

**Proposed Mixed Use Development
61 Brookes Street, Bowen Hills**

Environmental Noise Assessment Report

PLANS AND DOCUMENTS
referred to in the PDA APPROVAL

14 OCT 2015

MEDQ

HG Developments Pty Ltd

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1. Introduction

1.1. Background

TTM Soundmatters has been engaged by HG Developments Pty Ltd to undertake an environmental noise assessment of a proposed mixed use development located at 61 Brookes Street, Bowen Hills. This report will form part of the development application for consideration by Department of State Development, Infrastructure and Planning (DSDIP). The assessment is based on and considers the following:

- a. Noise criteria outlined in:
 - i. *Bowen Hills Urban Development Area Development Scheme (July, 2009).*
 - ii. *Environmental Protection Policy – Noise 2008 (January, 2012) (EPP).*
 - iii. *Policy for Development on Land Affected by Environmental Emissions from Transport and Transport Infrastructure Version 2 dated 10 May, 2013.*
 - iv. *Queensland Development Code Mandatory Part 4.4 (August, 2010) (QDC).*
- b. Development plans by *Cottee Parker* dated July, 2015 (samples shown in Appendix A).
- c. Site inspection, noise measurements, analysis and calculations conducted by TTM.

1.2. Scope

The assessment includes the following:

- i. Description of the site.
- ii. Statement of assessment criteria relating to road traffic and rail noise, environmental on-site and off-site noise emissions.
- iii. Measurement of existing road traffic and ambient noise levels.
- iv. Prediction of future road traffic and rail noise levels at the development.
- v. Prediction of noise produced by the development onto nearby sensitive receivers.
- vi. Prediction of noise associated with surrounding commercial premises onto noise sensitive areas of the development.
- vii. Analysis of predicted noise levels.
- viii. Details of recommendations to be incorporated to achieve predicted compliance.

2. Site Description

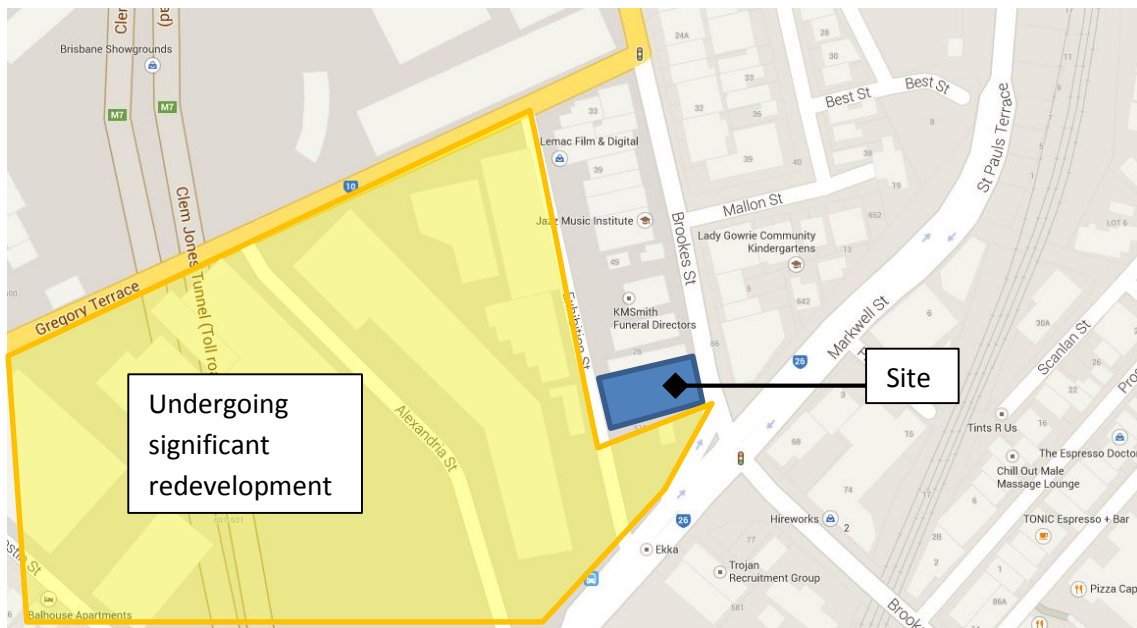
2.1. Site Location

The site is described by the following:

- Lot 4 on RP910687 and Lot 3 on RP910687.
- 61 Brookes Street, Bowen Hills

The site locality is shown in Figure 1.

Figure 1: Site Locality



2.2. Current Conditions Surrounding the Site

Brookes Street bounds the site to the east, with Exhibition Street to the west. There is a mixture of commercial tenancies to the north, east and south, with facilities from the Brisbane Showgrounds to the west of site, across Exhibition Street.

The site is primarily affected by road traffic noise on Saint Pauls Terrace, however, it is potentially affected by rail noise from the Queensland Rail Corridor located 140m south of site.

It is considered that impacts associated with typical commercial activities (i.e. car parking, conversations, etc.) will have negligible impact on the development due to the noise control design required from road traffic noise and rail noise. General off-site commercial activities were therefore not considered in this assessment.

3. The Proposed Development

3.1. Development Description

The proposal is to develop a 19 storey mixed use building with residential units and a commercial tenancy on the ground floor. The proposal includes the following:

Floor Levels	Uses
Ground Floor to Level 04 Podium	Car park spaces for residents, visitors and retail staff
Level 05 to 17	Typical residential floor with a mix of 1 and 2 bedroom apartments with approximately 10 apartments per floor
Rooftop	Communal area, pool area and plant room.

A sample of the development plans is shown in Appendix A.

3.2. Hours of Operation

This assessment has assumed operating times of the retail tenancies of 24 hours a day, 7 days a week. Recommendations shall provide time restrictions on activities which are predicted to exceed the criteria if required.

3.3. Access

The development plan proposes access to parking, commercial vehicles and waste collection from Exhibition Street, west of site

4. Noise Sensitive Receivers and Off-Site Premises

4.1. Residential Receivers

The area surrounding the site consists of mostly commercial and retail premises with a mixed use building across Brookes Street. This assessment will focus on the sensitive receivers as outlined below:

- Receiver 1: 44 Brookes Street, multiple storey mixed use building, approximately 40m from site.
- Receiver 2: 642 Saint Pauls Terrace, detached two storey dwelling, approximately 65m from site.
- Receiver 3: 53 Brookes Street, detached 2 storey funeral service (commercial), approximately 3m from site.
- Receiver 4: 76 Brooke Street, Fortitude Valley State School, approximately 130m from site.

The receiver location is shown in Figure 2.

Figure 2: Noise Sensitive Receivers

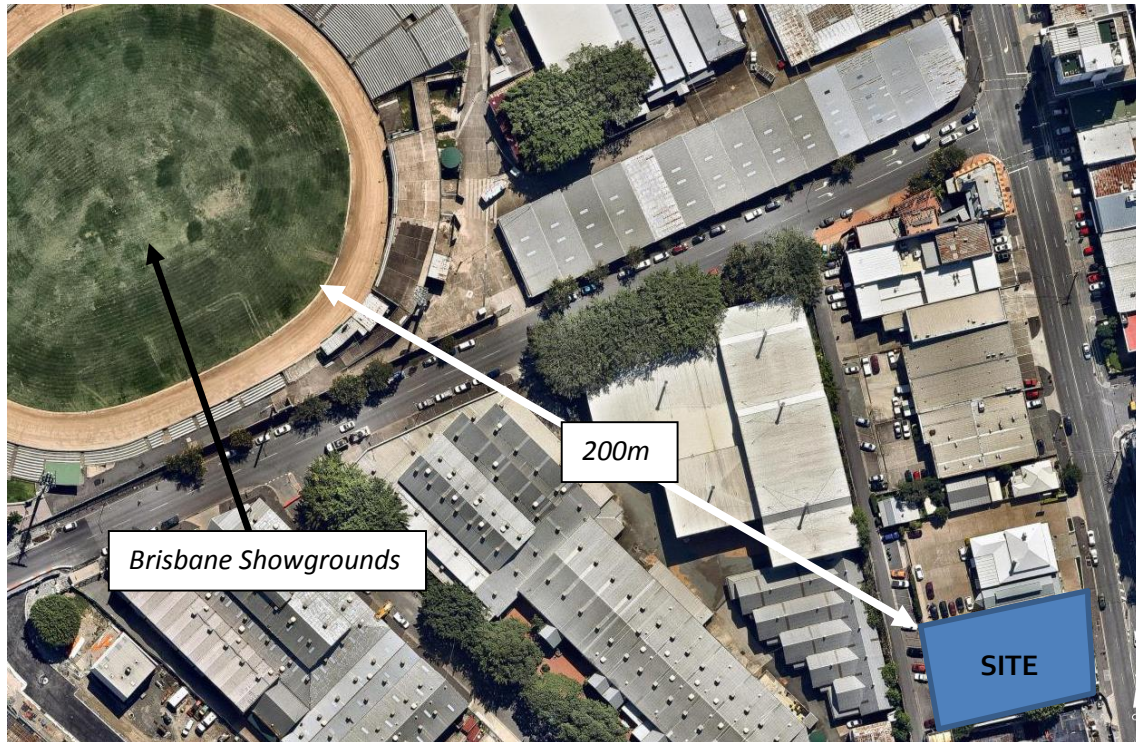


If compliance can be achieved at the residential receivers above, compliance is predicted at all remaining noise sensitive locations.

4.2. Off-Site Activities

Consideration has been given to the potential off-site activities associated with the Brisbane Showgrounds premises (refer to Figure 3).

Figure 3: Nearest Off-Site Commercial Premises



Major events take place in the Brisbane Showgrounds. Music events like Soundwave and major events such as the Ekka were considered as off-site activities that could impact amenity of the proposed development and were assessed in this report.

It is important to note that the frequency of the major events varies throughout the year, and it is considered that a major event occurring once per month or less should not be classified as a major source of noise in the locality.

5. Equipment and Measurements

Noise monitoring could not be conducted due to the interference from construction noise in the area surrounding the site.

