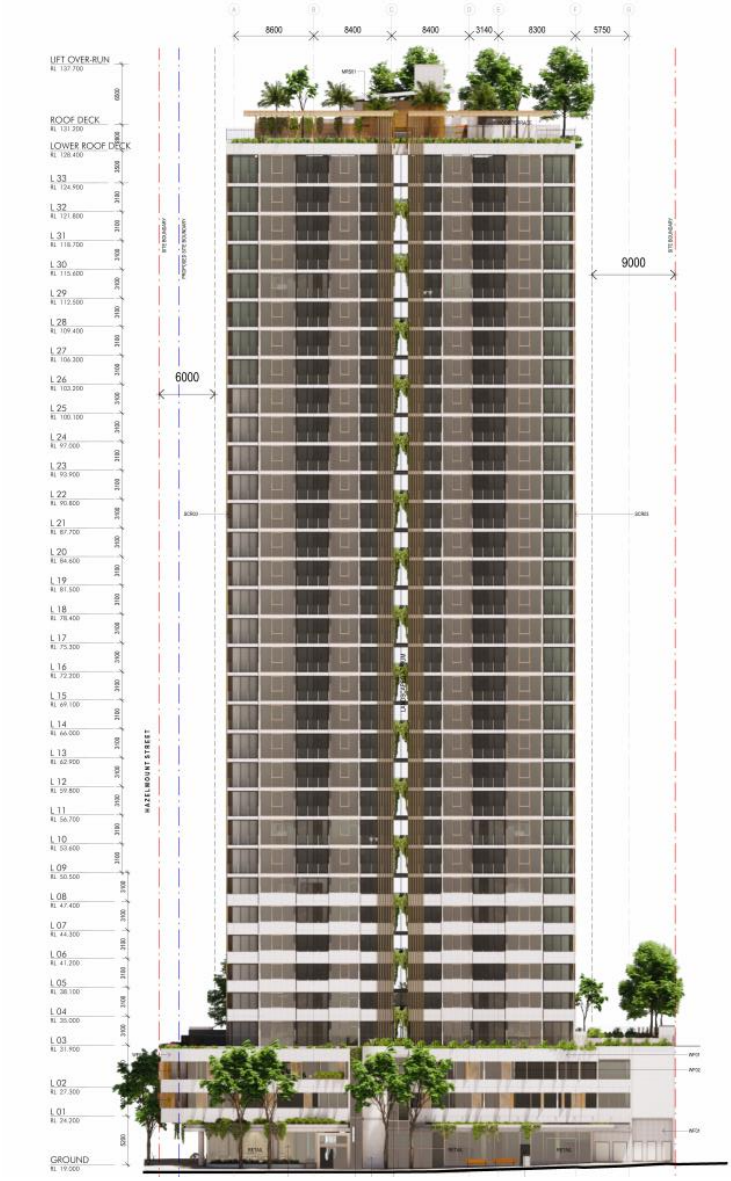
Project No. 24BRA0200	**Date:** 02/09/2024
Project Name: 19-25 Campbell Street, Bowen Hills	**Prepared by:** Andrew Ashworth (MAAS) **Reviewed by:** Steve Yorke (MAAS)
Document Ref: 24BRA0200 DN01_0	**Prepared for:** New Urban Villages
Document Title: Aircraft Noise Assessment (Advisory)	

This report provides an advisory strategy in relation to the aircraft noise and advice for improving acoustic comfort for building occupants, in addition to the Acoustic DA report (reference 21BRA0010 R01_1).

1 Proposed Development

The proposal is to develop a mixed-use development with residential units up to Level 33. This letter will focus on aircraft noise, specifically at higher floor levels. An example elevation is presented in Figure 1.

Figure 1: South Elevation



2 Australian Noise Exposure Forecast (ANEF) Zone

The site is approximately 2800m from the closest Australian Noise Exposure Forecast (ANEF) 20-25 noise overlay of Brisbane Airport as shown in Figure 1. An aircraft assessment for a site outside the ANEF 20-25 overlay is not usually a mandatory requirement but, in this instance, will be provided in response to EDQ's request.

Figure 1: BCC Mapping – ANEF Noise Contour Overlays

3 References

The assessment is based on the following information:

- Australian Standard *AS2021:2015 Acoustics – Aircraft Noise Intrusion – Building Siting and Construction* (AS2021).
- TTM Consulting Acoustic DA report, titled *Environmental Noise Assessment*, reference *21BRA0010 R01_1*, dated *24/05/2021*
- Queensland Development Code (QDC) MP4.4 – Buildings in a Transport Noise Corridor (August 2015)
- Calculations and analysis by TTM Consulting.

4 Internal Assessment Criteria

Australian Standard AS2021 states the indoor design sound levels are hypothesized values based on Australian experience. A design sound level is the maximum level from an aircraft flyover which, when heard inside a building by the average listener, will be judged as not intrusive or annoying by that listener while carrying out a specific activity. Owing to the variability of subject responses to aircraft noise, these values will

not provide sufficiently low interior noise levels for occupants who have a sensitivity to aircraft noise. Table 1 shows the internal noise levels applicable for residential buildings.

Table 1: Indoor Design Sound Levels for Determination of Aircraft Noise Reduction in Residential Buildings (AS2021)

Activity	Indoor design sound levels L_{max} (dBA)
Sleeping areas, dedicated lounges	50
Other habitable spaces	55
Bathroom, toilets, laundries	60

5 AS2021 - Predicted Aircraft Noise Levels

AS2021 provides an assessment method to determine the predicted aircraft noise level at the site location based on aircraft type and proximity to the airport runway. AS2021 provides aircraft noise levels based on long term average maximum values.

Aircraft types operating from Brisbane Airport were determined from the online service 'WebTrak' of Air Services Australia. The Aircraft Event Levels from Webtrak historical data (Aug 2023 – July 2024) for the nearest noise monitoring terminal (New Farm) are presented in Figure 2.

Figure 2: Aircraft Event Levels – New Farm Noise Monitoring Terminal (WebTrak)

Aircraft Type	Average Event Level	Event Counts			
		Total	Max/day	Min/day	Avg/day
A333	74.9	288	4	0	0.8
A332	74.7	476	7	0	1.3
B763	71.2	183	3	0	0.5
B733	71.2	93	3	0	0.3
F100	70.6	1826	17	0	5
B738	70.4	4755	50	0	13
B789	70.3	109	3	0	0.3
A21N	69.3	380	5	0	1
E190	69.2	3158	26	0	8.6
A320	69.2	1740	13	0	4.8
F70	69.1	1800	17	0	4.9
B737	68.9	333	7	0	0.9
A359	68.8	546	7	0	1.5
B788	68.5	396	3	0	1.1
B38M	67.3	339	4	0	0.9

The aircraft types in Figure 2 are sorted in descending order of 'average event level' (noise level). Based on consideration of aircraft noise level and frequency of aircraft events, aircraft operating less than once per day were ignored.

