive-thru activity can meet the requirements of the Brisbane City Plan 2014, and not pose an undue risk to acoustic amenity in the locale.

¹ As per the Association of Australasian Acoustical Consultants: *Guideline for Child Care Centre Acoustic Assessment v2*
Noise Measurement Services Pty Ltd
Report 4279R2 12th December 2017

4.5.2 Delivery Activities

Truck deliveries to the proposed development are expected to be sporadic, and generally of too short a duration to control emissions as expressed by an L_{eq} over the whole assessment period. Nonetheless, these events may be impulsive in nature (including metal impacts from doors and trolleys), and cause noise nuisance despite their relatively brief duration.

As a 'worst-case' scenario, calculations assume one delivery event per hour over the entire assessment periods, although typical activity is expected to be much less frequent. The environmental noise model assumes a 1.5m source height, and a SWL of 87.1 dB(Z) L_{eq} - which includes a +5 dB adjustment for impulsiveness².

Truck delivery noise emission forecasts are presented in **Table 8** below, along with the design noise criteria. The adjacent outdoor recreation area and child care centre are expected to only be in use during the daytime (7am – 6pm) period, and evening/night criteria has therefore not been assessed at these locations. Further details of the environmental noise model are presented in **Appendix B**.

Table 8: Noise emissions forecasts – truck deliveries. Levels are in dB(A) $L_{eq,adj,T}$. Exceedances highlighted

Receiver	Forecast	Design Noise Criteria			Assessment
		Day	Evening	Night	
R1	42	55	-	-	Pass
R2	49	55	50	45	+4 night
R3	47	55	50	45	+2 night
R4	44	55	50	45	Pass
R5	41	55	50	45	Pass
R6	19	55	50	45	Pass
R7	24	55	-	-	Pass

As shown above, noise from truck deliveries is forecast to meet criteria at all receivers during the daytime and evening periods, and in minor (2 – 4 dB(A)) exceedance of night criteria at future aged care suites. Due to the risk of sleep disturbance from sporadic, impulsive events, it is recommended that deliveries be limited to the daytime and evening periods (7am – 10pm). Subject to this restriction, it is concluded that noise emissions from truck deliveries can meet the requirements of the Brisbane City Plan 2014, and not pose an undue risk to acoustic amenity in the locale.

² As per the Soundplan 7.0 database for truck loading (piece goods): final duty cycle with a +5 dB adjustment

4.5.3 ‘Slamming’ Car Doors

Assessment of car door noise emissions is problematic due to the high degree of uncertainty surrounding the frequency and intensity of ‘slamming’ events. It is practically unknowable how often – and how hard – individuals may shut their car doors. In theory, ‘slamming’ is not a necessary outcome of car park activity, and should be preventable through active management. In practice, enforcement can be difficult, and ‘slam’ events are likely to occur at times, although infrequently.

As a conservative assumption, potential noise emissions have been forecast from two ‘worst-case’ locations, and assessed against the ‘average of the highest 15’ L_{max} criteria. It is not expected that 15 slam events would occur during a single night period from these (or adjacent) parks, although the precise distribution of car door events is essentially unknowable. Door closures have not been assessed during the daytime or evening periods, as these events are considered too infrequent and brief to be meaningfully expressed by the $L_{eq,adj,T}$ descriptor.

Noise forecasts assume a source height of 1.5m, and a SWL of 97.9 dB(Z) – including a +5 dB adjustment for impulsiveness³. Car door noise emission forecasts are presented in **Table 9** below, along with the design noise criteria. The adjacent outdoor recreation area and child care centre are expected to only be in use during the daytime (7am – 6pm) period, and these locations have therefore not been assessed. Further details of the environmental noise model are presented in **Appendix B**.

Table 9: Noise emissions forecasts – car door ‘slams’. Levels are in dB(A) $L_{max,adj,T}$.

Receiver	Forecast	Design Noise Criteria			Assessment
		Day	Evening	Night	
R2	58	-	-	59	Pass
R3	56	-	-	59	Pass
R4	53	-	-	59	Pass
R5	50	-	-	59	Pass
R6	49	-	-	59	Pass

As shown above, noise emissions from car door ‘slams’ are forecast to meet the ‘average of the highest 15’ L_{max} criteria at the future neighbouring aged care centre. On this basis, it is concluded that noise from car door closures can meet the requirements of the Brisbane City Plan 2014, and does not represent an undue risk to acoustic amenity in the locale.

³ Calculated from measurements previously undertaken by NMS of a 4WD door closure at full force

4.5.4 Vocal Activity

Noise from customer activity – such as talking and laughing – is expected to generate intermittent and relatively brief noise emissions. As a worst-case scenario, environmental noise calculations assume simultaneous and continuous activity over the entire assessment periods, although significant durations of relative inactivity are typically expected. Forecasts as expressed by the $L_{eq,adj,T}$ descriptor are therefore considered to be conservative.

Calculations assume a 1.5m source height, and a SWL of 72.4 dB(Z), corresponding with design noise levels for a ‘raised male voice’⁴. Calculations have been conducted concurrently, to account for reinforcement between sources. It is noted that under the BCC Noise Impact Assessment Planning Scheme Policy, assessment to L_{max} criteria specifically excludes ‘people noise’.

Car door noise emission forecasts are presented in **Table 10** below, along with the design noise criteria. The adjacent outdoor recreation area and child care centre are expected to only be in use during the daytime (7am – 6pm) period, and these locations have therefore not been assessed during the evening and night periods. Further details of the environmental noise model are presented in **Appendix B**.

Table 10: Noise emissions forecasts – vocal activity. Levels are in dB(A) $L_{eq,adj,T}$.