In lieu of ambient noise levels, *Australian Standard AS1055.2-1997 Acoustics-Description and measurement of environmental noise* can be utilised where actual noise measurements at the site cannot be obtained. The site is considered to be located in Noise Area Category 4 and as per Appendix A of *AS1055.2* the estimated average background A-weighted sound pressure levels ($L_{A90,T}$) for the site is detailed below.

Table 1: Estimated Average Background for Different Areas Containing Residences in Australia

Noise Area Category	Description of neighbourhood	Average background A-weighted sound pressure level, $L_{A90,T}$					
		Monday to Saturday			Sundays and public holidays		
		0700-1800	1800-2200	2200-0700	0700-1800	1800-2200	2200-0700
R4	Areas with dense transportation or some commerce or industry	55	50	45	55	50	45

These estimated levels will be used to determine the EPP2008 criteria for background creep.

5.1. On-site Transient Activity Noise Measurements

Noise levels associated with typical commercial activities were taken from similar investigations performed by Soundmatters and used in this assessment. All measurements were conducted in accordance with *AS1055:1997 Acoustics – Description & Measurement of Environmental Noise (AS1055)*.

5.2. Road Traffic and Rail Noise Measurements

As discussed previously, due to extraneous noise from the surrounding construction, up to date unattended noise monitoring could not be conducted to reaffirm TTM Soundmatters' road traffic and rail models. Therefore existing models previously prepared and verified models (since 2010) of road traffic and rail noise were validated using previously verified models of the locality where has been involved.

5.3. Results of Measurements

5.3.1. Measured Road Traffic Noise Levels

Table 2 presents the measured road traffic noise levels at the unattended noise monitoring locations of previously verified noise models prepared by TTM Soundmatters.

Table 2: Measured Road Traffic Noise Levels

Location & Date	Road Traffic Noise Descriptor	Time Period	Measured Level dB(A)
Saint Pauls Terrace, - February 2014	L _{A10,18hr}	6am to midnight	73.6
	Noisiest day-time L _{Aeq,1 hour}		73.1
	Noisiest night-time L _{Aeq,1 hour}		72.3
	L _{Aeq,24 hour}	Midnight to midnight	71.4
Hamilton Place, - June 2010	L _{A10,18hr}	6am to midnight	73
	Noisiest day-time L _{Aeq,1 hour}		73
	Noisiest night-time L _{Aeq,1 hour}		69
	L _{Aeq,24 hour}	Midnight to midnight	70
Campbell St/Markwell St Intersection – July 2010	L _{A10,18hr}	6am to midnight	72
	Noisiest day-time L _{Aeq,1 hour}		72
	Noisiest night-time L _{Aeq,1 hour}		67
	L _{Aeq,24 hour}	Midnight to midnight	69

The decimal place is detailed to show the rounding corrections used throughout the analysis.

5.4. Measured Rail Noise Levels

Table 3 presents the measured free-field rail noise levels taken from a previous assessment close to the rail line and are considered to be representative of train types, speed and consequent noise levels on this rail line.

Table 3: Measured Rail Noise Levels

Location/Date	Train Type	Approximate Distance to Rail Line (m)	Measured Level $L_{A\text{Max}}$ dB(A)	Measured Level SEL dB(A)
24 th November, 2010 Vicinity of the Bowen Hills Station	Passenger	17	94	96
	Passenger	8	95	97
	Passenger	8	86	92
	Passenger	3	88	90
	Passenger	8	92	95
	Passenger	12	84	84
	Passenger	17	85	91
	Passenger	17	74	84
	Passenger	12	85	88
	Passenger	17	90	93
	Passenger	3	88	93
	Passenger	17	76	84
	Passenger	12	74	82
	Passenger	3	73	81
	Passenger	8	90	94

An increase in rail traffic does not increase the maximum $L_{A\text{max}}$ noise levels; however it does increase the frequency of such occurrences and will increase the $L_{Aeq,24\text{hour}}$ noise level.

6. Noise Criteria

The following sections describe the criteria used to assess the acoustic impacts at the development and on surrounding noise sensitive receivers.

6.1. Road Traffic Noise

Road traffic noise levels are calculated as an outdoor level at the facade and then prescribed façade treatments to comply with internal noise levels for living, work and sleeping areas. The internal noise limits are the recommended design sound levels from AS2107 and are reproduced in Table 4.

Table 4: Internal Noise Limits for Residential Buildings from AS/NZS 2107:2000

Type of Occupancy / Activity	Recommended Maximum Design Sound Level, L_{Aeq} dB(A)
7. RESIDENTIAL BUILDINGS	
Houses and apartments near major roads -	
Living and working areas	45
Sleeping areas	40

Design calculations were conducted to determine typical façade treatment requirements for the development using the internal criteria stated above.

6.1.1. Queensland Development Code – Road Traffic Noise

The *Queensland Development Code Part MP 4.4 - 'Buildings in a Transport Noise Corridor'* September 2010 (QDC) specifies Noise Categories to ensure that habitable rooms of residential buildings are adequately protected from transport noise.

The Noise Categories list the minimum acoustic R_w ratings for each building component to comply with the indoor sound levels as outlined in Australian Standard AS2107. Details regarding the noise categories and acceptable forms of construction can be found within Schedule 1 and 2 of the QDC document. The triggers for each noise category are summarised in Table 5.

Table 5: Noise Category Levels – QDC MP4.4 (Schedule 3)

Noise Category	Level of Transport Noise* $L_{A10, 18 \text{ hour}}$ for State-Controlled Roads and Designated Local Government Roads
Category 4	≥ 73 dB(A)
Category 3	68 – 72 dB(A)
Category 2	63 – 67 dB(A)
Category 1	58 – 62 dB(A)
Category 0	≤ 57 dB(A)

* Measured at 1 metre from the façade of the proposed or existing building.

The noise categories presented in Table 5 were obtained from QDC and are applied to dwellings located within transport noise corridors.

As design calculations were performed for apartments of the site, it is considered that the QDC requirements are superseded.

6.2. Rail Noise - TMR

The *Policy for Development on Land Affected by Environmental Emissions from Transport and Transport Infrastructure* Version 2 dated 10 May, 2013 presents the noise criteria for the assessment of rail noise at a proposed development.

In accordance with the guide, the development should meet the external design level noise criteria of:

- 65 dB(A), assessed as the 24 hour average equivalent continuous L_{eq} A-weighted sound pressure level;
- 87 dB(A), assessed as a single event maximum L_{Max} sound pressure level when measured 1m from the most exposed part of the noise sensitive place.
- Furthermore, noise sensitive uses should be designed to achieve an indoor maximum sound level not greater than 45 dB(A) for living or sleeping areas.

6.2.1. Queensland Development Code

The Queensland Development Code Part MP 4.4 also specifies Noise Categories to ensure that habitable rooms of residential buildings are adequately protected from rail noise.

The noise categories relevant to rail noise are summarised in Table 6.

Table 6: Noise Category Levels – QDC MP4.4 Rail Noise (Schedule 3)

Noise Category	Single event maximum noise* ($L_{A_{Max}}$) for Railway Land
Category 4	≥ 85
Category 3	80 – 84
Category 2	75 – 79
Category 1	70 – 74
Category 0	≤ 69

* Measured at 1metre from the façade of the proposed or existing building.

The noise categories presented in Table 5 were obtained from QDC and are applied to apartments/floors/facade located within transport noise corridors.

As design calculations were performed for individual apartments of the site, it is considered that the QDC requirements are superseded.

6.3. Environmental Protection Policy (Noise) 2008

Noise emissions shall be assessed against the *Environmental Protection (Noise) Policy 2008* (EPP 2008). Details of the criteria and established noise limits are presented in the following sections.

6.3.1. EPP 2008 - Acoustic Quality Objectives

Table 7 below presents the acoustic quality objectives at noise sensitive receptors as detailed in Schedule 1 of the EPP2008.

Table 7: Acoustic Quality Objectives at Noise Sensitive Properties

Sensitive Receiver	Time of Day	Acoustic Quality Objectives, dB(A)		
		$L_{Aeq,adj,1hr}$	$L_{A10,adj,1hr}$	$L_{A1,adj,1hr}$
Dwelling (Outdoors)	Day and Evening (7am – 10pm)	50	55	65
Dwelling (Indoors)	Day and Evening (7am – 10pm)	35	40	45
	Night (10pm – 7am)	30	35	40
School (Indoors)	When open for business and when classes are being offered	35		
School or Playground (Outdoors)	When the children usually play outside	55		
Commercial and Retail activity (Indoors)	When the activity is open for business	45		

6.3.2. EPP 2008 - Background Creep

This criterion is to prevent background noise progressively increasing or creeping higher over time with the establishment of new developments in a locality. EPP2008 states that:

1. This section states the management intent for an activity involving noise.
2. To the extent that it is reasonable to do so, noise from an activity must not be—
 - a. for noise that is continuous noise measured by $L_{A90,T}$ —more than nil dB(A) greater than the existing acoustic environment measured by $L_{A90,T}$; or
 - b. for noise that varies over time measured by $L_{Aeq,adj,T}$ —more than 5dB(A) greater than the existing acoustic environment measured by $L_{A90,T}$.

In accordance with the Environmental Protection Regulation 2008, the time period (T) is considered to be a time interval of at least 15 minutes, or if the noise continues for less than 15 minutes, the duration of the noise source.

The Background Creep criteria for steady-state and transient noise sources are detailed below.

Table 8: Background Creep Noise Limits at Noise Sensitive Properties

Time Period	Steady-State Noise Emission Criteria, dB(A)	Time Varying Noise Emission Criteria, dB(A)
	$L_{A90,T}$	$L_{Aeq,T}$
Day (7am – 6pm)	55	60
Evening (6pm – 10pm)	50	55
Night (10pm – 7am)	45	50

The above steady-state criterion levels are quoted as a measured level, not a component level; hence, all plant proposed must be included in assessment. By designing plant noise to a measured level rather than a component level, the additive effect of multiple plant is taken into account.