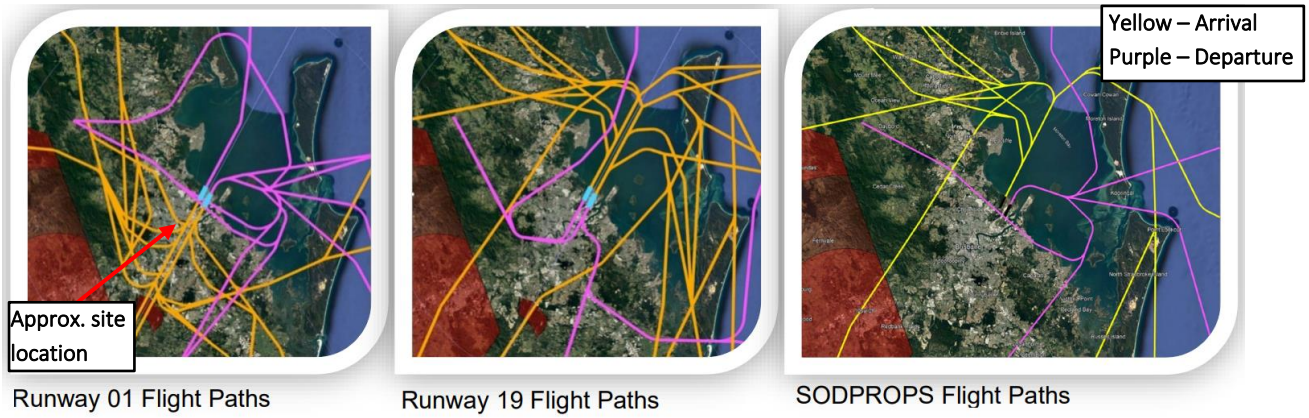
In this instance, the following aircraft type were looked at this assessment:

- Boeing 737-800 (13.0 events per day)
- Airbus A330-200 (1.3 events per day)
- Fokker F100 (5.0 events per day)

Information regarding flight paths could be found within an Air Services document (***Title: Brisbane New Parallel Runway Flight Paths Post Implementation Review (PIR) ver 1.0, dated 14 December 2022)***. The aircraft flight path maps shown in Figure 3 indicate that the site may be directly beneath one of the arrival

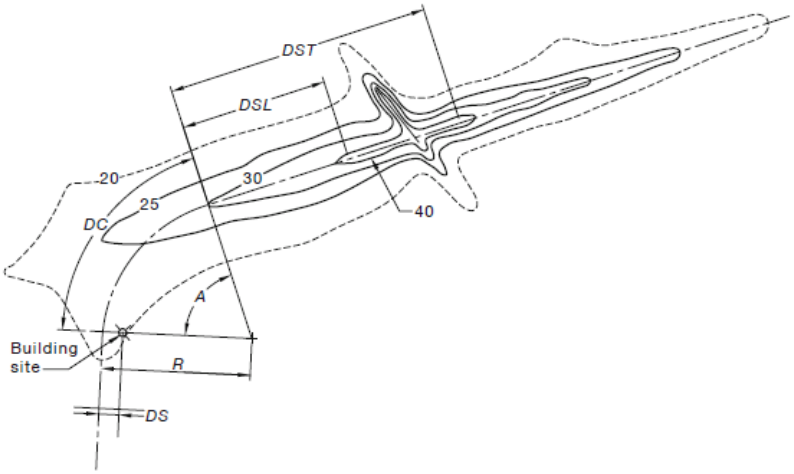
flights during runway 01 flight path operation. The site appears to be over 2.5kms from departure flightpaths during runway 19 flight path operation, therefore the assessment will look at noise levels from arriving aircraft as a worst case assessment.

Figure 3: Flight paths from Airservices document (reference: Brisbane Airport Changes to Departure Flight Paths)



Based on the flight paths and in accordance with AS2021 as shown in Figure 4, the distance coordinates for the site location relative to the aerodrome runway are presented in Table 2.

Figure 4: AS2021: Determination of distance coordinates for curved flight paths



DIMENSIONS IN ANEF UNITS

FIGURE 3.2 DETERMINATION OF *DS*, *DL* AND *DT* FOR CURVED FLIGHT PATHS

Table 2: Distance Coordinates for Site Location as per AS2021

Distance Coordinate	Distance (m)
DL (DSL + DC)	11,800m
DT (DST + DC)	15,100m
DS	0m
Elevation difference (runway to site)	Minimum: 17m (Ground Level) Maximum: 123m (Floor Level 33)

Based on the distance coordinates in Table 2, and Tables 3.15(A), 3.7(A) and 3.32(A) of AS2021, the predicted highest aircraft noise level at the development location are presented in Table 3.

Table 3: AS2021 Aircraft Noise Level Predictions at the Site

Aircraft Type	Aircraft Noise Level, Arrivals, dB(A) L_{max}		
	Boeing 737-800	Airbus A320-200	Fokker F100
Ground Level	69	68	68
Level 33	72	72	72

6 Internal Noise Attenuation

Table 4 presents the required aircraft noise attenuation for each habitable room for the aircraft noise impact level stated in Table 3, to achieve the specified internal noise levels from AS2021.

Table 4: Attenuation Requirements for Aircraft Noise

Room(s)	Aircraft Noise Impact Level (dBA)		Indoor design sound levels (dBA)	Assumed Orientation Correction	Required Aircraft Noise Reduction (ANR), dB	
	Ground	Level 33			Ground	Level 33
Sleeping areas, dedicated lounges	69	72	50	0*	19	22
Other habitable spaces			55		14	17
Bathroom, toilets, laundries			60		9	12

*The assumed orientation correction of 0 is used as a worst case assumption, as it is unclear exactly how the flight paths will be located relative to the development.

7 Conclusions

Based upon the analysis conducted to AS2021 and assuming a worst case arrival flight path over the development the following conclusions can be made:

- Facades for sleeping areas and dedicated lounges on higher levels are required to achieve a minimum noise reduction of 22dB.
- All other facades require less than 20dB noise reduction.
    - Standard construction is expected to achieve a minimum noise reduction of 18-20dB.
- High level residential dwellings are already recommended to have Queensland Development Code (QDC) MP4.4 category 1 and category 2 construction, to attenuate rail and road traffic noise.
    - Based upon the recommendations shown within Section 9 and Appendix C of the DA acoustic report *21BRA0010 R01_1*,
- QDC Category 1 construction is designed to provide 25dB noise reduction, therefore meeting the requirement of 22dB for level 33 sleeping areas.

Based on the points outlined above, compliance with the AS2021 criteria is achieved, based upon the implementation of the recommendations (minimum QDC Category 1 construction) outlined in TTM DA acoustic report 21BRA0010 R01_1.

Environmental Noise Assessment

Proposed Mixed Use Development

At 19-25 Campbell Street, Bowen Hills

On behalf of Dowse Projects

21BRA0010 R01_1

About TTM

For 30 years, we've been at the centre of the Australian development and infrastructure industry. Our unique combination of acoustics, data, traffic and waste services is fundamental to the success of any architectural or development project.

We have over 50 staff, with an unrivalled depth of experience. Our industry knowledge, technical expertise and commercial insight allow us to deliver an exceptional and reliable service.

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Revision Record

No.	Author	Reviewed/Approved	Description	Date
A	A Ashworth	S Yorke	Internal draft	12/05/2021
0	A Ashworth		Client issue	12/05/2021
1	A Ashworth		Updated Plans	24/05/2021

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Executive Summary

TTM was engaged by Dowse Projects to undertake an environmental noise impact assessment of a proposed mixed use development located at 19-25 Campbell Street, Bowen Hills. The assessment was based upon Brisbane City Council *City Plan 2014* planning scheme and State Development Assessment Provision codes.

Unattended noise monitoring was conducted to determine the current road traffic, rail and ambient noise levels at the development location.

Noise generated by the development was assessed onto the nearest noise sensitive receivers during all time periods in accordance with the Centre and Mixed Use Code and compliance was predicted to be achieved with operation of alfresco dining and waste collection between 6am-10pm.

Noise modelling of road traffic noise and rail noise was conducted. Planning scheme and State code requirements result in almost all façades requiring acoustic attenuation requirements. Solid balustrades are recommended for facades impacted by noise category 2 or higher.

Mechanical plant selections are not available at this stage. To comply with planning scheme acceptable outcomes for mechanical plant (Multiple Dwelling Code AO42), we recommend mechanical plant is acoustically screened from nearby sensitive uses. A mechanical plant noise assessment should be conducted once plant selections are finalised during design development stage.

Compliance with the relevant planning scheme and State transport noise requirements is predicted based on the implementation of the recommendations outlined in Section 9 of this report.

Contents

Table Index

Figure Index

1 Introduction

1.1 Background

TTM was engaged by Dowse Projects to undertake an environmental noise impact assessment of a proposed mixed use development located at 19-25 Campbell Street, Bowen Hills. The proposal is for ground floor commercial retail and multiple dwellings over 29 levels of residential apartments with car parking and communal facilities.