Receiver	Forecast	Design Noise Criteria			Assessment
		Day	Evening	Night	
R1	34	55	-	-	Pass
R2	41	55	50	45	Pass
R3	43	55	50	45	Pass
R4	40	55	50	45	Pass
R5	38	55	50	45	Pass
R6	36	55	50	45	Pass
R7	44	55	-	-	Pass

As shown above, noise emissions from vocal activity are forecast to meet criteria at all receivers during all periods. On this basis, it is concluded that customer noise can meet the requirements of the Brisbane City Plan 2014, and does not represent an undue risk to acoustic amenity in the locale.

⁴ As per “Handbook of Acoustical Measurements and Noise Control” -3rd Ed, Chapter 16.3 by Harris, CM (Mc-Graw-Hill Inc).
Noise Measurement Services Pty Ltd
Report 4279R2 12th December 2017

4.5.5 Drive-Thru Intercom

It is understood that drive-thru intercoms can be adjusted for volume, and are therefore able to be directly managed through appropriate configuration. Nonetheless, it may be desirable to have the intercom set at a comparatively high volume, to prevent miscommunication which can extend the duration of noise generating activity. Assessment has therefore been conducted to a 'realistic worst-case' scenario assuming a SWL of 91 dB(Z) L_{eq} and 105.7 dB(Z) L_{max} – both including a +5 dB adjustment for impulsiveness⁵. Emissions have been modelled at a source height of 1.5m, and as a conservative measure, continuous L_{eq} activity has been assumed.

Intercom noise emission forecasts are presented in **Table 11** below, along with the design noise criteria. The adjacent outdoor recreation area and child care centre are expected to only be in use during the daytime (7am – 6pm) period, and these locations have therefore not been assessed during the evening and night periods. Further details of the environmental noise model are presented in **Appendix B**.

Table 11: Noise emissions forecasts – drive-thru intercom. Levels are in dB(A). Exceedances highlighted

Receiver	Descriptor	Forecast	Design Noise Criteria			Assessment
			Day	Evening	Night	
R1	$L_{eq,adj,T}$	45	55	-	-	Pass
R2	$L_{eq,adj,T}$	55	55	50	45	+10 night
R3	$L_{eq,adj,T}$	56	55	50	45	+11 night
R4	$L_{eq,adj,T}$	53	55	50	45	+8 night
R5	$L_{eq,adj,T}$	49	55	50	45	+4
R6	$L_{eq,adj,T}$	46	55	50	45	+1
R7	$L_{eq,adj,T}$	36	55	-	-	Pass
R2	L_{max}	71	-	-	59	+12
R3	L_{max}	73	-	-	59	+14
R4	L_{max}	69	-	-	59	+10
R5	L_{max}	66	-	-	59	+7
R6	L_{max}	63	-	-	59	+4

As shown above, potential noise emissions from the drive-thru intercom are forecast in significant exceedance of criteria. It is therefore recommended that an acoustic canopy be constructed over the order point area in order to screen the upper stories of future aged care suites. This acoustic canopy is discussed in **Section 4.6** below, and is calculated to provide more than 14 dB(A) of noise reduction to the most affected receivers. It is therefore concluded that – with the construction of an acoustic canopy as discussed in **Section 4.6** – noise emissions from the drive-thru intercom can be controlled to meet the requirements of the Brisbane City Plan 2014, and not pose an undue risk to acoustic amenity in the locale.

⁵ Representing the highest of the range of drive-thru intercoms previously measured by NMS.

4.5.6 Air Conditioning / Mechanical Plant

It is expected that the proposed development will incorporate air conditioning and mechanical ventilation, although the precise model and siting of plant has not been determined at the Development Approval stage. To meet the requirements of the Brisbane City Plan 2014, it is recommended that plant be selected, installed and (if necessary) screened to not exceed 45 dB(A) at nearby sensitive receivers. This may be achievable through acoustic screening of external plant, in accordance with Acceptable Outcome **AO1.2** of the Centre or Mixed Use Code. However, it is noted that ongoing legislative requirements also exist under the *Environmental Protection Act 1994* – although the required criteria is less stringent than BBC criteria – and it is further recommended that plant be maintained to meet EPA 1994 requirements at all times.

Detailed calculations of air conditioning noise emissions can be conducted at the Building Approval stage, once specific equipment and installation has been determined, although the relevant criteria are considered to be readily achievable through appropriate plant selection and installation.

4.6 Recommended Acoustic Canopy

As shown in **Section 4.5.5**, noise emissions from the drive-thru intercom are forecast in significant excess of criteria. It is therefore recommended that an acoustically rated fence and canopy be constructed along part of the northern boundary, as presented in **Plate 10** below.

Plate 10: Showing the extent of the recommended acoustic canopy



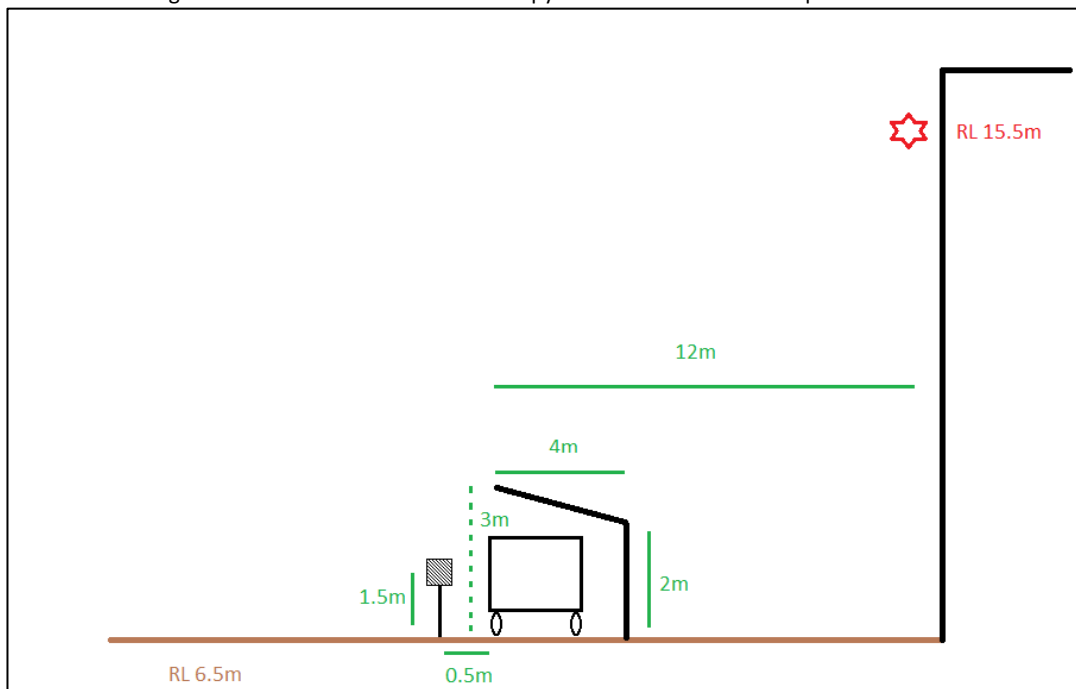
To effectively function as an acoustic barrier, the fence and canopy system should be continuous and gap-free, and have a density of not less than 12.5 kg/m². Other engineering constraints (such as wind loading) may apply, and we therefore do not recommend specific materials or designs, other than it being fit for purpose, gap-free, and at least 12.5 kg/m². An indicative cantilevered roof system is presented in **Plate 11** below.