6.4. Brisbane Exhibition Ground

No specific criterion exists for noise generated by the Brisbane Exhibition Grounds (RNA). We have therefore applied the sleep disturbance criteria from the World Health Organisation's "Guidelines for Community Noise" March 1999 and is summarised as follows:

"The effects of noise in dwellings, typically, are sleep disturbance, annoyance and speech interference. For bedrooms the critical effect is sleep disturbance. Indoor guideline values for bedrooms are 30dB L_{Aeq} for continuous noise and 45dB L_{Amax} for single sound events."

It is considered that the worst-case noise event emanating from the RNA are concerts. As these are infrequent events a criteria of 45dB L_{Amax} is considered to provide reasonable levels of acoustic amenity and was applied to the assessment of concert noise from the RNA.

7. Analysis - Road Traffic Noise

Section 7 relates to the assessment of road traffic noise impacting the proposed development presenting the assumptions and results of the modelling.

7.1. Traffic Volumes

The existing traffic volumes for the surrounding road network were obtained from TTM Data. Predicted traffic volumes for 2015 and 2025 are presented in Table 9 and are based upon a growth rate shown below as advised by TTM Traffic.

Table 9: Road Traffic Volumes of Surrounding Road Network

Road	Traffic Volume (AADT)			Heavy Vehicles (% AADT)	Growth Rate (% p.a.)
	2010	2015	2025		
Saint Pauls Terrace	18,075	19,956	24,327	4.0	2.0
Brookes Street	8,775	10,953	19,068	1.2	5.7

The 18 hour traffic volumes were used in the noise model which was approximated as 95% of the Average Annual Daily Traffic.

7.2. Noise Model

7.2.1. Noise Modelling Parameters

Road traffic noise predictions were conducted using 'SoundPLAN' v7.3, a CoRTN based modelling program. The basis of the 'SoundPLAN' model is as follows:

Table 10: Noise Modelling Parameters

Description	Value
Angle Increment	1°
Road surface type	Impervious (+0 dB(A))
Saint Pauls Terrace, Brookes Street	60km/h
Noise source height above grade	0.5m
Receiver heights	1.5m above floor level
Residential floor heights	3.0m
Façade correction	+2.5 dB(A)

7.2.2. Noise Model Verification

Due to the construction sites surrounding the proposed development valid road traffic noise measurements could not be obtained. Therefore, previously verified noise models prepared by TTM Soundmatters were adapted to include the subject site. To verify the road traffic noise prediction model, the $L_{10(18 \text{ hour})}$ noise level at the monitoring positions are calculated (using SoundPLAN) and compared to the measured level as presented in Table 11. The noise monitors were located in a free-field position and therefore the predicted level is also shown as free-field.

Table 11: Comparison of Measured and Predicted Road Traffic Noise Levels

Location	Measured $L_{A10, 18 \text{ hour}}$	Predicted $L_{A10, 18 \text{ hour}}$	Required Correction
Abbotsford Road	71.5	71.7	0
Saint Pauls Terrace	73.6	73.8	0

As the modelled levels are within the allowable tolerance of 2 dB(A) of the measured level, no correction is required to the model.

7.3. Predicted Road Traffic Noise Levels

The noise levels are based on the assumptions detailed in Section 7.2.1 with the results presented in Figure 4 to Figure 6.

Figure 4: Predicted Traffic Noise Impacts – Ground Floor

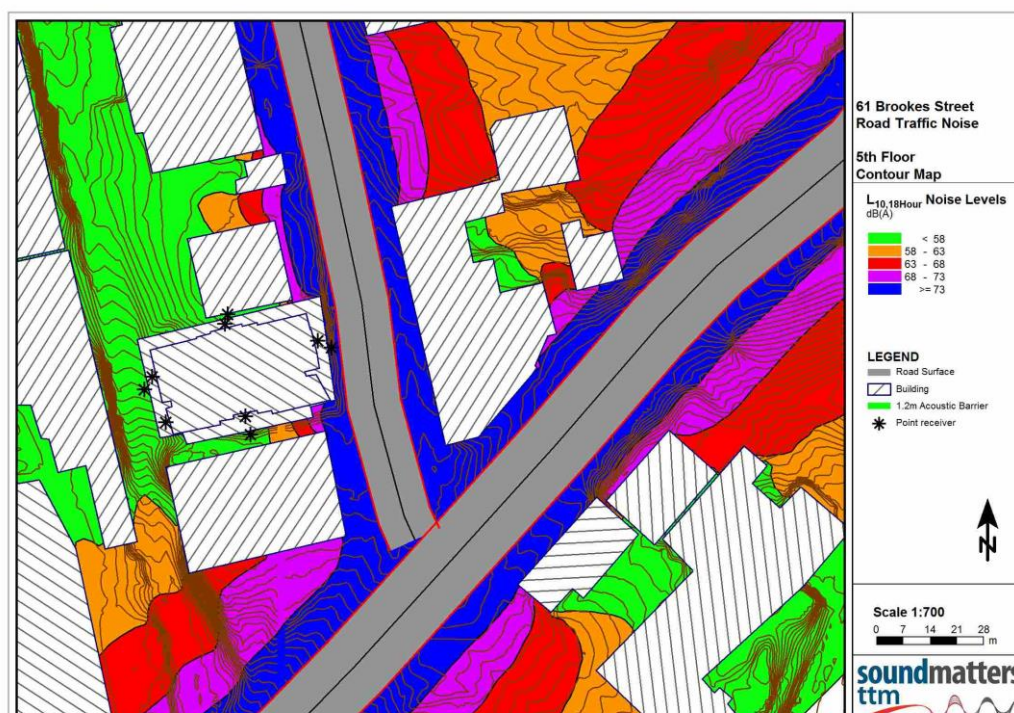


Figure 5: Predicted Traffic Noise Impacts - Level 8

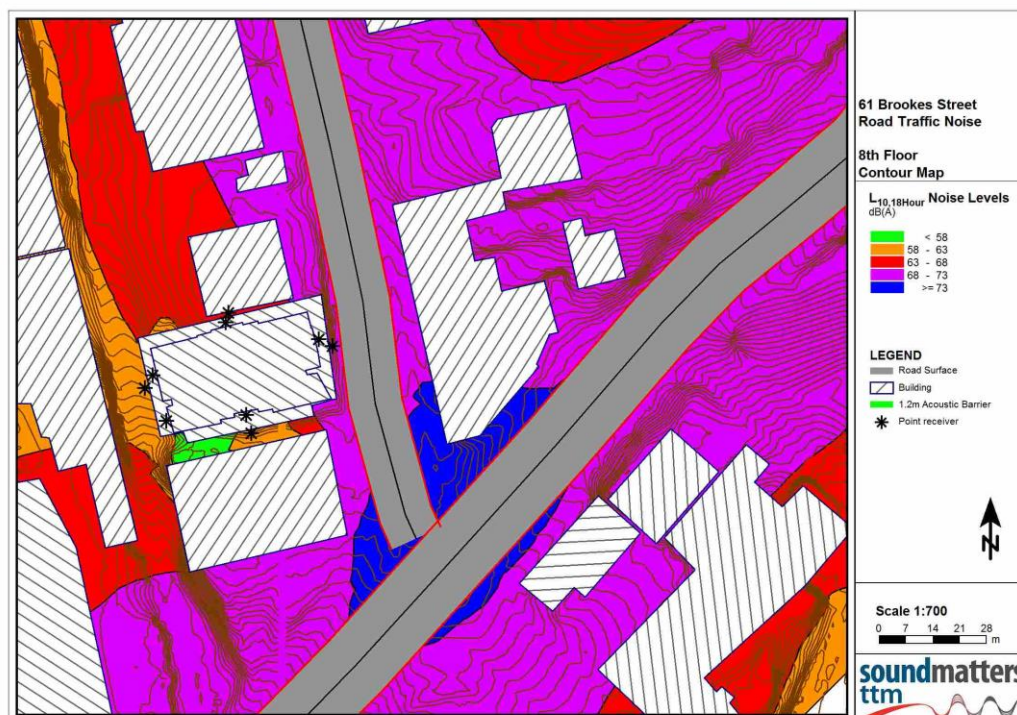


Figure 6: Predicted Traffic Noise Impacts – Level 17



Based on the modelled levels, the development is predicted to exceed external criteria and will require additional acoustic treatment to the building envelope as detailed in Section 12.

8. Analysis - Rail Noise

8.1. Noise Modelling Parameters

Rail noise predictions were conducted using 'SoundPLAN' v7.3. The basis of the 'SoundPLAN' model is as follows:

Table 12: Train Noise Modelling Parameters

Description	Value
Train Frequency	600 Passenger
Angle Increment	1°
Assumed Ground FFL	DERM 0.25m contour Interval data
Train Speed	40-60km/h
Residential receiver height above ground	1.5m above each floor level
Façade correction	+2.5 dB(A)

The model was prepared including all current buildings and future development sites to predict current and known future screening features surrounding the development.

8.2. Predicted Rail Noise Levels

The noise levels are based on the assumptions detailed in Table 12 with the results presented in Figure 7 to Figure 9.