1.2 References

This report is based on the following:

- Brisbane City Council (BCC) *City Plan 2014*
- *Noise impact assessment planning scheme policy* - Schedule 6, City Plan 2014
- State Development Assessment Provisions (SDAP) Version 2.6
- Queensland Development Code (QDC) MP4.4 – *Buildings in a Transport Noise Corridor* (August 2015)
- Development plans as shown in Appendix A
- Site inspection, noise measurements, analysis and calculations conducted by TTM

1.3 Scope

The assessment includes the following:

- Description of the site.
- Measurement of existing road traffic, rail and ambient noise levels.
- Statement of assessment criteria relating to noise emissions, road traffic and rail noise impacts.
- Prediction of future road traffic and rail noise onto the development.
- Analysis of measured and predicted noise levels.
- Details of noise control recommendations to be incorporated to achieve predicted compliance.

2 Site Description

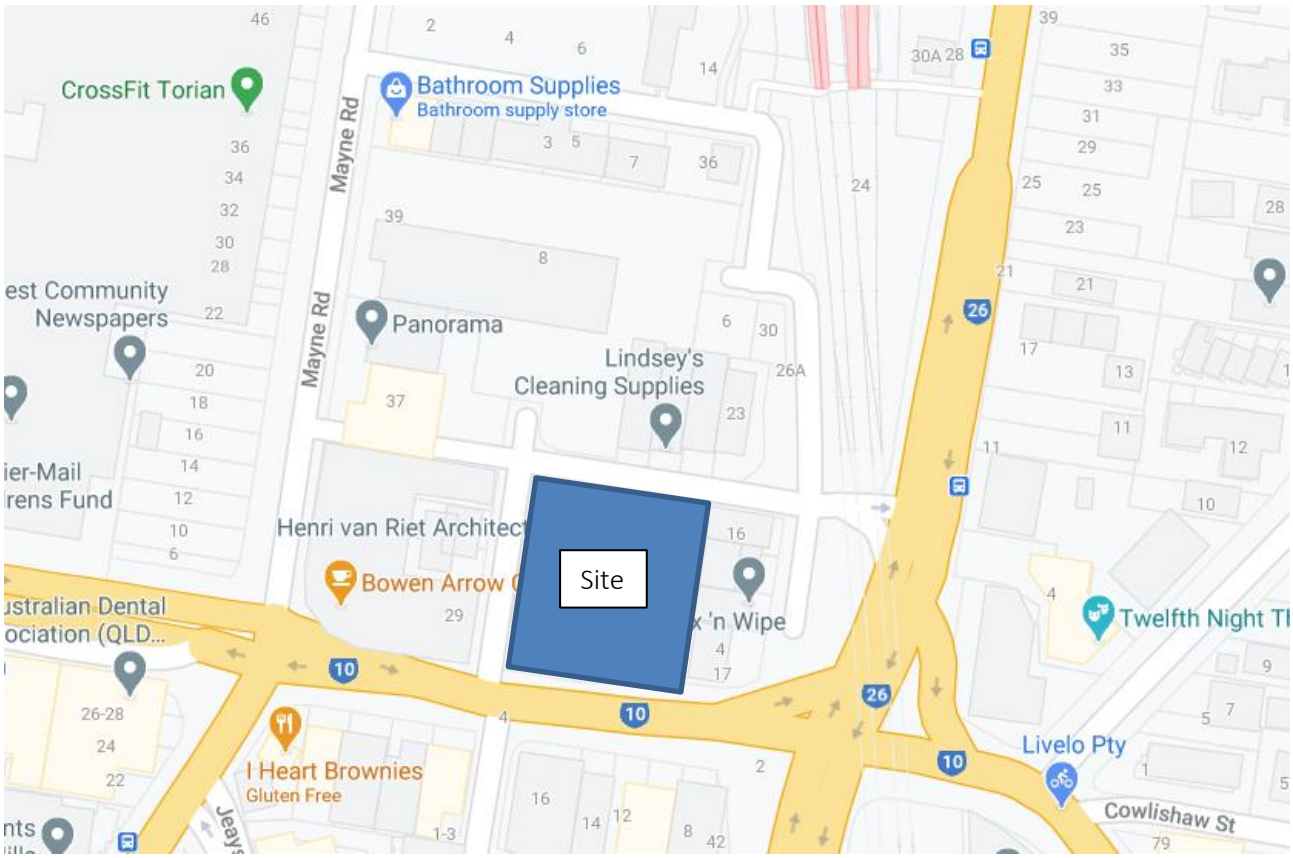
2.1 Site Location

The site is described by the following:

- 19-25 Campbell Street, Bowen Hills

The site locality is shown in Figure 1.

Figure 1: Site Locality



2.2 Current Site Conditions

The site at 19-25 Campbell Street, Bowen Hills currently consists of commercial uses. The site is bound by other commercial uses to the east, Edgar Street to the north, Campbell Street to the south and Hazelmount Street to the west. The current acoustic environment at the ground level of the site is primarily comprised of road traffic noise from Campbell Street and Abbotsford Road / Markwell Street.

3 The Proposed Development

3.1 Development Description

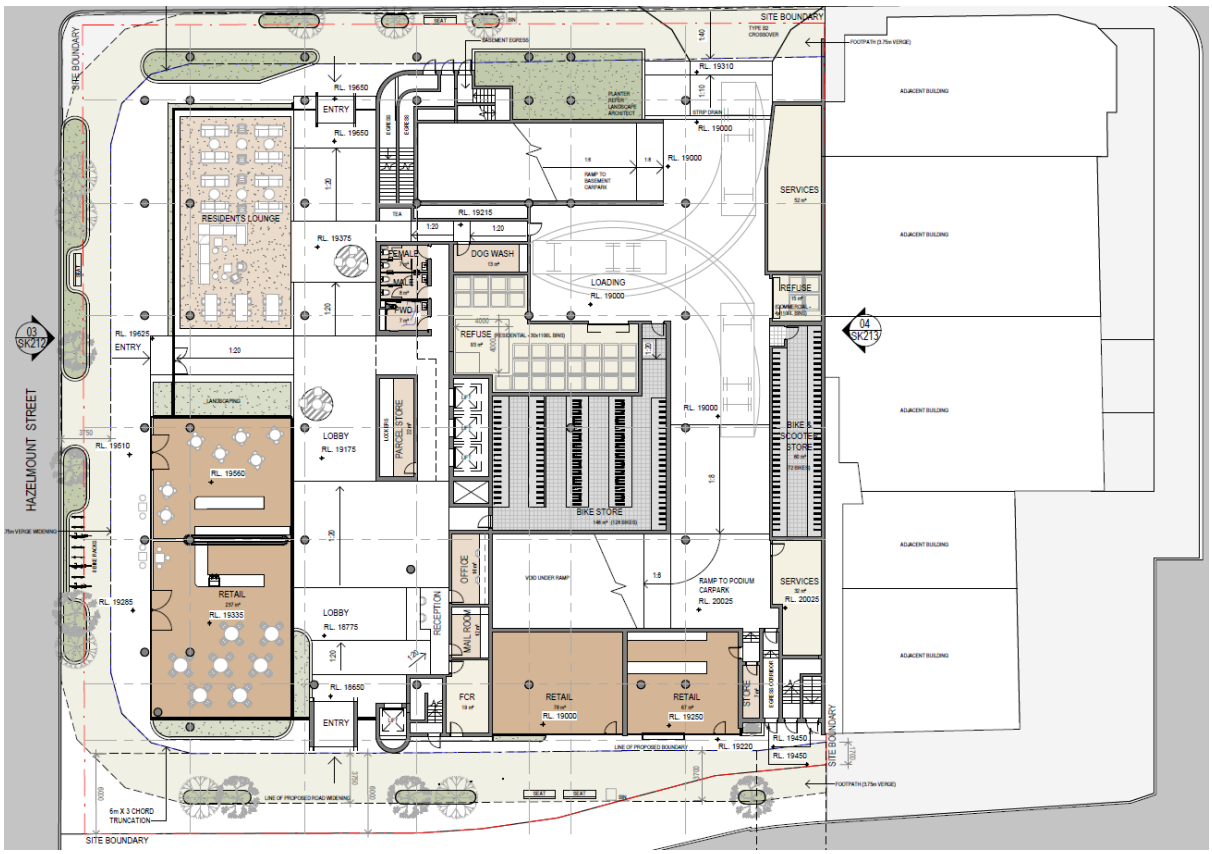
The proposal is to develop a mixed use development comprising of the following:

- Basement levels for car parking and services
- Ground floor level with retail and residential services.
- Levels 1 to 3 for car parking, with podium apartments.
- Level 4 - Apartments, gymnasium and outdoor common space.
- Levels 5 to 29 - Approximately 12 apartments per level.
- Rooftop - Mechanical plant, pool, and outdoor common space

This report assessed operation during all time periods and recommend restrictions where required.