Plate 12: Showing an indicative cantilevered acoustic canopy and fence system



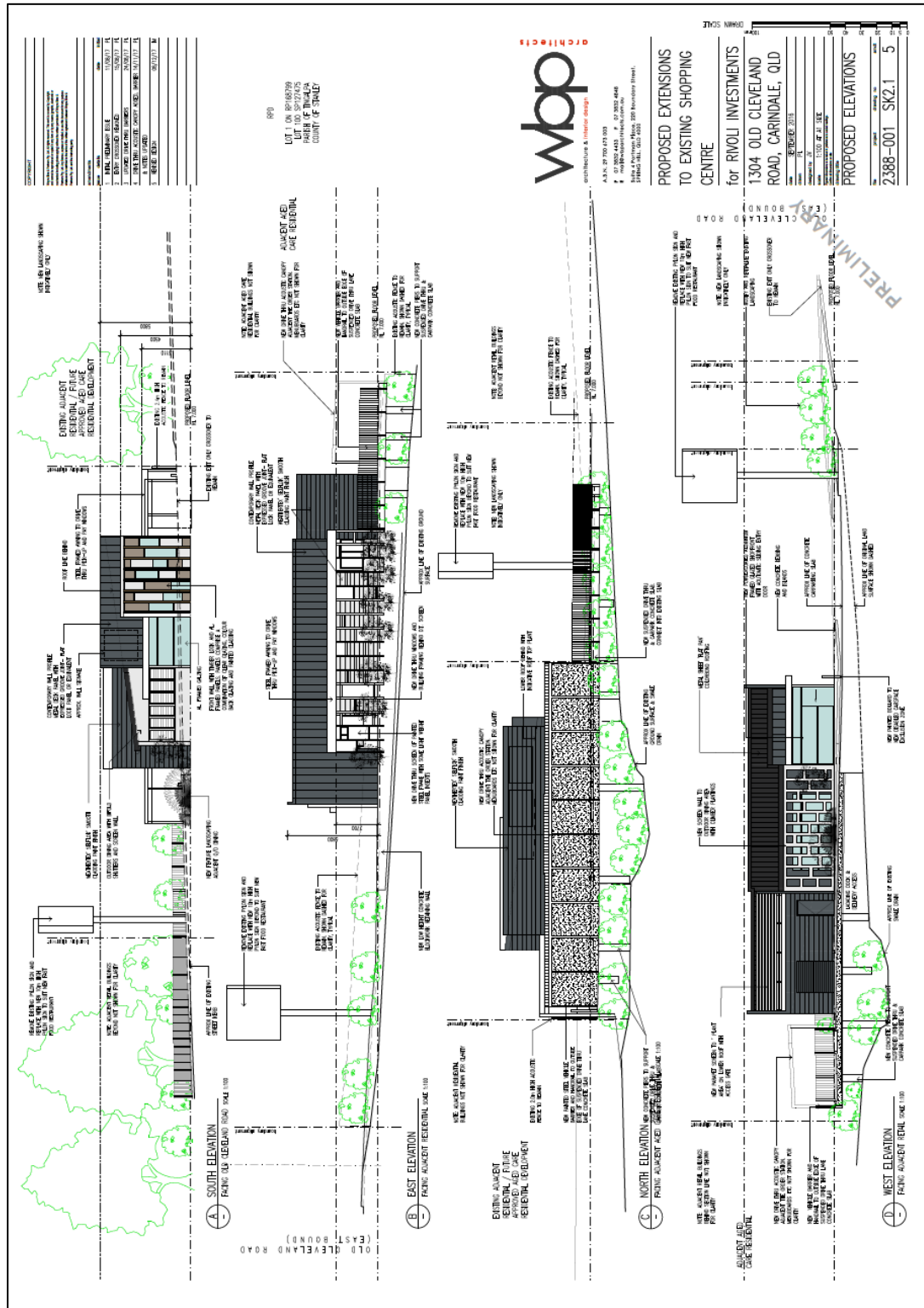
Screening from horizontal plane barriers is a limitation of the environmental noise modelling software used in noise emissions predictions. The potential screening from this acoustic canopy has therefore been calculated separately, based upon the transmission path to the most affected receiver (R3). Assumptions for the screening calculations are presented in **Plate 13** below.