Figure 7: Predicted Rail Noise Impacts - Ground Floor

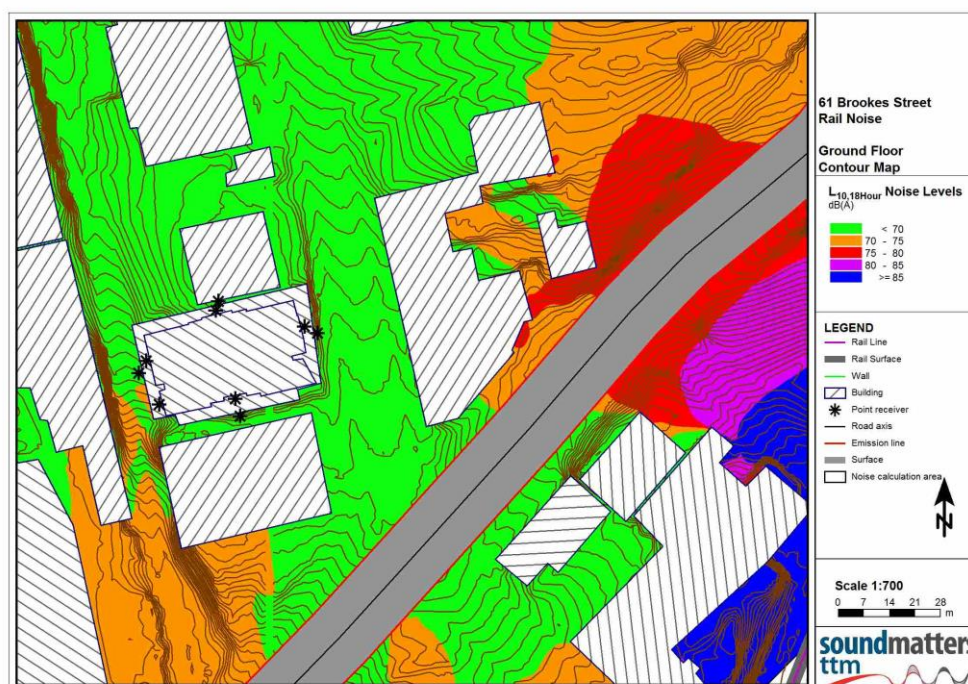


Figure 8: Predicted Rail Noise Impacts - Level 8

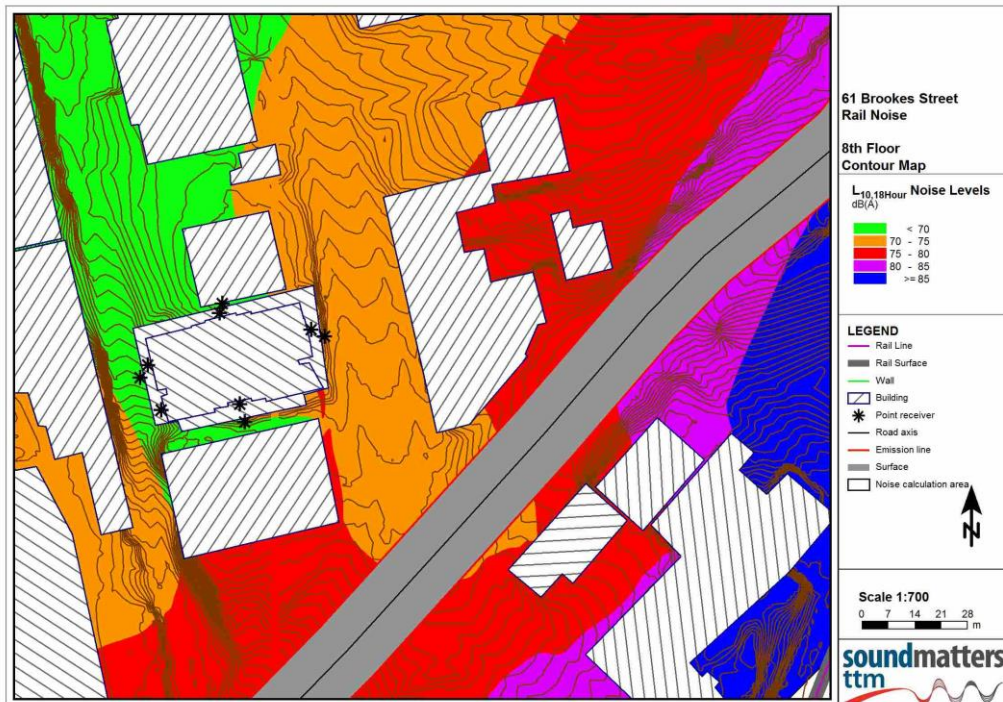
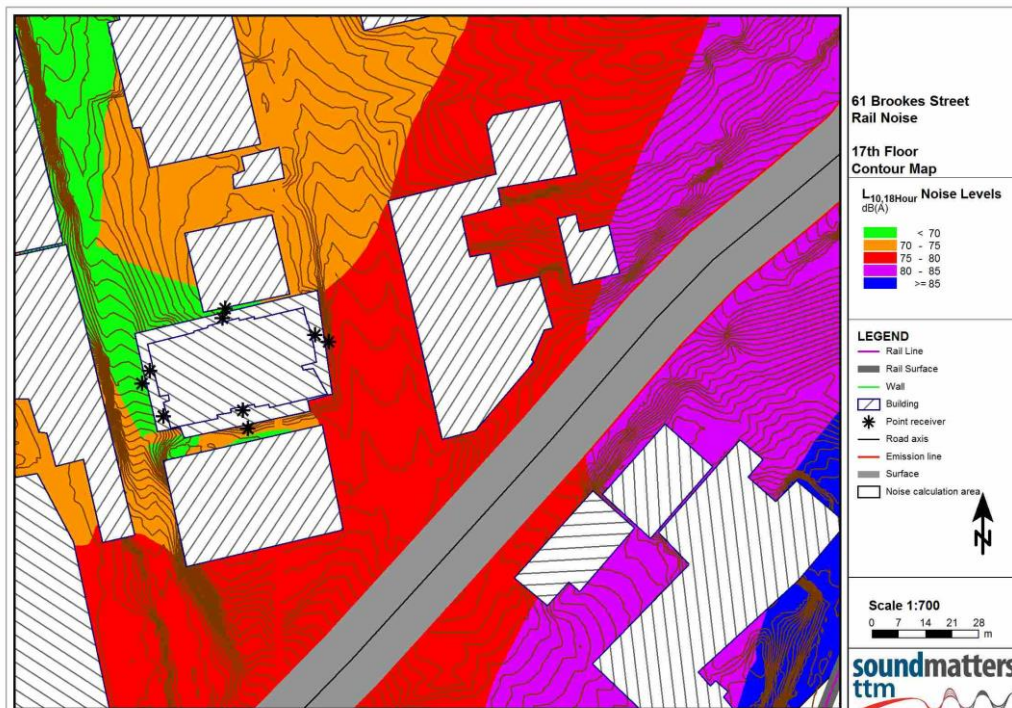


Figure 9: Predicted Rail Noise Impacts - Level 17



External noise levels are predicted to comply with the TMR $L_{Aeq,24\text{hour}}$ noise criterion and the L_{max} noise criterion due to sufficient separation distance from the rail line. Based on the model it is also predicted that the development will require external treatments to achieve internal criteria.

9. On-site Activity Noise

9.1. Noise Source Levels

Table 13 presents the potential noise sources and respective noise levels in L_{Aeq} , L_{A10} and L_{A1} . The noise sources used were selected as they represent the likely activities onsite that have the potential to adversely impact nearby noise sensitive receivers.

Table 13: Typical Transient Noise Source Levels

Noise Source Description	Noise Level at 1m, dB(A)			Measured Duration (s)
	$L_{Aeq,T}$	$L_{A10,T}$	L_{A1}	
Single event car door closure	75*	77*	83*	2
Single event car pass by @ 5km/h	69	75	75	6
Single event car engine ignition	72	74	74	3
Voice – Outdoor dining	65	60	70	450
Deliveries - refrigeration vehicle	85 [#]	86 [#]	86 [#]	60
Truck manoeuvring/passbys	80	82	83	30
Waste collection	93*	94*	105*	40

* Includes 2 dB(A) adjustment to account for impulsiveness characteristics in accordance with AS1055.

Includes 5 dB(A) adjustment to account for tonal noise characteristics in accordance with AS1055.

9.2. Calculation Assumptions

The following assumptions have been made for noise calculations:

- The traffic generation rate during peak hour period was applied. We have assumed that not all vehicles parked on-site will be leaving during the peak 1 hour period.
- Car door closures and engine starts predicted from nearest group of car spaces relative to the receiver during normal operation.
- For Acoustic Quality Objective predictions, the method of predicting car park noise from the nearest single location is not representative as the noise sources would be spread out across the car park at varying distances from each receiver. Therefore the AQO predictions are considered to be conservative.
- Outdoor dining predicted from outside commercial/retail area.
- Truck movements and deliveries and waste collection predicted from the loading bay access on Exhibition Street.
- Conversation noise were calculated on normal speech levels are based on published data contained in Harris CM, Handbook of Acoustical Measurements and Noise Control – 3rd ed. Ch 16.3, Mc Graw-Hill Inc.

- Predictions have taken into account screening from proposed and existing buildings.
- Noise attenuation of 5 dB(A) through an open window at a receiver was applied. It is noted that between 15 and 20dB could be expected to be achieved through a closed window or door.
- For the purposes of the calculations we have assumed the following events per hour.

Table 14: Parameters used for Noise Calculations - Day/Evening

Noise Source Description (Type of Event)	Daytime/Evening Period
	(Events/Per hour)
Single event car door closure	120
Single event car pass by @ 5km/h	60
Single event car engine ignition	60
Outdoor dining	20
Deliveries - refrigeration vehicle	3
Truck manoeuvring/pass-by	2
Waste collection	1

9.3. Predicted Noise Levels at Receivers

Predicted noise levels are based on the noise source levels presented in Table 13 and the calculation assumptions listed in Section 9.2.

9.3.1. EPP2008 - Acoustic Quality Objectives

Table 15 presents the predicted acoustic quality objective noise levels.

The criteria for day/evening periods is specified in the table heading, with the night time criteria being 5dB more stringent, shown in brackets.