The ground floor plan is presented in Figure 2. Further samples of the development plans are shown in Appendix A.

Figure 2: Ground Floor Plan



4 Measurements

4.1 Equipment

The following equipment was used to measure existing noise levels:

- ARL EL316 Environmental noise logger (SN# 16-306-005)
- ARL EL315 Environmental noise logger (SN# 15-302-489)
- Norsonic 140 noise logger (SN# 1406507)
- Norsonic Nor131 Sound Level Meter (SN# 1313158)
- B&K Sound Calibrator (SN# 3009814)

All equipment was calibrated by a National Association of Testing Authorities (NATA) accredited laboratory. The sound analysing equipment was field calibrated before and after the measurement session. No significant drift from the reference signal was recorded.

4.2 Unattended Noise Monitoring

Unattended noise monitoring was conducted to establish the existing ambient and road traffic noise levels between Monday 19th and Friday 23rd April 2021 and rail noise levels were measured between Tuesday 6th and Friday 9th April 2021. The noise monitoring locations are shown in Figure 3.

The noise monitors were in positions considered representative of the noise environment near the site with consideration to both access and security requirements. After surveying the area, a secure and safe location to measure rail noise was only possible south of the site, and the rail line closest to the site is within a tunnel. For road traffic noise, secure and safe locations were found as close to the site as possible to measure road traffic noise for Campbell Street and Abbotsford Road / Markwell Street. The ambient noise logger (and Campbell Street road traffic noise) was placed on site.

Verification between the rail and road traffic noise 3D SoundPLAN models and the measured noise levels, enables the 3D models to be representative of this noise environment.

Figure 3: Noise Monitoring Locations

The microphones were in free-field locations and 1.5m above ground level.

The noise monitors for ambient and road traffic noise were set to measure statistical noise levels in 'A'-weighting, 'Fast' response, over 15 minute intervals. Ambient noise levels were measured in accordance with Australian Standard *AS1055:1997 Acoustics – Description and Measurement of Environmental Noise* (AS1055). Road traffic noise levels were measured in accordance with Australian Standard *AS2702:1984 Acoustics – Methods for the measurement of road traffic noise* (AS2702).

The noise monitor for rail noise was set to 1 minute intervals and set to record audio with a trigger noise level of 75dB(A). The audio recordings were used to confirm the L_{Amax} levels were from a train pass-by event and not an extraneous noise source. Attended noise measurements were undertaken on Monday 6th April and were used to verify the unattended noise logging data. Weather during the monitoring periods was generally fine (source: Bureau of Meteorology).

4.3 Results of Measurements

4.3.1 Ambient Noise Levels

Table 1 presents the measured ambient noise levels. The Rating Background Level (RBL) was determined in accordance with the BCC *Noise Impact Assessment Planning Scheme Policy* (NIAPSP). Graphical presentation of the measured levels is shown in Appendix B.

Table 1: Measured Ambient Noise Levels

Time Period	Measured Noise Levels, dB(A)	
	RBL L_{90}	L_{eq}
Daytime (7am – 6pm)	55	67
Evening (6pm – 10pm)	50	65
Night time (10pm – 7am)	40	62

4.3.2 Road Traffic Noise Levels

Table 2 presents the measured road traffic noise levels at the unattended noise monitoring location. Graphical presentation of the measured noise levels is presented in Appendix B.

Table 2: Measured Road Traffic Noise Levels - Campbell Street

Road Traffic Noise Descriptor	Time Period	Measured Level dB(A)
$L_{A10,18hr}$	6am to midnight	69
Noisiest day-time $L_{Aeq,1\ hour}$	6am to 7am	69
Noisiest night-time $L_{Aeq,1\ hour}$	5am to 6am	65
$L_{Aeq,24\ hour}$	Midnight to midnight	66
$L_{90,\ 8\ hour}$	10pm to 6am	44
$L_{90,\ 18\ hour}$	6am to midnight	55

Table 3: Measured Road Traffic Noise Levels - Markwell Street / Abbotsford Road

Road Traffic Noise Descriptor	Time Period	Measured Level dB(A)
$L_{A10,18hr}$	6am to midnight	69
Noisiest day-time $L_{Aeq,1\ hour}$	5pm to 6pm	71
Noisiest night-time $L_{Aeq,1\ hour}$	5am to 6am	64
$L_{Aeq,24\ hour}$	Midnight to midnight	66
$L_{90,\ 8\ hour}$	10pm to 6am	45
$L_{90,\ 18\ hour}$	6am to midnight	56

4.3.3 Rail Noise Levels

Rail timetables provided by Queensland Rail (QR) indicate a maximum of 850 passenger trains and up to 19 diesel powered freight train pass the site per weekday.

The Queensland Rail Code of Practice – Railway Noise Management defines the single event maximum (SEM) sound pressure level as the arithmetic average of the highest 15 single maximum noise level events over a 24-hour period. Table 4 presents the highest 15 free-field L_{Amax} rail noise levels during the measured 24-hour period.

The calculated $L_{Aeq,24hr}$ is based on these measured L_{Aeq} results (logarithmic average) and number of trains over a 24 hour period, and is therefore a conservative approach. This approach is required as the proximity of road traffic and other extraneous noises, results in a significant portion of measured non-rail noise and it is not practical to identify and remove all non-rail event measurement data over each 24 hour period.

Table 4: Measured Rail Noise Levels (Highest 15 each day)

Date	Train Type*	Maximum Noise Level L_{MAX} dB(A)	Noise Level L_{eq} dB(A)	Warning Device
7th April 2021	Passenger	98.1	80.5	No
	Passenger	96.3	75.7	Yes
	Passenger	91.4	77.5	No
	Passenger	91	75.8	No
	Passenger	90	77.4	No
	Passenger	89.5	72.8	No
	Passenger	89.4	76.8	No
	Passenger	89.1	76.2	No
	Passenger	88.8	75.8	No
	Passenger	88.7	72.3	No
	Passenger	88.5	73.5	No
	Passenger	88.3	77.4	No
	Passenger	88.2	77.9	No
	Passenger	87.9	77.2	No
	Passenger	87.8	76.2	No
	Single event maximum noise level (SEM) dB(A)	**90.2**		
	Leq,24hour dB(A)		**58.5**	
8th April 2021	Passenger	95.4	78.6	No
	Passenger	93.7	78.7	No
	Freight	90.9	78.3	No
	Passenger	90.8	77.9	No
	Passenger	90.6	76.2	No

Date	Train Type*	Maximum Noise Level L_{MAX} dB(A)	Noise Level L_{eq} dB(A)	Warning Device
	Passenger	90.4	76.3	No
	Passenger	90.4	80.3	No
	Passenger	89.7	81.5	No
	Passenger	89.6	79.8	No
	Passenger	89.5	71.6	No
	Passenger	89.4	80.2	No
	Passenger	88.9	75	No
	Passenger	88.8	72.6	No
	Passenger	88.7	75.5	No
	Passenger	88.7	78.2	No
	Single event maximum noise level (SEM) dB(A)	**90.4**		
	Leq,24hour dB(A)		**58.6**	
Maximum of both 24 hour periods	**Single event maximum noise level (SEM) dB(A)**	**90.4**		
	Leq,24hour dB(A)		**58.6**	

*L_{MAX} noise levels were dominated by the noise of train wheel / brake squeal.