Plate 13: Showing a cross-section of the acoustic canopy barrier calculation assumptions



Appendix A: Plans





Appendix B: Environmental Noise Model

Noise predictions been prepared with PEN3D, a software program implementing a prediction model based on the method described in Bies & Hansen, *ISO 9613-2 (1996) Acoustics – Attenuation of sound propagation outdoors Part 2: General Method of Calculation* and *CONCAWE*. The model takes into account meteorological factors, and predictions assume neutral conditions. The basic equation adopted is-

$$L_p = L_w - 20 \log_{10}(r) - 10 \log_{10}(4\pi) + AE$$

Where:

- L_p is the sound pressure level at an observer
- L_w is the sound power level of the source
- $20 \log_{10}r - 10 \log_{10}(4\pi)$ is the Distance attenuation (spherical)
- AE is the excess attenuation factors and is determined as the sum of the contributions

All prediction models have limits to their accuracy of prediction. This is due to the inherent nature of the calculation algorithms that go into the design of the models, the assumptions made in the implementation of the model, and the availability of good source sound power data. Various researchers have suggested that an uncalibrated model has an accuracy of ± 5 dB while a calibrated model has an accuracy of ± 2 dB. ISO 9613-2 has an estimated accuracy for broadband noise of ± 3 dB at 1000 metres. Calibration means that the model has been established with reference to measured sound levels at a receiver, known source levels and tightly defined propagation variables. Alternatively a series of predictions with different programs but the same assumption variables can be used for verification purposes. Meteorological effects are included in calculations, but are not considered significant at the distances involved. Topographic data was sourced from Geosciences Australia, cross-checked with BCC contours and development plans. Sound power levels are presented in **Table B1** below.

Table B1: Source sound power levels

1/1 Octave Sound Power Levels in dB(Z)									Total in dB(A)
Name	63 Hz	125 Hz	250 Hz	500 Hz	1kHz	2 kHz	4 kHz	8 kHz	
Vehicle movements	83.0	89.9	83.6	81.0	83.5	85.3	81.3	78.4	90.0
Truck unloading*	78.2	78.1	77.6	78.2	78.0	77.8	78.0	78.1	85.0
Car door slam*	87.6	91.7	87.5	88.9	92.5	86.8	85.1	83.3	95.4
Raised male voice	43.7	38.1	37.6	39.7	71.0	66.8	50.5	41.6	72.8
Intercom L_{eq} *	83.0	82.0	80.0	84.0	84.0	84.0	74.0	74.0	88.9
Intercom L_{max} *	91.0	88.0	84.0	94.0	105.0	87.0	78.0	78.0	105.3
Sound Pressure Levels at 1m									Total in dB(A)
Vehicle Movements	75.2	82.1	75.8	73.2	75.7	77.5	73.5	70.6	
Truck unloading*	70.4	70.3	69.8	70.4	70.3	70.0	70.3	70.3	77.2
Car door slam*	79.8	83.9	79.7	81.1	84.7	79.0	77.3	75.5	87.6
Raised male voice	35.9	30.3	29.8	31.9	63.2	59.0	42.7	33.8	65.0
Intercom L_{eq} *	75.2	74.2	72.2	76.2	76.2	76.2	66.2	66.2	81.1
Intercom L_{max} *	83.2	80.2	76.2	86.2	97.2	79.2	70.2	70.2	97.5

* Includes a +5 dB adjustment for impulsiveness

Results from the environmental noise model are presented in the following **plates** and **tables**.

Table B2: Receiver point calculations, vehicle movements. Levels are in dB(A) $L_{eq,adj,T}$

POINT CALCULATIONS					
Pen3D2000 V 1.9.32					
Project Code: 4279					
Project Description: Noise assessment of 1304 Old Cleveland Road, Carindale					
File:D:\UZ Drive\4279 1304 Old Cleveland Road, Carindale - Commercial\Model\4279 vehicles.PEN					
Thursday 30 Nov, 2017 at 09:42:28					
Environmental Calculations (Moving Line Source)					
All moving line sources included. Line source segmentation angle: 10 degrees. Calculations for specified meteorology.					
Noise level results include the Leq (1 hour) of all noise sources					
Meteorology :Wind speed 0.0 (m/s) Wind direction 0 Mast height 10.0 (m) Temperature 20.0 (C) Temperature Gradient 0.0 (C/100m) Humidity 50.0 (%)					
Surface Roughness of terrain 0.023000000 (m) Zero plane offset 0.080000000 (m)					
Receptor	X Posn (m)	Y Posn (m)	Height (m)	Noise Level (dB(A))	
R1	511508.7	6957990.7	9.8	39.5	
R2	511539.8	6957979.6	15.5	48.7	
R3	511549.5	6957800.8	15.5	48.9	
R4	511560.8	6957983.1	15.5	47.2	
R5	511573.0	6957984.1	15.5	44.5	
R6	511583.9	6957982.6	15.5	42.5	
R7	511568.2	6957951.3	7.5	51.0	

Table B3: Receiver point calculations, truck deliveries. Levels are in dB(A) $L_{eq,adj,T}$

POINT CALCULATIONS					
Pen3D2000 V 1.9.32					
Project Code: 4279					
Project Description: Noise assessment of 1304 Old Cleveland Road, Carindale					
File:D:\UZ Drive\4279 1304 Old Cleveland Road, Carindale - Commercial\Model\4279 deliveries.PEN					
Monday 30 Oct, 2017 at 19:02:06					
Environmental Calculations					
All point and line sources included. Line source segmentation angle: 10 degrees. Calculations for specified meteorology.					
Noise level results are the logarithmic addition of all the noise sources Noise level results incorporate the incoherent ground reflection algorithm					
Meteorology :Wind speed 0.0 (m/s) Wind direction 0 Mast height 10.0 (m) Temperature 20.0 (C) Temperature Gradient 0.0 (C/100m) Humidity 50.0 (%)					
Surface Roughness of terrain 0.023000000 (m) Zero plane offset 0.080000000 (m)					
Receptor	X Posn (m)	Y Posn (m)	Height (m)	Ground (m)	Noise Level (dB(A))
R1	511508.7	6957990.7	9.8	7.7	41.7
R2	511539.8	6957979.6	15.5	5.2	49.0
R3	511549.5	6957980.8	15.5	4.9	47.2
R4	511560.8	6957983.1	15.5	4.0	44.1
R5	511573.0	6957984.1	15.5	4.3	41.4
R6	511583.9	6957982.6	15.5	4.2	19.1
R7	511568.2	6957951.3	7.5	6.3	23.6