Table 15: Acoustic Quality Objective Predictions

Receiver	Noise Source	Predicted Noise Level, dB(A)					
		L _{Aeq, 1hr}		L _{A10, 1 hr}		L _{A1, 1hr}	
		Outdoors	Indoors	Outdoors	Indoors	Outdoors	Indoors
	Criteria	50	35 (30)	55	40 (35)	65	45 (40)
1	Car door closure	31	26	33	28	39	34
	Car pass by	27	22	33	28	33	28
	Car engine ignition	27	22	29	24	29	24
	Outdoor dining	35	30	35	30	40	35
	Deliveries	12	<10	13	<10	13	<10
	Truck pass by	<10	<10	<10	<10	<10	<10
	Waste collection	13	<10	15	10	26	21
2	Car door closure	26	21	28	23	34	29
	Car pass by	22	17	28	23	28	23
	Car engine ignition	22	17	24	19	24	19
	Outdoor dining	32	27	32	27	37	32
	Deliveries	<10	<10	10	<10	10	<10
	Truck pass by	<10	<10	<10	<10	<10	<10
	Waste collection	10	<10	11	<10	22	17
Criteria for commercial and retail activities							
Receiver	Criteria	Outdoors	Indoors 45	Outdoors	Indoors	Outdoors	Indoors
3	Car door closure	Not Applica- ble	41	Not Applicable			
	Car pass by		37				
	Car engine ignition		34				
	Outdoor dining		12				
	Deliveries		19				
	Truck pass by		<10				
	Waste collection		20				
Criteria for educational institutions							
Receiver	Criteria	Outdoors 55	Indoors 35	Outdoors	Indoors	Outdoors	Indoors
4	Car door closure	22	19	Not Applicable			
	Car pass by	18	15				
	Car engine ignition	18	15				
	Outdoor dining	28	25				
	Deliveries	31	28				
	Truck pass by	21	19				
	Waste collection	32	30				

All of the proposed development transient activities are predicted to comply with the Acoustic Quality Objective noise criteria without acoustic treatments.

9.3.2. EPP2008 - Background Creep

Table 16 presents the predicted background creep noise levels at Receivers. These noise levels are shown in brackets.

Table 16: Background Creep Predictions at Receivers 1-3

Receiver	Noise Source	Predicted Noise Level, L _{Aeq} dB(A)	Complies with Criteria: (Yes/No)		
			Day 60 dB(A)	Evening 55 dB(A)	Night 50 dB(A)
1	Car door closure	43	✓	✓	✓
	Car pass by	37	✓	✓	✓
	Car engine ignition	40	✓	✓	✓
	Outdoor dining	31	✓	✓	✓
	Deliveries	25	✓	✓	✓
	Truck pass by	20	✓	✓	✓
	Waste collection	33	✓	✓	✓
2	Car door closure	38	✓	✓	✓
	Car pass by	32	✓	✓	✓
	Car engine ignition	35	✓	✓	✓
	Outdoor dining	28	✓	✓	✓
	Deliveries	22	✓	✓	✓
	Truck pass by	17	✓	✓	✓
	Waste collection	30	✓	✓	✓
3	Car door closure	58	✓	Not Applicable	
	Car pass by	52	✓		
	Car engine ignition	52	✓		
	Outdoor dining	13	✓		
	Deliveries	37	✓		
	Truck pass by	32	✓		
	Waste collection	45	✓		
4	Car door closure	<10	✓	Not Applicable	
	Car pass by	<10	✓		
	Car engine ignition	<10	✓		
	Outdoor dining	21	✓		
	Deliveries	19	✓		
	Truck pass by	14	✓		
	Waste collection	27	✓		

It is predicted that the site complies with the background creep criteria without additional acoustic treatments.

10. Off-site Activity Noise

The proposed development is located approximately 200m from the *RNA*, and could be affected by the noise from major events. The following section presents the assumptions and noise prediction results.

10.1. Noise level prediction methodology

At the time the report and analysis was prepared there were no music events scheduled at the *RNA* and noise measurements could be obtained. Noise levels were predicted by applying the following methodology:

- A typical dance music spectrum was established (detailed in Section 10.2), which is weighted towards the lower frequencies and then normalised to reach 115dB at 20m from the edge of the modelled stage. Typically large concerts are usually 110-120dB at the front of the house mixing desk, which is generally located approximately 20-30m from the stage and are considered conservatively high based for noise impact prediction purposes.
- The sound source was located at the worst representative locations (facing towards the site) and modelled in SoundPLAN v7.3 computer software as point sources.
- SoundPLAN used the Concawe noise prediction methodology and considered such factors as; distance, shielding and reflections from buildings to predict sound pressure levels at various points on the façade of the proposed development.
- The incident octave band (63Hz - 8kHz) sound pressure levels were predicted to 1m outside and inside the façade of the proposed development using the transmission loss performances of various glazing configurations.

10.2. Source Noise Level

The source noise level presented in Table 17 was applied as two point sources 2m above the ground level of the Brisbane Showground to simulate speakers array on a stage of a major music concert.

Table 17: Noise Source Frequency Spectrum Sound Level

Source Noise Spectrum Measured at 1m from the façade (dB(A))								Broadband Level	
63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	dB(A)	dB(C)
121.0	126.0	122.5	122.0	127.	128.4	122.2	115.1	133.6	147.9

10.3. Predicted Noise Levels

The noise levels are predicted based on the methodology in Section 10.1. The results are presented figures Figure 10 to Figure 12.

Figure 10: Predicted Music Event Impacts - Ground Floor

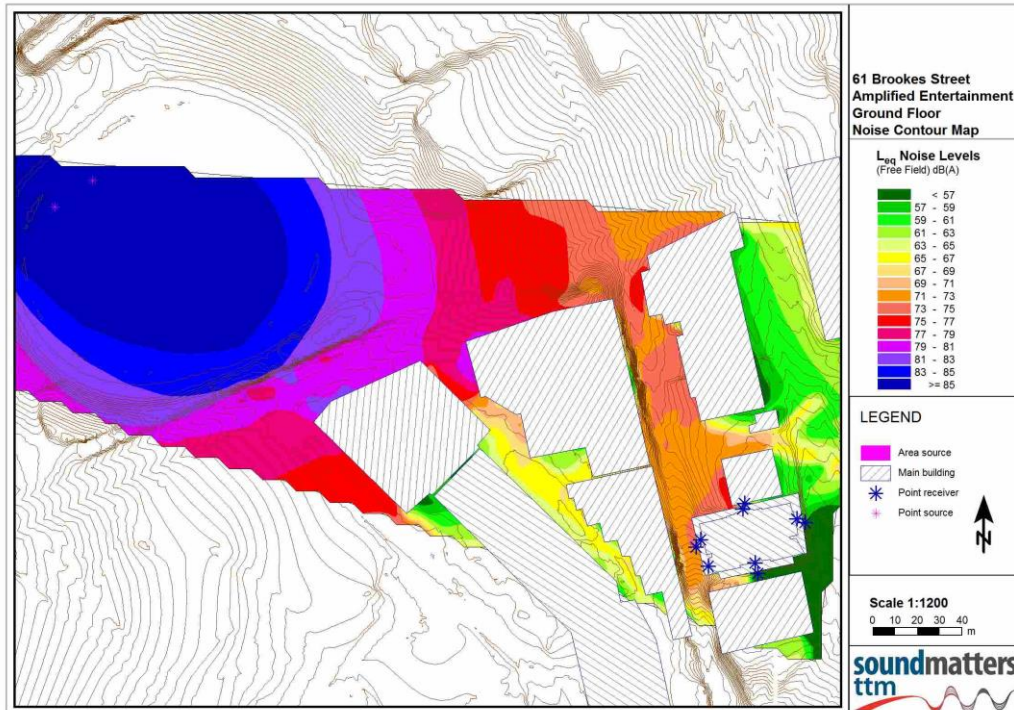


Figure 11: Predicted Music Event Impacts - Level 8

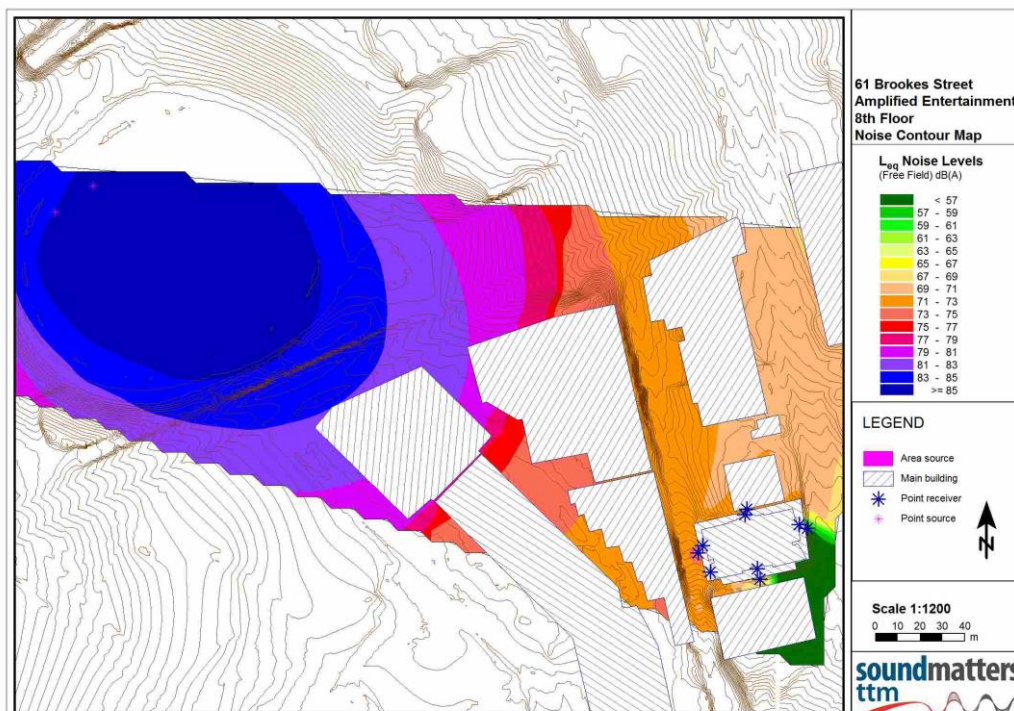
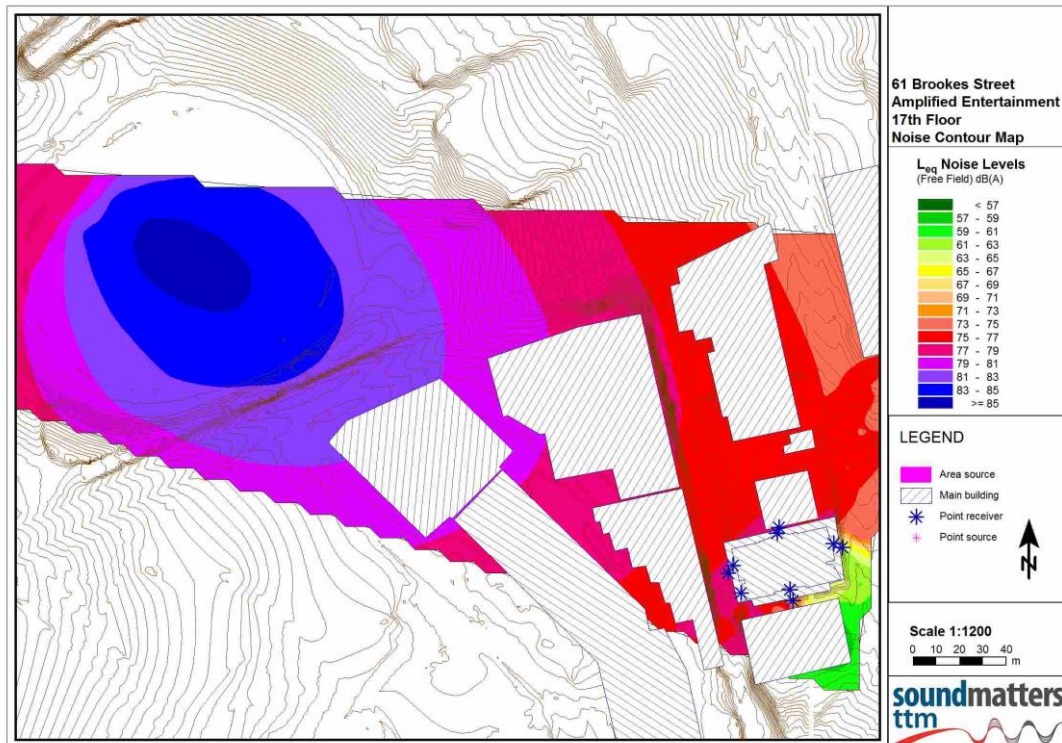