5 Noise Criteria

The Brisbane City Council *City Plan 2014* details site specific planning scheme zones, overlays and codes relevant to a site in the BCC local government area. Table 5 summarises the planning scheme requirements for the site which are relevant to the noise assessment.

Table 5: City Plan 2014 - Site Specific Acoustic Requirements

Zone	Code	Overlay Code
Emerging Community Zone	Mixed Use Code Multiple Dwelling Code	Transport Noise Corridor Overlay

5.1 Multiple Dwelling Code

The primarily performance outcomes relating to acoustics within the *Multiple Dwelling Code* are detailed in the following Tables.

Table 6: Multiple Dwelling Code Performance Outcome P042

Performance Outcomes	Acceptable Outcomes
PO42 Development that includes mechanical plant (including air-conditioning plant, heat pumps and swimming pool pumps) ensures it is located, designed and attenuated to achieve the following criteria: $L_{Aeq,adj,T}$ emitted from mechanical plant is not greater than the rating background level plus 3 at a sensitive use not associated with the development. Note— Where T is • Day (7am to 6pm): 11hr, • Evening (6pm to 10pm): 4hr, • Night (10pm to 7am): 9hr. Where- $L_{Aeq,adj,T}$ is the A-weighted equivalent continuous sound pressure level during measurement time T, adjusted for tonal and impulsive noise characteristics, determined in accordance with the methodology described in the Noise impact assessment planning scheme policy. The rating background level is determined in accordance with the methodology described in the Noise impact assessment planning scheme policy. 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.	**AO42** Development ensures mechanical plant is acoustically screened from nearby sensitive uses.

To comply with *Performance Outcome PO42* it is recommended the development comply with *Acceptable Outcome AO42* by applying acoustic screening to exposed mechanical plant with the potential to impact adjacent noise sensitive receivers.

PO42 criteria based on the measured ambient noise levels are summarised in Table 7.

Table 7: Mechanical Plant Criteria

Time Period	Measured RBL L_{90} dB(A)	Criteria $L_{Aeq,adj,T}$
Day (7am – 6pm)	55	58
Evening (6pm – 10pm)	50	53
Night (10pm – 7am)	40	43

5.2 Centre or Mixed Use Code

The development proposes retail/commercial uses which are applicable for assessment with the *Centre or Mixed Use Code*. Table 8 summarises the primary acoustic requirements that apply to the site.

Table 8: Centre or Mixed Use Code Performance Outcome P01

Performance Outcomes	Acceptable Outcomes
PO1 Development: (a) has hours of operation which are controlled so that the use does not detrimentally impact on the amenity of adjoining residents; (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 9.3.3.3.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. 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.	**AO1.1** Development: (a)for accommodation activities, dwelling unit or emergency services has unlimited hours of operation; (b)for a club, if licensed, function facility, hotel or nightclub entertainment facility does not generate noise which is clearly audible and detectable, or impacts on the amenity of a resident, in a dwelling or other sensitive use; Note-Development for a club, if licensed, function facility, hotel or nightclub entertainment facility is not expected to achieve this outcome. (c)for any other use: i. Where in the Principal centre zone or Major centre zone has unlimited hours of operation; ii. Where in District centre zone, Neighbourhood centre zone or Mixed use zone: a. Has hours of operation, including deliveries, which are limited to 6am to 10pm; or b. Does not generate noise which is clearly audible and disturbing in a dwelling or other sensitive use; iii. Where in any other zone: a. Has hours of operation, including for deliveries, which are limited to 6am to 8pm; or b. Does not generate noise which is clearly audible and disturbing in a dwelling or other sensitive use.
	AO1.2 Development ensures mechanical plant or equipment is acoustically screened from an adjoining sensitive use.
PO61 Development of garages, driveways and parking structures minimise impacts on the amenity of neighbouring dwellings.	**AO61.1** Development for a car park: **(a)** provides a 2m-high acoustic fence and a landscaped area 1.5m wide where located adjacent to a neighbouring dwelling;

	is acoustically screened where the car park is used at night and where located adjacent to a neighbouring dwelling.
	AO61.2 Development for a driveway or vehicle movement area is screened by a 2m-high acoustic fence along the side or rear boundary if located adjacent to a residential dwelling.

Accommodation and dwelling unit activities comply with *Acceptable Outcome A01.1 (a)* as these activities are allowed unlimited hours of operation.

The development proposes ground floor retail / commercial uses. As the site is located in an Emerging Community zone, the acceptable hours of operation apply as follows:

- *Acceptable Outcome A01.1 (c)(iii)* allows hours of operation, including deliveries from 6am to 8pm.

An assessment of commercial activities will be conducted to determine if the hours of operation can be extended beyond 8pm.

It is recommended the development comply with *Acceptable Outcome AO1.2* by applying acoustic screening to exposed mechanical plant with the potential to impact adjacent noise sensitive receivers.

PO61 is not applicable as the site is not located adjacent to a residential dwelling. Onsite noise generated by car movements and car park activities will be assessed in accordance with the criteria of PO1.

5.2.1 Noise (Planning) Criteria

The noise emission criteria of Performance Outcome PO1 of the Centre or Mixed Use Code (Table 9.3.3.F) is presented in Table 9. The project specific criteria are identified in 'bold'.

Table 9: Noise (Planning) Criteria (Table 9.3.3.3.F)

Criteria Location	Intrusive noise criteria, dB(A) Day, evening and night $L_{Aeq,adj,T}$ are not greater than the RBL plus the value shown in Column 1 below.				Acoustic amenity criteria, dB(A) Day, evening and night $L_{Aeq,adj,T}$ are not greater than the values in this column for the relevant criteria location		
	Column 1	Day	Evening	Night	Day	Evening	Night
Emerging Community Zone boundary	+5	60	55	45	55	50	45
Project Specific Criteria					**55**	**50**	**45**

Day: 7am – 6pm. Evening: 6pm – 10pm. Night 10pm – 7am.

*The project specific noise criterion is taken as the most stringent value for each time period from the Intrusive and Amenity noise criteria.

5.2.2 Night-time Noise Criteria

The night-time noise criteria for 'impact / short duration' type noise sources are outlined in *Table 9.3.3.3.H* of the code. This criteria is reproduced in Table 10. The project specific criteria is identified in 'bold'.

Table 10: Night-time Noise Criteria (Table 9.3.3.3.H)

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 period is not greater than the following values at the relevant criteria location	The Absolute highest single L_{Amax} event over a given night period is not greater than the following values at the relevant criteria location
At the zone boundary of an emerging community zone	> 60 dB(A) 62 dB(A) measured	65 dB(A)	70 dB(A)

5.3 Transport Noise Corridor Overlay Code

The Transport Noise Corridor Overlay of City Plan 2014 identifies the site as being situated within a transport noise corridor as specified by the Queensland Development Code MP4.4. Table 11 outlines the performance outcomes of the Transport Noise Corridor Overlay Code.

Table 11: Transport Noise Corridor Overlay Code outcomes, City Plan 2014

Performance Outcomes	Acceptable Outcomes
PO1 Development provides outdoor space for passive recreation in a manner where transport noise has been minimised.	AO1 Development ensures that each dwelling: (a) has a balcony or outdoor recreation area shielded by the building from direct road traffic noise; or (b) with a balcony exposed to road traffic noise has a solid gap free balustrade

It will be recommended the development adopt *Acceptable Outcome AO1* where each balcony exposed to road traffic noise (QDC noise category 2 or higher) has a solid gap free balustrade.

5.4 Road Traffic Noise

The site is located in the Local government transport noise corridor of Campbell Street and Abbotsford Road / Markwell Street which identifies the site to be affected by road traffic noise at the worst-case level of Queensland Development Code (QDC) MP4.4 Noise Category 4 (at the boundary). Details of the QDC MP4.4 requirements are included below.