Table B4: Receiver point calculations, car door slam. Levels are in dB(A) $L_{max,adj}$

POINT CALCULATIONS					
Pen3D2000 V 1.9.32					
Project Code: 4279					
Project Description: Noise assessment of 1304 Old Cleveland Road, Carindale					
File:D:\UZ Drive\4279 1304 Old Cleveland Road, Carindale - Commercial\Model\4279 car door.PEN					
Thursday 30 Nov, 2017 at 10:09:48					
Environmental Calculations					
All point and line sources included. Line source segmentation angle: 10 degrees. Calculations for specified meteorology.					
Noise level results are the maximum of all the noise sources Noise level results incorporate the incoherent ground reflection algorithm					
Meteorology :Wind speed 0.0 (m/s) Wind direction 0 Mast height 10.0 (m) Temperature 20.0 (C) Temperature Gradient 0.0 (C/100m) Humidity 50.0 (%)					
Surface Roughness of terrain 0.023000000 (m) Zero plane offset 0.080000000 (m)					
Receptor	X Posn (m)	Y Posn (m)	Height (m)	Ground (m)	Noise Level (dB(A))
R2	511539.8	6957979.6	15.5	6.1	57.7
R3	511549.5	6957800.8	15.5	5.0	55.7
R4	511560.8	6957983.1	15.5	4.0	53.1
R5	511573.0	6957984.1	15.5	4.3	49.7
R6	511583.9	6957982.6	15.5	4.2	49.1

Table B5: Receiver point calculations, vocal activity. Levels are in dB(A) $L_{eq,adj,T}$

POINT CALCULATIONS					
Pen3D2000 V 1.9.32					
Project Code: 4279					
Project Description: Noise assessment of 1304 Old Cleveland Road, Carindale					
File:D:\Z Drive\4279 1304 Old Cleveland Road, Carindale - CommercialModel\4279 voices.PEN					
Monday 30 Oct, 2017 at 20:28:55					
Environmental Calculations					
All point and line sources included. Line source segmentation angle: 10 degrees. Calculations for specified meteorology.					
Noise level results are the logarithmic addition of all the noise sources Noise level results incorporate the incoherent ground reflection algorithm					
Meteorology :Wind speed 0.0 (m/s) Wind direction 0 Mast height 10.0 (m) Temperature 20.0 (C) Temperature Gradient 0.0 (C/100m) Humidity 50.0 (%)					
Surface Roughness of terrain 0.023000000 (m) Zero plane offset 0.080000000 (m)					
Receptor	X Posn	Y Posn	Height	Ground	Noise Level
	(m)	(m)	(m)	(m)	(dB(A))
R1	511508.7	6957990.7	9.8	7.5	34.3
R2	511539.8	6957979.6	15.5	6.1	41.2
R3	511549.5	6957980.8	15.5	4.9	42.8
R4	511560.8	6957983.1	15.5	4.2	40.4
R5	511573.0	6957984.1	15.5	4.3	37.7
R6	511583.9	6957982.6	15.5	4.2	35.8
R7	511568.2	6957951.3	7.5	6.2	44.4

Table B6: Receiver point calculations, drive-thru intercom. Levels are in dB(A) $L_{eq,adj,T}$

POINT CALCULATIONS					
Pen3D2000 V 1.9.32					
Project Code: 4279					
Project Description: Noise assessment of 1304 Old Cleveland Road, Carindale					
File:D:\Z Drive\4279 1304 Old Cleveland Road, Carindale - CommercialModel\4279 drivethru.PEN					
Monday 30 Oct, 2017 at 21:50:44					
Environmental Calculations					
All point and line sources included. Line source segmentation angle: 10 degrees. Calculations for specified meteorology.					
Noise level results are the logarithmic addition of all the noise sources Noise level results incorporate the incoherent ground reflection algorithm					
Meteorology :Wind speed 0.0 (m/s) Wind direction 0 Mast height 10.0 (m) Temperature 20.0 (C) Temperature Gradient 0.0 (C/100m) Humidity 50.0 (%)					
Surface Roughness of terrain 0.023000000 (m) Zero plane offset 0.080000000 (m)					
Receptor	X Posn	Y Posn	Height	Ground	Noise Level
	(m)	(m)	(m)	(m)	(dB(A))
R1	511508.7	6957990.7	9.8	7.5	45.2
R2	511539.8	6957979.6	15.5	6.1	54.6
R3	511549.5	6957980.8	15.5	5.0	55.7
R4	511560.8	6957983.1	15.5	4.3	52.5
R5	511573.0	6957984.1	15.5	4.3	48.8
R6	511583.9	6957982.6	15.5	4.2	46.4
R7	511568.2	6957951.3	7.5	6.2	35.5

Table B7: Receiver point calculations, drive-thru intercom. Levels are in dB(A) $L_{max,adj}$

POINT CALCULATIONS					
Pen3D2000 V 1.9.32					
Project Code: 4279					
Project Description: Noise assessment of 1304 Old Cleveland Road, Carindale					
File:D:\Z Drive\4279 1304 Old Cleveland Road, Carindale - CommercialModel\4279 drivethru lmax.PEN					
Monday 30 Oct, 2017 at 21:53:29					
Environmental Calculations					
All point and line sources included. Line source segmentation angle: 10 degrees. Calculations for specified meteorology.					
Noise level results are the maximum of all the noise sources Noise level results incorporate the incoherent ground reflection algorithm					
Meteorology :Wind speed 0.0 (m/s) Wind direction 0 Mast height 10.0 (m) Temperature 20.0 (C) Temperature Gradient 0.0 (C/100m) Humidity 50.0 (%)					
Surface Roughness of terrain 0.023000000 (m) Zero plane offset 0.080000000 (m)					
Receptor	X Posn	Y Posn	Height	Ground	Noise Level
	(m)	(m)	(m)	(m)	(dB(A))
R2	511539.8	6957979.6	15.5	6.1	71.4
R3	511549.5	6957980.8	15.5	5.0	72.5
R4	511560.8	6957983.1	15.5	4.3	69.2
R5	511573.0	6957984.1	15.5	4.3	65.5
R6	511583.9	6957982.6	15.5	4.2	63.1