Figure 12: Predicted Music Event Impacts - Level 17



Predicted noise levels are expected to impact the site and are considered to require acoustic attenuation to the external façade to achieve an compliance with WHO criteria. Treatment recommendations are provided in Section 12.2.

11. Aircraft Noise

A site visit to measure aircraft noise could not be conducted due to the existing constructions sites surrounding the development. Due to the development location and experience with different projects in the area, it is considered that aircraft noise will not be a significant impact at the site and would be treated by the more onerous road and rail noise requirements.

12. Recommendations

The recommended acoustic treatments are presented in Sections 12.1 to 12.5 and are predicted to achieve the relevant Brisbane City Council assessment criteria when incorporated into the design.

12.1. Road Traffic Noise

Based on the predicted noise levels, all floor levels exceed the criteria and require additional acoustic treatment to the building façade to achieve compliance with AS2107 within the apartments.

Calculations were performed in accordance with AS3671:1989 to determine typical treatment requirements that are predicted to comply with AS2107 and are presented in Appendix D. The mark-up provided shows the typical glazing requirements considering noise impacts from road traffic, rail and the simulated concert at the RNA showgrounds.

Once the building application drawings are finalised we recommend a detailed assessment is conducted to optimise glazing treatments and should be conducted by a suitably qualified consultant.

12.2. Off-Site Brisbane Showground Noise

The development was designed to comply with the WHO guidelines for community noise recommended sleep disturbance criteria within bedrooms.

Refer to Appendix D for recommended glazing treatments of a typical floor level at the site. The typical glazing treatments take into account noise impacts from road traffic, rail and the simulated concert at the RNA showgrounds.

Once the layout is finalised it is recommended detailed assessment is conducted to ensure the glazing requirements are optimised across all floors and facades.

12.3. Rail Noise

Table 18 presents the QDC Noise Category for the building facades which provides indicative acoustic treatments required for rail noise impacts.

Table 18: QDC Noise Treatments for Rail Noise

Floor Level	QDC Noise Category By Façade and Floor			
	NW	NE	SW	S
GF	0	0	0	0
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	1	0	0
5	0	1	0	0
6	0	1	0	0
7	0	1	0	0
8	0	1	1	0
9	0	1	1	0
10	0	1	1	0
11	0	1	1	0
12	0	1	1	0
13	0	1	1	0
14	0	1	1	0
15	0	1	1	0
16	0	1	1	0
17	0	1	1	0

Based on the predicted levels it is expected that all rail noise treatment requirements will be attenuated by road traffic noise due to significant separation distance and screening.

12.4. On-Site Transient Activity Noise

This assessment has investigated the 'worst case scenario', by considering potential noise impacts from onsite activities at the nearest location to the sensitive receivers and by applying the criteria described in Section 6.

Based on the results of the calculations and to minimise noise annoyance, we recommend the following management controls:

- Any grates or other protective covers in the car parks and access driveways must be rigidly fixed in position to eliminate clanging, and be maintained.
- Speed bumps should be built into the finished surface of the car park and not be made of metal.
- To minimise annoyance it is recommended that the commercial/retail area operating hours are limited to day and evening time periods (7am to 10pm).

12.5. Mechanical Plant Noise

As detailed plant selections are not available at this stage, it is not possible to carry out a detailed examination of the ameliorative measures that may be required to achieve the noise targets.

Plant should be acoustically treated to achieve the criteria detailed in Section 6.3.2 to prevent noise emissions from adversely impacting the surrounding properties. This may include selecting the quietest plant possible, or treating the plant equipment with enclosures, barriers, duct lining and silencers, etc.

A mechanical plant noise assessment should be conducted by a suitably qualified acoustic consultant once plant selections are finalised. Noise criteria compliance measurements should then be conducted after the equipment is installed. Such measures should also be conditioned in the Development Approval.

12.6. Alternative Detailed Design

Once the layout is finalised it is recommended detailed assessment is conducted to ensure the glazing requirements are optimised across all floors and facades.

It is recommended detailed design is conducted by a suitably qualified acoustic consultant once building floor plans are finalised to optimise the glazing treatments.

12.7. Further Design Consideration

Further to the recommendations above, consideration is required to the acoustic amenity of residents with respect to the isolation of the pool, plant and AC condenser room and the communal recreation area. This is to minimise structure-borne noise and vibration to the apartments below.

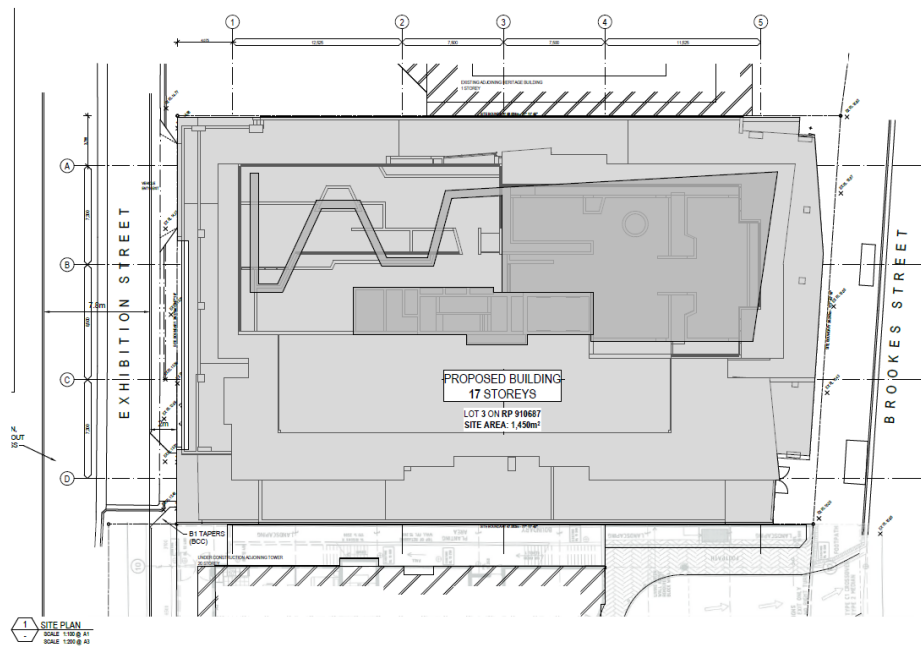
The key component is to ensure these activities and components are isolated and attenuated correctly.

A detailed assessment should be conducted during the detailed design stage to provide any required mitigation in the design.

13. Conclusion

An environmental noise assessment has been conducted for the proposed mixed use development at 61 Brookes Street, Bowen Hills. On the condition the treatment recommendations presented in Section 12 are implemented, the development is predicted to comply with the DSDIP assessment criteria in relation to road traffic, rail, onsite and offsite activity noise.