5.4.1 Queensland Development Code MP4.4 – Road Traffic Noise

The *Queensland Development Code Part MP 4.4 - 'Buildings in a Transport Noise Corridor'* August 2015 (QDC) specifies Noise Categories to ensure that habitable rooms of residential buildings are adequately protected from transport noise over a 10-year planning horizon.

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[1]. Details regarding the noise categories and acceptable forms of construction can be found within Schedule 1 and 2 of the QDC document (see Appendix E). The triggers for each noise category are summarised in Table 12.

Table 12: Road Traffic Noise Category Levels – QDC MP4.4 (Schedule 3)

Noise Category	Level of Transport Noise* $L_{A10,18Hour}$ 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.

5.5 Rail Noise

The assessment of rail noise is considered under the following criteria.

5.5.1 State Development Assessment Provisions

The noise criteria for land affected by emissions from rail activities are contained in State Code 2 of the State Development Assessment Provisions (SDAP). The criteria are reproduced in Table 13.

Table 13: SDAP Noise Criteria - Rail Noise

Performance Outcomes	Acceptable Outcomes
PO25 Development involving: 1. an accommodation activity; or 2. land for a future accommodation activity minimises noise intrusion from a railway or type 2 multi-modal corridor in habitable rooms.	**AO25**.1 A noise barrier or earth mound is provided which is designed, sited and constructed: 1. to meet the following external noise criteria at all facades of the building envelope: a. ≤65 dB(A) Leq (24 hour) façade corrected b. ≤87 dB(A) (single event maximum sound pressure level) façade corrected 2. in accordance with the Civil Engineering Technical Requirement – CIVIL-SR-014 Design of noise barriers adjacent to railways, Queensland Rail, 2011. Habitable rooms of relevant residential buildings located within a transport noise corridor must comply with the Queensland Development Code MP4.4 Buildings in a transport noise corridor, Queensland Government, 2015. Transport noise corridors are mapped on the State Planning Policy Interactive Mapping System.

[1] AS NZS 2107:2016. Acoustics - Recommended design sound levels and reverberation times for building interiors

Performance Outcomes	Acceptable Outcomes
PO26 Development involving an accommodation activity minimises noise intrusion from a railway or type 2 multimodal corridor in outdoor spaces for passive recreation	**AO26.1** A noise barrier or earth mound is provided which is designed, sited and constructed: 1. to meet the following external noise criteria in outdoor spaces for passive recreation: a. ≤62 dB(A) Leq (24 hour) free field b. ≤84 dB(A) (single event maximum sound pressure level) free field 2. in accordance with the Civil Engineering Technical Requirement – CIVIL-SR-014 Design of noise barriers adjacent to railways, Queensland Rail, 2011. OR **AO26.2** Each dwelling has access to an outdoor space for passive recreation which is shielded from a railway or type 2 multi-modal corridor by a building, a solid gap-free fence, or other solid gap-free structure. AND **AO26.3** Each dwelling with a balcony directly exposed to noise from a railway or type 2 multi-modal corridor has a continuous solid gap-free balustrade (other than gaps required for drainage purposes to comply with the Building Code of Australia).

5.5.2 Queensland Development Code MP4.4 - Rail

The *Queensland Development Code Part MP 4.4 - 'Buildings in a Transport Noise Corridor* August 2015 (QDC) specifies Noise Categories to ensure that habitable rooms of residential buildings are adequately protected from transport noise over a 10-year planning horizon.

The Noise Categories list the minimum acoustic R_W ratings for each building component to comply with the indoor sound criteria. 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 14.

Table 14: Rail Noise Category Levels – QDC MP4.4 (Schedule 3)

Noise Category	Single event maximum noise* (L_{Amax}) 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.

6 Assessment of Noise Emissions

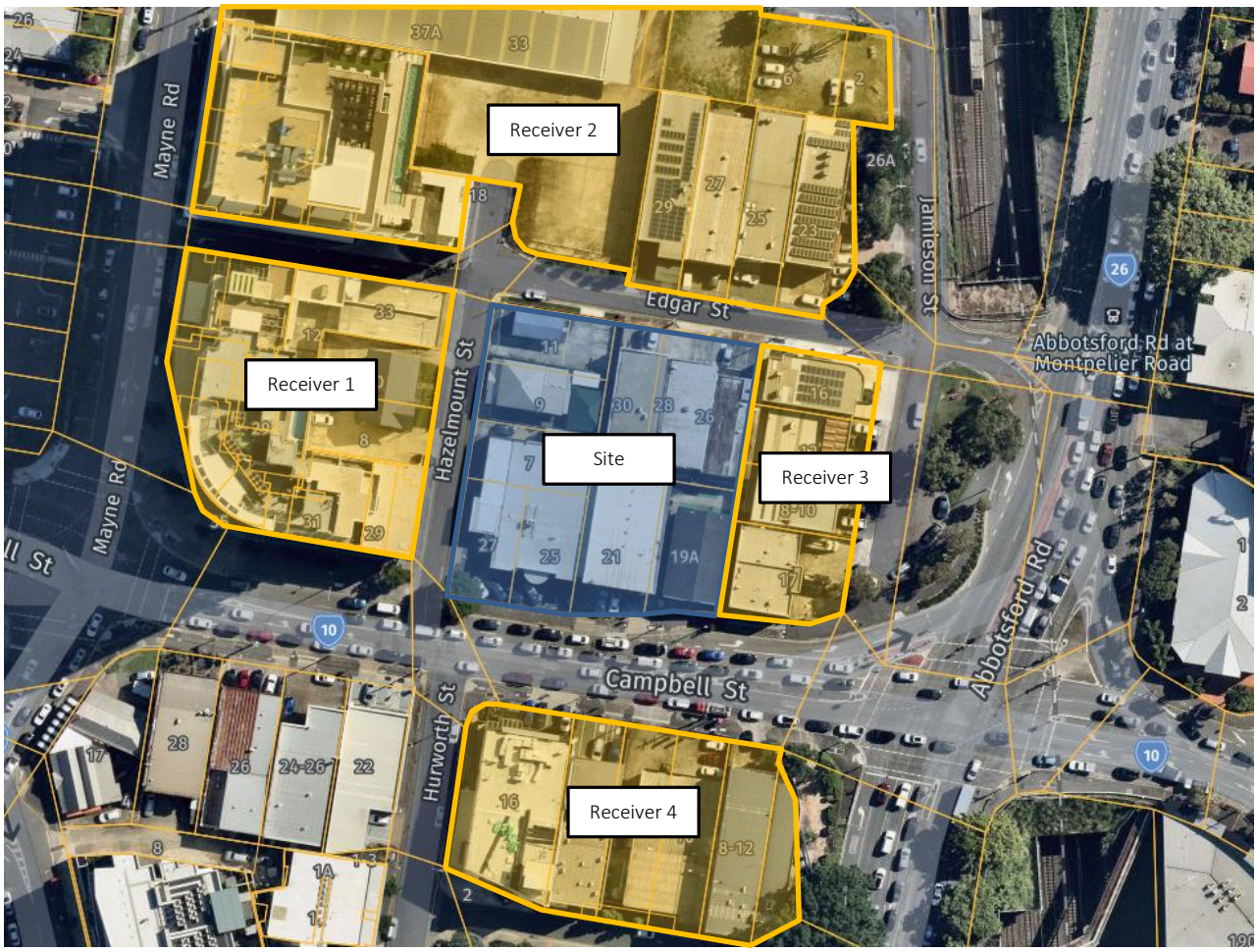
The following section presents an assessment of noise associated with the commercial component of the development to determine the potential impacts at the nearest noise sensitive receivers.

6.1 Noise Sensitive Receivers

This assessment will focus on the nearest noise sensitive receivers as outlined below and shown in Figure 4. If compliance can be achieved at these nearest receivers, then all remaining noise sensitive locations are expected to comply.

- Receivers 1 and 2: Emerging Community Zone (includes residential apartments)
- Receivers 3 and 4: Emerging Community Zone

Figure 4: Noise Sensitive Receivers



6.2 Noise Source Levels

Table 15 presents the typical noise sources with the potential to impact noise sensitive receivers and the respective measured noise levels. The noise source levels were calculated to one metre and include corrections for tonality and impulsiveness as per *AS1055* where applicable.