Plate B1: Noise contours at 8.1m (Level 3 height) – vehicle movements. Levels are in dB(A), $L_{eq,adj,T}$



Plate B2: Noise contours at 8.1m (Level 3 height) – truck deliveries. Levels are in dB(A), $L_{eq,adj,T}$

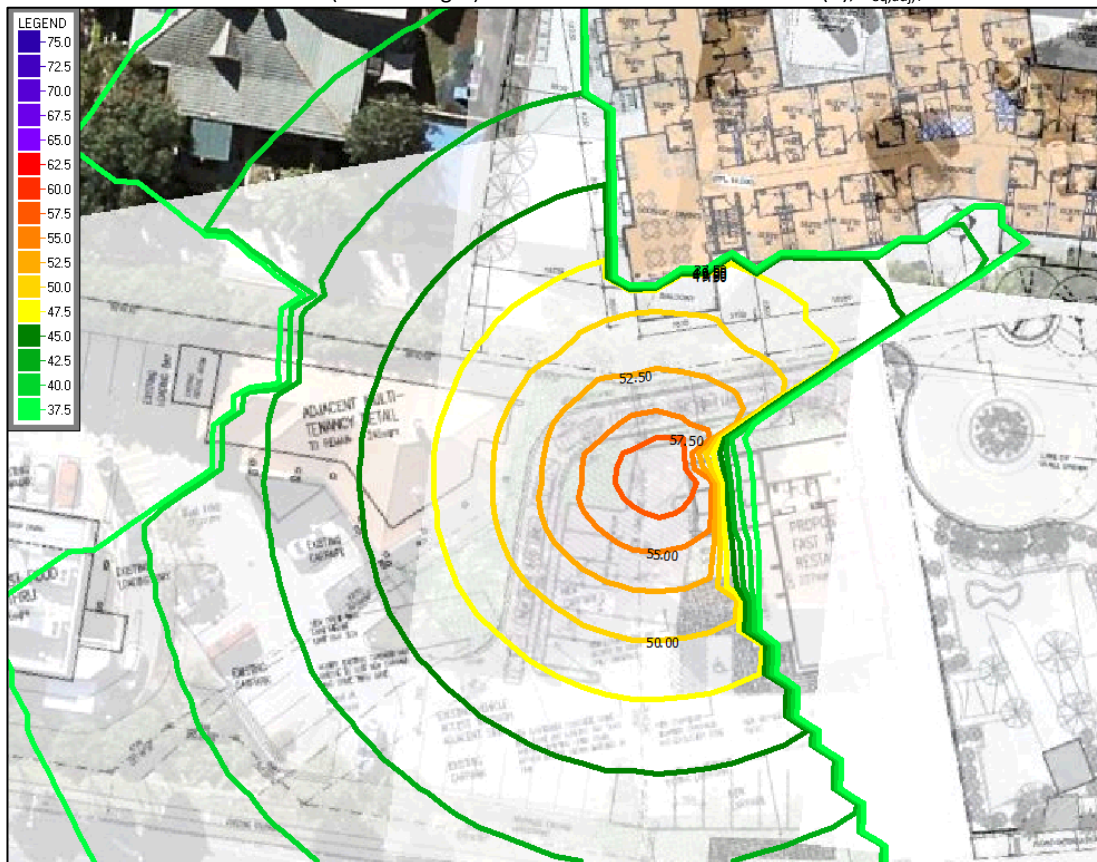


Plate B3: Noise contours at 8.1m (Level 3 height) – car door slam. Levels are in dB(A), $L_{max,adj}$