Appendix A Development Plans



Schematic MULTI RESIDENTIAL

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CONSISTENT WITH SUBMISSION TO BOWEN HILLS LOCAL COUNCIL FOR CONSIDERATION OF A DEVELOPMENT APPLICATION FOR THE PROPOSED BUILDING

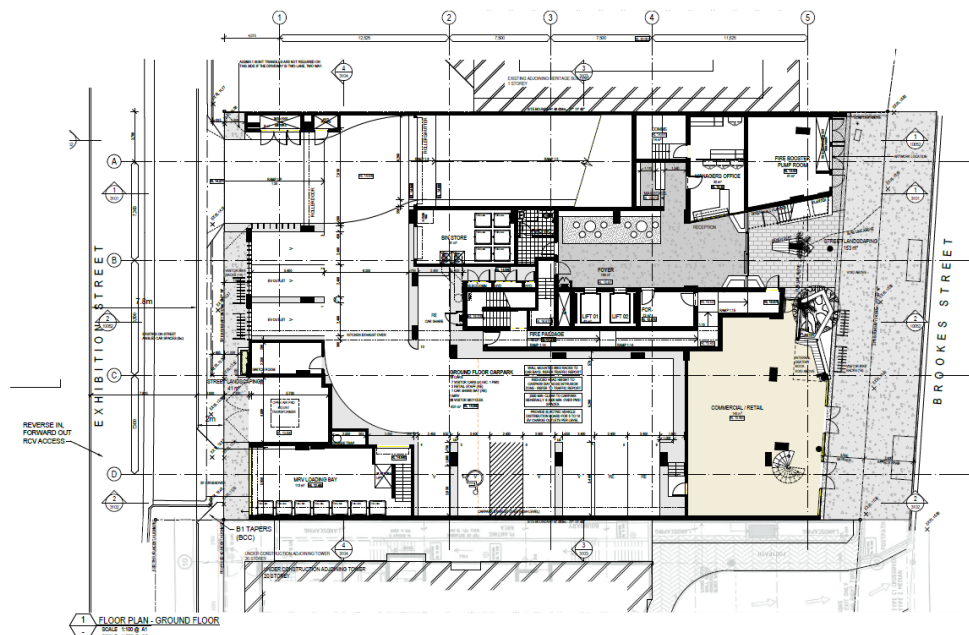


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Drawing Title	SITE PLAN
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Checked by	00

Scale	As Shown
Date	2018/01/10
Drawn by	SD 1003
Checked by	00

Job No.	2018/01/10
Client	BROOKES PTY LTD
Project Name and Location	MULTI RESIDENTIAL, 61 BROOKES STREET, BOWEN HILLS
Drawing Title	SITE PLAN
Drawn by	SD 1003
Checked by	00



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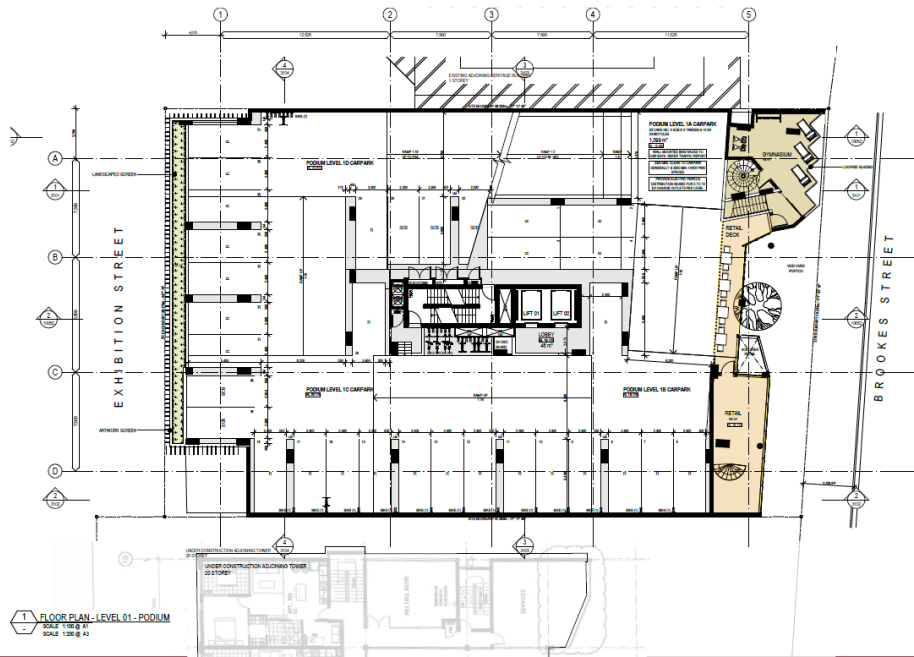
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Drawn by	SD 2010
Checked by	03

Scale	As Shown
Date	2018/01/10
Drawn by	SD 2010
Checked by	03

Job No.	2018/01/10
Client	BROOKES PTY LTD
Project Name and Location	MULTI RESIDENTIAL, 61 BROOKES STREET, BOWEN HILLS
Drawing Title	FLOOR PLAN - GROUND FLOOR
Drawn by	SD 2010
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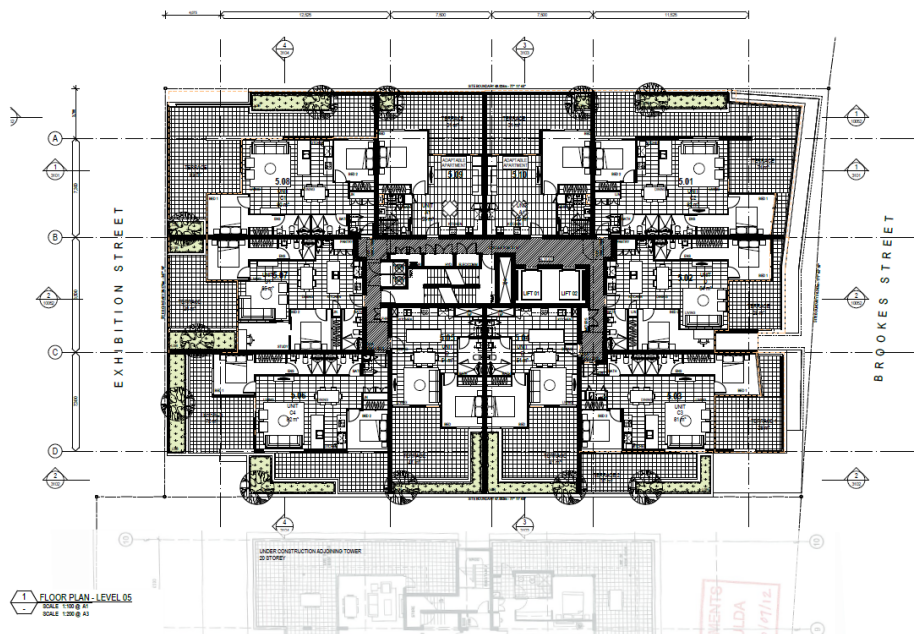


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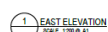


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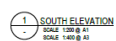
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01	La 199.0	2007/08	24
02	La 199.0	07/06/08	24
Issue	Revision	Date	By

Scale As Shown	Date JAN 2015	Job no. 4991
Drawn JH	Checked MT	Approved MT
Drawing no. SD 3002		Issue 01

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01	CA 196J2	2007/18	JH
02	CA 196J2	0706/18	JH
Issue	Revistas	Ciclo	Id.

Scale As Shown	Date JAN 2015	Job no. 4991
Drawn JH	Checked MT	Approved MT
Drawing no. SD 3003		Issue 01

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Appendix B SoundPLAN Modelling Results

Brisbane Model
Assessed receiver levels
15BRA0015 Planning Horzion 2025

Receiver	Fl	Dir	L10(18h) dB(A)
61 Brookes St GF to	GF 1.FL 2.FL 3.FL 4.FL	E	76.8 76.9 75.6 74.5 73.6
61 Brookes St GF to	GF 1.FL 2.FL 3.FL 4.FL	N	45.8 49.0 54.5 58.3 60.9
61 Brookes St GF to	GF 1.FL 2.FL 3.FL 4.FL	W	56.8 58.0 59.0 59.8 60.3
61 Brookes St GF to	GF 1.FL 2.FL 3.FL 4.FL	S	55.8 57.5 58.3 58.1 57.9
61 Brookes St Lvl 05 to Lvl	GF 1.FL 2.FL 3.FL 4.FL 5.FL 6.FL 7.FL 8.FL 9.FL 10.FL 11.FL 12.FL	E	66.0 69.4 70.7 70.9 70.8 70.5 70.3 70.0 69.7 69.5 69.2 69.0 68.8
61 Brookes St Lvl 05 to Lvl	GF 1.FL 2.FL 3.FL 4.FL 5.FL 6.FL 7.FL 8.FL 9.FL	N	62.5 64.6 65.1 65.2 65.2 65.1 65.0 64.8 64.7 64.5
TTM Consulting (Qld) Pty Ltd Level 1 - 129 Logan Rd Woolloongabba, QLD 4102			1

SoundPLAN 7.4

Brisbane Model
Assessed receiver levels
15BRA0015 Planning Horzion 2025

Receiver	Fl	Dir	L10(18h) dB(A)
61 Brookes St Lvl 05 to Lvl	10.FL	S	64.4
	11.FL		64.2
	12.FL		64.1
	GF		48.3
	1.FL		52.9
	2.FL		54.5
	3.FL		56.4
	4.FL		57.6
	5.FL		57.9
	6.FL		58.0
	7.FL		58.2
	8.FL		58.2
61 Brookes St Lvl 05 to Lvl	9.FL	W	58.3
	10.FL		58.2
	11.FL		58.2
	12.FL		58.1
	GF		59.8
	1.FL		60.1
	2.FL		60.2
	3.FL		60.2
	4.FL		60.2
	5.FL		60.2
	6.FL		60.2
	7.FL		60.2
61 Brookes St Lvl 05 to Lvl	8.FL	W	60.2
	9.FL		60.1
	10.FL		60.1
	11.FL		60.1
	12.FL		60.2
	GF		59.1
	1.FL		60.2
	2.FL		60.4
	3.FL		60.5
	4.FL		60.5
	5.FL		60.5
	6.FL		60.5
	7.FL		60.5
	8.FL		60.5
	9.FL		60.4
	10.FL		60.4
	11.FL		60.4
	12.FL		60.4