Table 15: Typical Transient Noise Source Levels

Noise Source Description	Noise Level at 1m, dB(A)		Measured Duration (sec)
	$L_{Aeq,T}$	L_{Amax}	
Car door closure	75*	83*	2
Car bypass @ 5km/h	69	N/A^	6
Car engine ignition	72	74	3
Conversations	65*	N/A^	60
Alfresco dining (Crowd Noise for 50 patrons)	75	N/A^	60
Gymnasium activities	74*	85*	600
Truck passby / deliveries	80	N/A^	30
Waste collection	93*	105*	40

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

^People and vehicle pass-by noise is excluded from L_{max} assessment in accordance with NIAPSP.

6.3 Noise Assessment Methodology

The following assumptions have been made for noise calculations:

- Car movements were predicted from the nearest car parking or driveway area to the receiver. Car door closures and engine starts were predicted from the nearest group of car parking spaces relative to the receiver.
- The method of predicting vehicle noise from the nearest single location is conservative as the noise sources would be spread out across the car park at varying distances from the receiver.
- Site car parking generation rates are based on 187 events per hour (based on 0.5vph/dwelling with 374 units).
- Conversation noise is predicted from the communal areas on level 4 and the roof and was based on 'raised, male voice' speech levels as per published data contained in Harris CM, Handbook of Acoustical Measurements and Noise Control – 3rd ed. Ch 16.3, Mc Graw-Hill Inc.
- Alfresco dining is predicted from the large ground level retail unit. The noise duration was assumed to be continuous during the assessment time period.
- Gymnasium activities are predicted from the gym on level 4 of the development.
- Truck passby / deliveries are based on a maximum of 3 events per hour.

- It is expected that deliveries and waste collection will both occur at ground level in the loading area.
- Shielding from buildings was included where applicable.
- Table 16 presents the expected proportion of time / number of noise events for the basis of the calculations. These have then been assumed to be the same across all time periods (day, evening and night).

Table 16: Assumptions used for Onsite Noise Calculations

Noise Source Description (Type of Event)	Prediction Location	Day/Evening/Night Period
		Events/Per hour or % of Hour
Car door closure	Podium car park	374 events per hour (2 door closures per car)
Car bypass @ 5km/h	Driveways and podium car park	187 events per hour
Car engine ignition	Podium car park	187 events per hour
Conversation noise	Communal Areas - Level 4 / Roof	100% of the time
Alfresco dining	Ground floor large retail unit	100% of the time
Gymnasium activities	Internal gyms	100% of the time
Truck passby / deliveries	Ground floor driveway and loading	3 events per hour
Waste collection	Ground floor loading area	3 events per hour

6.4 Predicted Noise Levels at Receivers

The predicted noise levels from typical onsite activities are based on the assumptions outlined in Section 6.2, noise sources presented in Table 15, distance loss to each receiver, and noise reduction from the building structure where applicable. Sample calculations are shown in Appendix C.

6.4.1 Noise Planning Criteria – L_{eq}

Table 17 presents the predicted noise emission levels at all four nearest receivers

Table 17: Predicted Noise Planning Impacts

Receiver	Noise Source	Predicted External Noise Level L_{Aeq} dB(A)	Complies with Criteria?		
			Day 55 dB(A)	Evening 50 dB(A)	Night 45 dB(A)
1	Car door closure	44	✓	✓	✓
	Car bypass @ 5km/h	37	✓	✓	✓
	Car engine ignition	39	✓	✓	✓
	Conversation noise	37	✓	✓	✓
	Alfresco dining	48	✓	✓	✗
	Gymnasium activities	21	✓	✓	✓
	Truck passby / deliveries	10	✓	✓	✓

Receiver	Noise Source	Predicted External Noise Level L_{Aeq} dB(A)	Complies with Criteria?		
			Day 55 dB(A)	Evening 50 dB(A)	Night 45 dB(A)
	Waste collection	24	✓	✓	✓
2	Car door closure	45	✓	✓	✓
	Car bypass @ 5km/h	38	✓	✓	✓
	Car engine ignition	41	✓	✓	✓
	Conversation noise	37	✓	✓	✓
	Alfresco dining	41	✓	✓	✓
	Gymnasium activities	22	✓	✓	✓
	Truck passby / deliveries	42	✓	✓	✓
	Waste collection	50	✓	✓	✗
3	Car door closure	39	✓	✓	✓
	Car bypass @ 5km/h	26	✓	✓	✓
	Car engine ignition	34	✓	✓	✓
	Conversation noise	43	✓	✓	✓
	Alfresco dining	24	✓	✓	✓
	Gymnasium activities	28	✓	✓	✓
	Truck passby / deliveries	20	✓	✓	✓
	Waste collection	35	✓	✓	✓
4	Car door closure	17	✓	✓	✓
	Car bypass @ 5km/h	13	✓	✓	✓
	Car engine ignition	13	✓	✓	✓
	Conversation noise	33	✓	✓	✓
	Alfresco dining	42	✓	✓	✓
	Gymnasium activities	20	✓	✓	✓
	Truck passby / deliveries	8	✓	✓	✓
	Waste collection	23	✓	✓	✓

Noise levels associated with the development are predicted to comply for all instances during day and evening time. At night time, alfresco dining noise and waste collection noise is predicted to exceed the criteria and recommendations have been made accordingly in Section 9.

6.4.2 Night Time Criteria – L_{max}

Table 18 presents the predicted night time noise emission levels at the nearest noise sensitive receivers. The criteria are specified in the table heading. In accordance with Section 6.2 of the NIAPSP, the L_{max} assessment only applies to impact type noise sources which excludes vehicle passbys and patron noise.

Table 18: Predicted Night-time Noise Levels

Receiver	Noise Source	Predicted External Noise Level L_{max} dB(A)	Complies with Criteria? 65 / 70 dB(A)
1	Car door closure	58	✓
	Car bypass @ 5km/h	n/a^	✓
	Car engine ignition	49	✓
	Conversation noise	n/a^	✓
	Alfresco dining	n/a^	✓
	Gymnasium activities	32	✓
	Truck passby / deliveries	n/a^	✓
	Waste collection	51	✓
2	Car door closure	60	✓
	Car bypass @ 5km/h	n/a^	✓
	Car engine ignition	51	✓
	Conversation noise	n/a^	✓
	Alfresco dining	n/a^	✓
	Gymnasium activities	33	✓
	Truck passby / deliveries	n/a^	✓
	Waste collection	77	✗
3	Car door closure	53	✓
	Car bypass @ 5km/h	n/a^	✓
	Car engine ignition	44	✓
	Conversation noise	n/a^	✓
	Alfresco dining	n/a^	✓
	Gymnasium activities	39	✓
	Truck passby / deliveries	n/a^	✓
	Waste collection	61	✓
4	Car door closure	32	✓
	Car bypass @ 5km/h	n/a^	✓
	Car engine ignition	23	✓
	Conversation noise	n/a^	✓
	Alfresco dining	n/a^	✓
	Gymnasium activities	31	✓
	Truck passby / deliveries	n/a^	✓
	Waste collection	49	✓

^People and vehicle pass-by noise is excluded from L_{max} assessment in accordance with NIAPSP.

Noise levels from the relevant impact noise sources are predicted to comply with the night criteria except for waste collection noise, which is predicted to exceed the criteria. Recommendations have been made accordingly in Section 9.

6.4.3 Preliminary Mechanical Plant Assessment

The majority of mechanical plant is expected to be located in an open air plant are on the roof. A reverse calculation was conducted to determine the allowable noise source level of onsite mechanical equipment prior to the inclusion of acoustic treatment / screening. Based on the criteria detailed in Section 5.1 and distance attenuation from the plant location to the nearest sensitive receivers, the allowable mechanical plant noise levels are presented in Table 19.