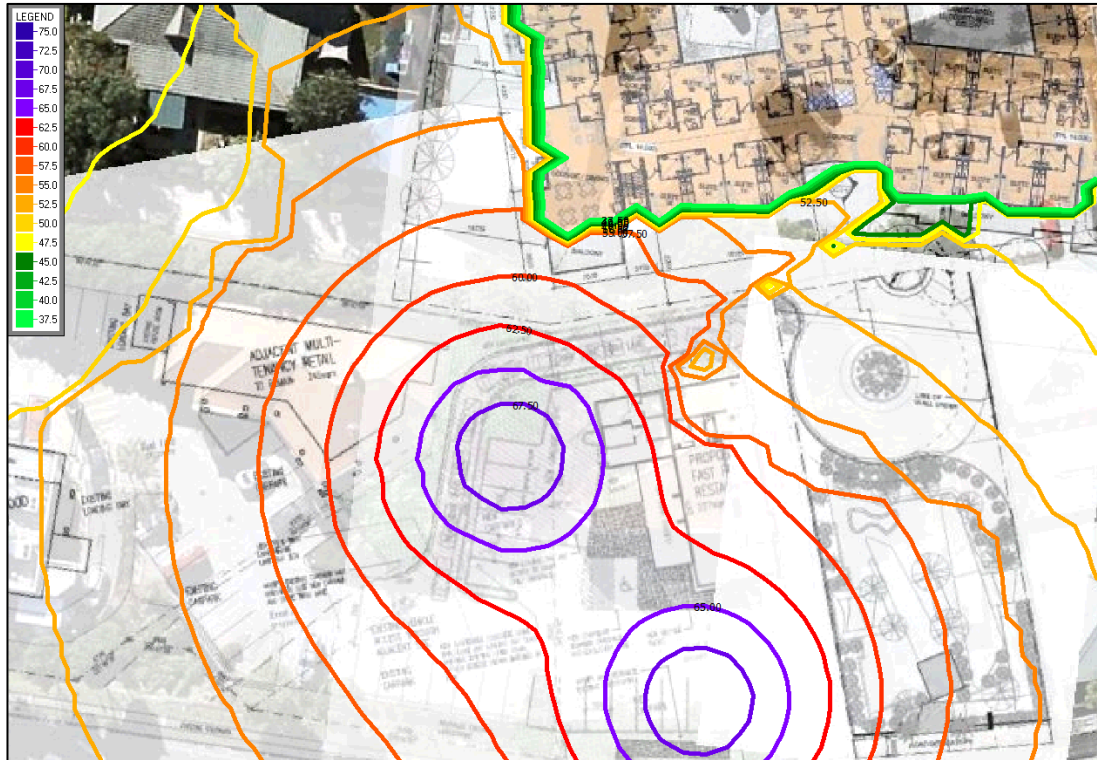


Plate B4: Noise contours at 8.1m (Level 3 height) – vocal activity. Levels are in dB(A), $L_{eq,adj,T}$

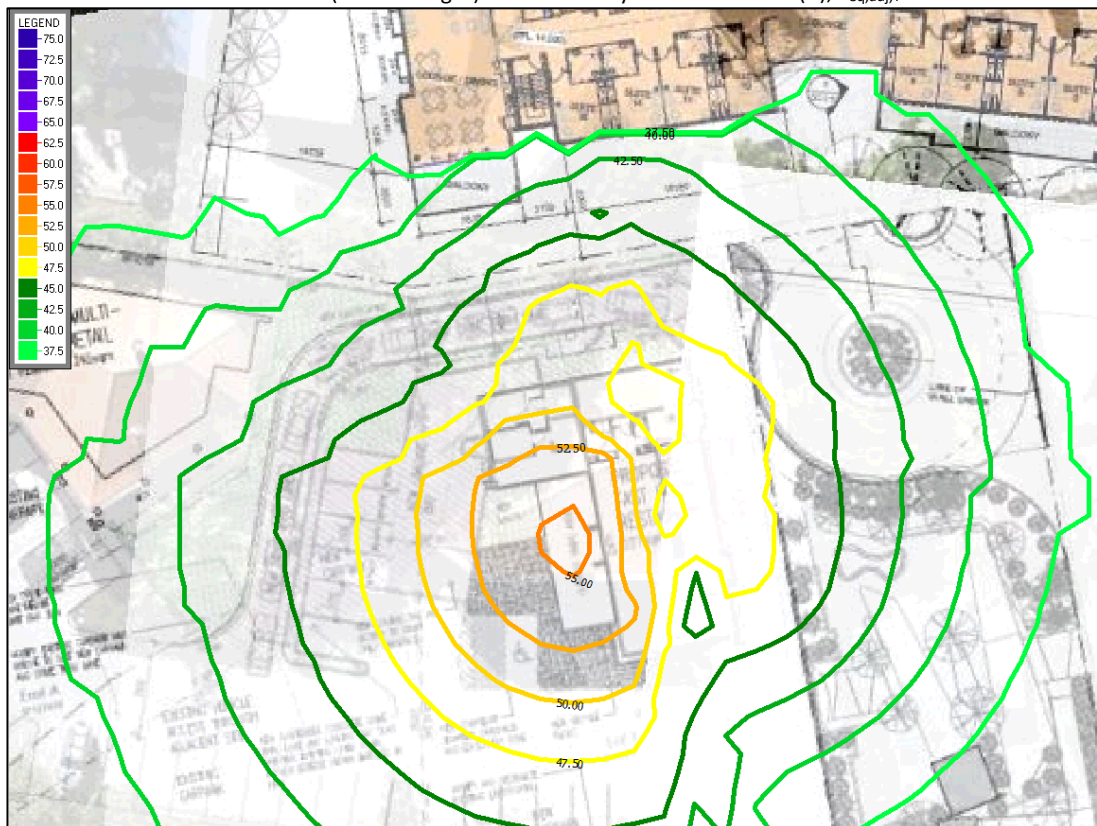


Plate B5: Noise contours at 8.1m (Level 3 height) – drive-thru intercom. Levels are in dB(A), $L_{eq,adj,T}$