SoundPLAN 7.4

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4102

2

Brisbane Model
Assessed receiver levels
15BRA0015 Planning Horizon RAIL

Receiver	Fl	Dir	Lmax dB(A)
61 Brookes St GF to	GF 1.FL 2.FL 3.FL 4.FL	E	62.5 65.0 66.0 67.9 70.1
61 Brookes St GF to	GF 1.FL 2.FL 3.FL 4.FL	N	55.1 55.7 57.6 58.1 59.4
61 Brookes St GF to	GF 1.FL 2.FL 3.FL 4.FL	W	66.0 66.6 67.0 67.2 67.2
61 Brookes St GF to	GF 1.FL 2.FL 3.FL 4.FL	S	59.2 60.1 60.3 61.1 62.3
61 Brookes St Lvl 05 to Lvl	GF 1.FL 2.FL 3.FL 4.FL 5.FL 6.FL 7.FL 8.FL 9.FL 10.FL 11.FL 12.FL	E	70.0 70.6 70.6 71.0 71.6 72.3 72.4 72.6 72.9 73.1 73.2 73.6 73.8
61 Brookes St Lvl 05 to Lvl	GF 1.FL 2.FL 3.FL 4.FL 5.FL 6.FL 7.FL 8.FL 9.FL	N	59.2 59.8 61.0 61.9 62.7 63.1 63.2 63.4 63.5 63.6
TTM Consulting (Qld) Pty Ltd Level 1 - 129 Logan Rd Woolloongabba, QLD 4102			1

SoundPLAN 7.4

Brisbane Model
Assessed receiver levels
15BRA0015 Planning Horizon RAIL

Receiver	Fl	Dir	Lmax dB(A)
61 Brookes St Lvl 05 to Lvl	10.FL	S	63.7
	11.FL		63.8
	12.FL		64.0
	GF		66.0
	1.FL		68.6
	2.FL		69.4
	3.FL		70.0
	4.FL		70.4
	5.FL		70.8
	6.FL		71.1
	7.FL		71.4
	8.FL		71.5
61 Brookes St Lvl 05 to Lvl	9.FL	W	71.6
	10.FL		71.7
	11.FL		71.9
	12.FL		72.3
	GF		54.8
	1.FL		55.1
	2.FL		55.3
	3.FL		55.6
	4.FL		55.9
	5.FL		56.3
	6.FL		56.8
	7.FL		57.4
61 Brookes St Lvl 05 to Lvl	8.FL	W	58.0
	9.FL		58.6
	10.FL		59.4
	11.FL		60.3
	12.FL		61.2
	GF		64.2
	1.FL		64.3
	2.FL		64.5
	3.FL		64.6
	4.FL		64.7
	5.FL		64.8
	6.FL		64.9
	7.FL	65.1	
	8.FL	65.1	
	9.FL	65.2	
	10.FL	65.3	
	11.FL	65.4	
	12.FL	65.5	
TTM Consulting (Qld) Pty Ltd Level 1 - 129 Logan Rd Woolloongabba, QLD 4102			2

SoundPLAN 7.4

Brisbane Model Assessed receiver levels 15BRA0015 Brisbane Showground Impact S02			
Receiver	Fl	Dir	LrS dB(A)
61 Brookes St GF to	GF	E	56.6
	1.FL		56.5
	2.FL		51.0
	3.FL		52.3
	4.FL		52.3
61 Brookes St GF to	GF	N	53.9
	1.FL		59.5
	2.FL		65.6
	3.FL		70.4
	4.FL		70.4
61 Brookes St GF to	GF	W	70.4
	1.FL		70.5
	2.FL		70.6
	3.FL		70.8
	4.FL		71.0
61 Brookes St GF to	GF	S	55.1
	1.FL		56.7
	2.FL		57.3
	3.FL		58.5
	4.FL		61.1
61 Brookes St Lvl 05 to Lvl	GF	E	51.9
	1.FL		55.2
	2.FL		55.2
	3.FL		55.2
	4.FL		55.3
	5.FL		55.3
	6.FL		55.3
	7.FL		55.3
	8.FL		55.4
	9.FL		58.3
	10.FL		59.9
	11.FL		60.5
61 Brookes St Lvl 05 to Lvl	12.FL	N	62.5
	GF		70.3
	1.FL		70.3
	2.FL		70.3
	3.FL		70.2
	4.FL		70.2
	5.FL		70.2
	6.FL		70.2
	7.FL		70.1
8.FL	73.9		
9.FL	75.7		
TTM Consulting (Qld) Pty Ltd Level 1 - 129 Logan Rd Woolloongabba, QLD 4102			1

SoundPLAN 7.4

Brisbane Model Assessed receiver levels 15BRA0015 Brisbane Showground Impact S02			
Receiver	Fl	Dir	LrS dB(A)
61 Brookes St Lvl 05 to Lvl	10.FL	S	75.6
	11.FL		75.6
	12.FL		75.5
	GF		60.6
	1.FL		60.7
	2.FL		60.7
	3.FL		60.7
	4.FL		60.7
	5.FL		60.7
	6.FL		60.7
	7.FL		60.7
	8.FL		60.7
61 Brookes St Lvl 05 to Lvl	9.FL	W	62.6
	10.FL		67.6
	11.FL		67.9
	12.FL		67.8
	GF		70.4
	1.FL		70.4
	2.FL		70.4
	3.FL		70.4
	4.FL		70.3
	5.FL		70.3
	6.FL		70.3
	7.FL		75.9
61 Brookes St Lvl 05 to Lvl	8.FL	W	75.9
	9.FL		75.8
	10.FL		75.7
	11.FL		75.7
	12.FL		75.6
	GF		70.8
	1.FL		70.7
	2.FL		70.7
	3.FL		70.7
	4.FL		70.7
	5.FL		70.6
	6.FL		70.6
	7.FL		76.2
	8.FL		76.1
	9.FL		76.0
	10.FL		76.0
	11.FL		75.9
	12.FL		75.9
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SoundPLAN 7.4

Appendix C Sample Calculations

AS3671:1989 Calculations

AS3671:1989 Calculations												
Building Component	Impact dB(A)	Criteria dB(A)	TeR dB(A)	Element Area (m2)	Floor Area (m2)	Height (m)	RT60 (s)	C	TeA		Alternate	
										R _W	R _W 2	
Unit 10 - Living/Kitchen/Dining											R _W	
Glazing N	74	45	28.5	8.40	34.1	2.60	1.25	2	30.03	36	30	
Wall N	74	45	28.5	0.96	34.1	2.60	1.25	2	20.61	27	50	
YOU CANNOT DELETE OR ADD ROWS! THE SPREADSHEET WILL NOT BE CORRECT IF YOU DO!!!										0.000448116 33.5	0.0008985 30.5	
Unit 10 Bed 1											R _W	R _W 2
Glazing N	74	45	28.5	7.2	9.0	2.60	0.50	2	31.16	37	35	
Wall N	74	45	28.5	5.8	9.0	2.60	0.50	2	30.22	36	50	
YOU CANNOT DELETE OR ADD ROWS! THE SPREADSHEET WILL NOT BE CORRECT IF YOU DO!!!										0.000212888 36.7	0.0001796 37.5	
Unit 1 - Living/Kitchen/Dining											R _W	
Glazing N	74	45	28.5	7.20	32.2	2.60	1.25	4	32.61	39	30	
Wall N	74	45	28.5	10.74	32.2	2.60	1.25	4	34.35	40	50	
Glazing E	59	45	13.5	9.36	32.2	2.60	1.25	4	18.75	25	32	
Wall E	59	45	13.5	1.04	32.2	2.60	1.25	4	9.21	15	50	
YOU CANNOT DELETE OR ADD ROWS! THE SPREADSHEET WILL NOT BE CORRECT IF YOU DO!!!										0.002282434 26.4	0.0004666 33.3	
Unit 1 Bed 1											R _W	R _W 2
Glazing E	59	45	13.5	7.2	9.0	2.60	0.50	2	16.16	22	33	
Wall E	59	45	13.5	9.18	9.0	2.60	0.50	2	17.22	23	50	
YOU CANNOT DELETE OR ADD ROWS! THE SPREADSHEET WILL NOT BE CORRECT IF YOU DO!!!										0.005342945 22.7	0.0002259 36.5	
Unit 1 Bed 2											R _W	R _W 2
Glazing N	74	45	28.5	7.2	9.0	2.60	0.50	2	31.16	37	35	
Wall N	74	45	28.5	0.86	9.0	2.60	0.50	2	21.93	28	50	
YOU CANNOT DELETE OR ADD ROWS! THE SPREADSHEET WILL NOT BE CORRECT IF YOU DO!!!										0.000343368 34.6	0.0002836 35.5	
Unit 2 - Living/Kitchen/Dining											R _W	
Glazing E	59	45	13.5	8.28	35.7	2.60	1.25	2	14.76	21	30	
Wall E	59	45	13.5	3.68	35.7	2.60	1.25	2	11.24	17	50	
YOU CANNOT DELETE OR ADD ROWS! THE SPREADSHEET WILL NOT BE CORRECT IF YOU DO!!!										0.011610452 19.4	0.0006954 31.6	
Unit 2 Bed 1											R _W	R _W 2
Glazing E	59	45	13.5	7.2	9.0	2.60	0.50	2	16.16	22	33	
Wall E	59	45	13.5	9.18	9.0	2.60	0.50	2	17.22	23	50	
YOU CANNOT DELETE OR ADD ROWS! THE SPREADSHEET WILL NOT BE CORRECT IF YOU DO!!!										0.005342945 22.7	0.0002259 36.5	
Unit 2 Bed 2											R _W	R _W 2
Glazing E	59	45	13.5	2.8	12.8	2.60	0.50	2	10.49	16	30	
Wall E	59	45	13.5	1.14	12.8	2.60	0.50	2	6.65	13	50	
YOU CANNOT DELETE OR ADD ROWS! THE SPREADSHEET WILL NOT BE CORRECT IF YOU DO!!!										0.031790523 15.0	0.0007106 31.5	

Appendix D Typical Glazing Treatment Mark-Up



RW Rating	Indicative Glazing	Acoustic Seals	Use
24	4mm Float	No	Window
25	5mm Toughened	No	Sliding Door
27	4mm Float	Yes	Window
28	5mm Toughened	Yes	Sliding Door
29	6mm Float	Yes	Window
30	6.38mm Laminated	Yes	Sliding Door/window
32	10mm Float	Yes	Window
33	10mm Toughened	Yes	Sliding Door/window
35	10.38mm Laminated	Yes	Sliding Door/window
37	11.52mm Laminated	Yes	Sliding Door/window
38	12.76mm Laminated	Yes	Sliding Door/window