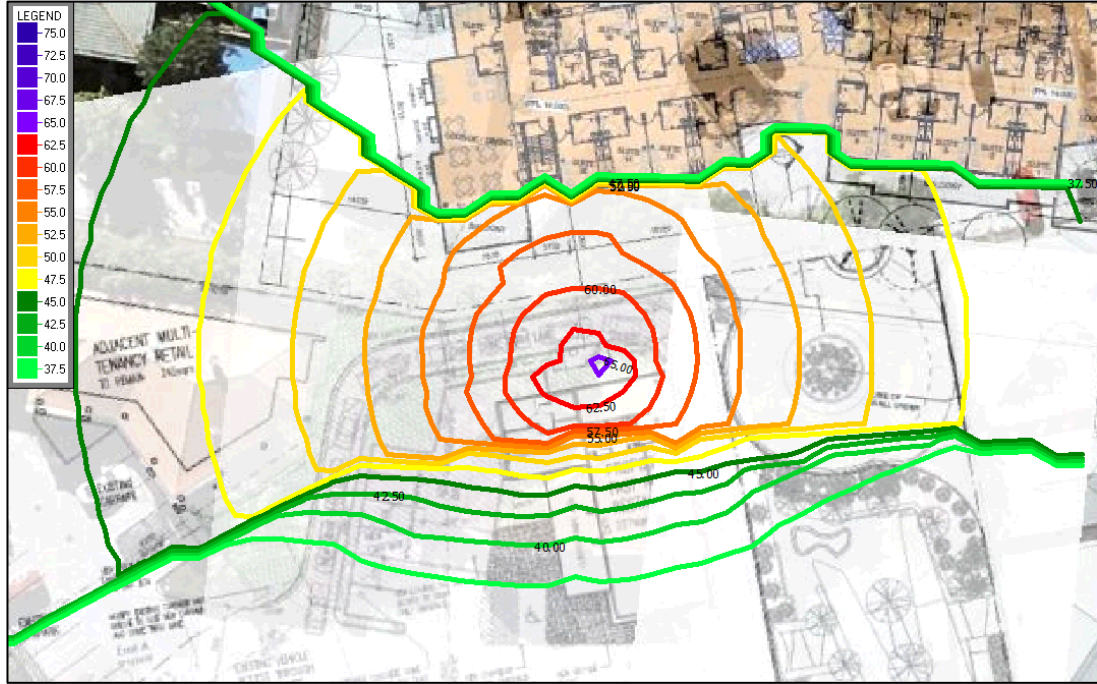
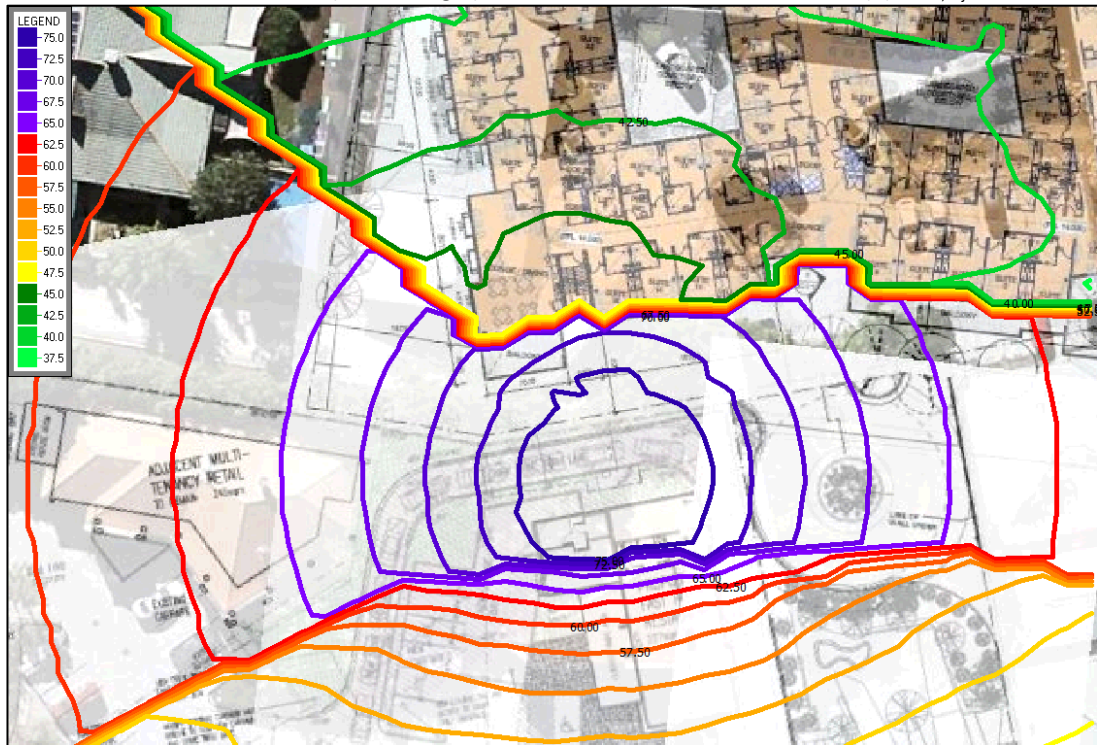


Plate B6: Noise contours at 8.1m (Level 3 height) – drive-thru intercom. Levels are in dB(A), $L_{max,adj}$



Appendix C: Glossary

“Peak” maximum level (LA_{max},T).

The peak maximum level is the absolute highest (1 second or less) sound level within the whole of the measurement time.

Event maximum sound pressure level (LA_{%adj},T), L01

The L01 level is calculated as the noise level equalled and exceeded for 1% of the measurement time, for example 9 seconds in any 15 minute interval. L01 is an appropriate level to characterise single events, such as from train bypass.

In this Report, the measured L01 levels for day/evening/night are not averaged but are arranged from low to high in the relevant day/evening/night interval and the value that is found at the 90th percentile (L10 of L01 sample) in the interval is recorded as its “L01” level.

Average maximum sound pressure level (LA_{%adj}, T), L10

The “L10” level is an indicator of “steady-state” noise or intrusive noise conditions from traffic, music and other relatively non-impulsive noise sources. The L10 level is calculated as the noise level equalled and exceeded for 10% the measurement time, for example 90 seconds in any 15 minute interval. The measured L10 time-intervals for day/evening/night are arithmetically averaged to present the “average maximum” levels of the environment for day/evening/night. The level can be adjusted for tonality or impulsiveness.

Background sound pressure level (LA₉₀,T), L90

Commonly called the “L90” or “background” level and is an indicator of the quietest times of day, evening or night. The L90 level is calculated as the noise level equalled and exceeded for 90% the measurement time. The measured L90 time-intervals are arithmetically averaged to present the “average background” levels of the environment for day/evening/night. The level is recorded in the absence of any noise under investigation. The level is not adjusted for tonality or impulsiveness.

Equivalent Continuous or time average sound pressure level (LA_{eq},T), Leq

Commonly called the “Leq” level it is the logarithmic average noise level from all sources far and near. The maximum 1-hour levels within the day/evening/night time intervals are referenced for building design. The level can be adjusted for tonality.

Façade-adjusted level

A sound level that is measured at a distance of 1.0 metre from a wall or facade. The level is nominally 2.5 dB higher than the free-field level.

Free-field level

A sound level that is measured at a distance of more than 3.5 metres from a wall or facade.