Table 19: Mechanical Plant Predictions

Potential Plant Location	Allowable Noise Level at 1m from nearest group of plant relative to the nearest receiver, to achieve compliance, L_{eq} dB(A)		
	Day 7am - 6pm	Evening 6pm – 10pm	Night 10pm – 7am
Current Proposed Rooftop Location	84	79	69

Acoustic treatment, screening, or greater distance separation between the plant and the nearest receiver may allow a higher noise limit. Compliance with the noise limits and design criteria should be checked by an acoustic consultant once plant selections for the development are finalised.

7 Road Traffic Noise Assessment

The site is located in the Local government transport noise corridor of Campbell Street and Abbotsford Road / Markwell Street. An assessment of road traffic noise onto the proposed development was conducted to determine the acoustic treatment requirements.

7.1 Traffic Volumes

Existing traffic volumes and growth rate for Campbell Street and Abbotsford Road were obtained from TTM Traffic data. The traffic volumes used in the noise model are presented in Table 20.

Table 20: Traffic Volumes used in the Noise Model

Road	Traffic Volumes (AADT)			Heavy Vehicles (%)	Growth Rate (%)
	2017	2021	2031		
Campbell Street	13,495	15,858	23,738	3.2%	4.1%
Abbotsford Road	25,025	27,864	36,471	3.0%	2.7%

The 18 hour traffic volumes used in the noise model are taken to be 95% of the AADT (Annual average daily traffic).

7.2 Noise Model

7.2.1 Noise Modelling Parameters

Road traffic noise predictions were conducted using 'SoundPLAN v8.1', a CoRTN based modelling program. The basis of the 'SoundPLAN' model is presented in Table 21.

Table 21: Noise Modelling Parameters

Description	Value
Noise modelling standard	CoRTN (UK)
Grid spacing (noise maps)	2m
CoRTN correction for QLD roads (Except Pacific Motorway, Logan Motorway to Nerang)	-0.7dB(A) (free-field) -1.7dB(A) (1m in front of building façade)
Campbell Street Speed limit	60 km/h
Abbotsford Road Speed limit	60 km/h
Noise source height above grade	0.5m
Ground contours	DEM data 2015 1m (Source: ELVIS)
Floor heights	Ground: 5m, Levels 1 -29: 3.1 to 3.5m
Receiver heights	1.5m above ground/floor level
Façade correction	+2.5 dB(A)

7.2.2 Noise Model Verification

To verify the road traffic noise model, the $L_{A10,\ 18hour}$ noise levels were modelled and compared to the measured levels as presented in Table 22. As the noise monitor was in a free-field location, the predicted noise level is also shown as free-field.

Table 22: Comparison of Measured and Predicted Road Traffic Noise Levels

Road	Measured $L_{A10,\ 18\ hour}$	Predicted $L_{A10,\ 18\ hour}$
Campbell Street	68.9	69.8
Abbotsford Road / Markwell Street	69.3	70.1

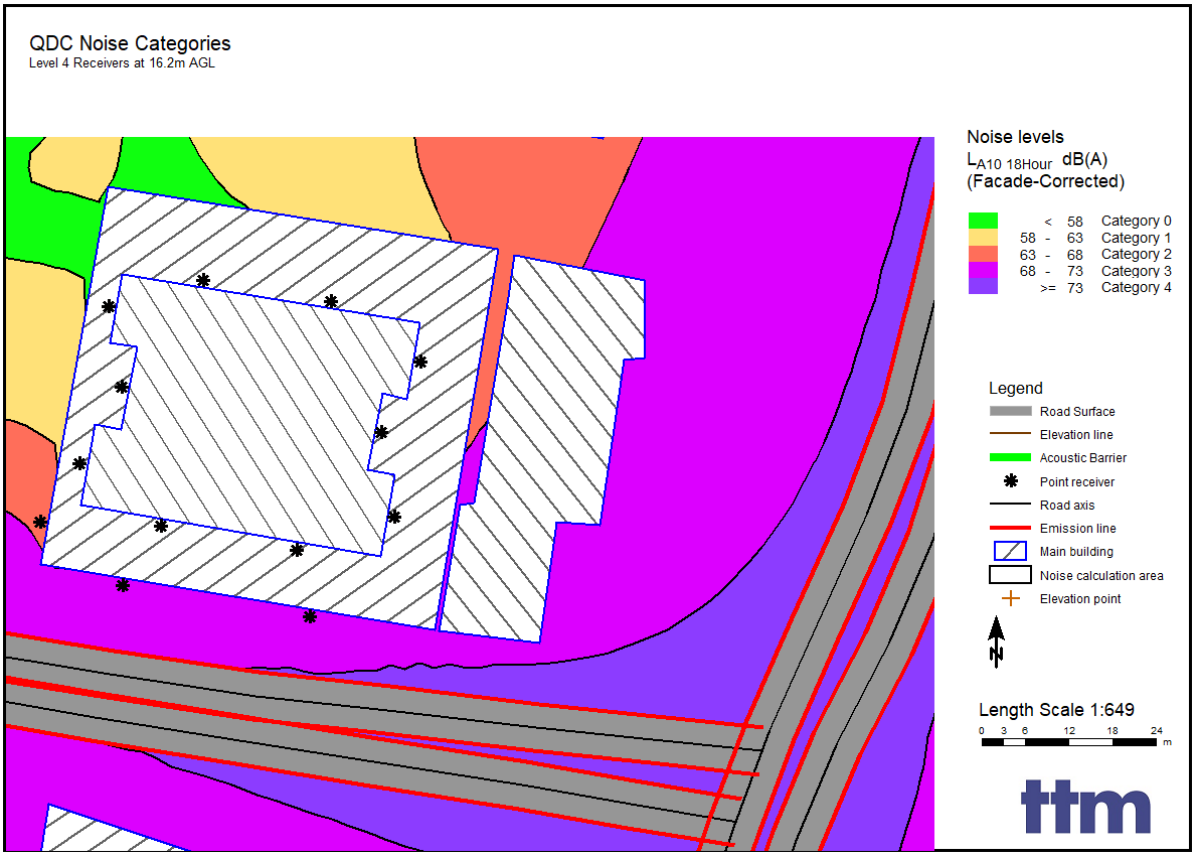
The modelled level is within the allowable tolerance of 2 dB(A) of the measured level, therefore no correction is required to the model.

7.3 Predicted Road Traffic Noise Levels

Modelling was conducted to determine road traffic noise levels at the development in the 10 year planning horizon (2031). Indicative road traffic noise contours at various heights above ground level (AGL) are presented in the following Figures. SoundPLAN receiver point results are shown in 0.

Figure 5: Predicted Road Traffic Noise Levels – Level 1 at 6.5m AGL

Figure 6: Predicted Road Traffic Noise Levels – Level 4 at 16.2m AGL



Based on the noise modelling results, the development is predicted to be impacted by road traffic noise ranging from QDC noise category 0 to 3. QDC noise categories and associated acoustic treatment requirements for each façade and floor level are detailed in Section 9.

8 Rail Noise Assessment

An assessment of rail noise on the proposed development was conducted to determine the acoustic treatment requirements for predicted compliance with the relevant criteria.

8.1 Rail Volumes

Rail timetables provided by Queensland Rail (QR) indicate a maximum of 850 passenger trains per day passed the site during the measurement period including approximately 19 diesel trains. QR advised that all services are subject to alteration, addition and cancellation which may vary the number of actual trains passing daily.

8.2 Noise Model

8.2.1 Noise Modelling Parameters

Rail noise predictions were conducted using 'SoundPLAN' v8.2. The parameters of the model are outlined in Table 23.

Table 23: Rail Noise Modelling Parameters

Description	Value
Prediction methodology	Nordic Rail Prediction (Kilde Rep. 130)
Grid spacing (noise maps)	2m
Train Frequency (daily) passenger / freight	850 / 19 (approximate)
Train speed	Passenger: 60km/h reduced at station Freight: 80km/h (standard reference speed)
Train length	Passenger: 144m Freight: 1000m Diesel engine: 36m (dual locomotive)
Rail track head height	0.6m above ground
Rail noise source height	0.5m (wheels) and 4.0m (diesel engine) above track head height (includes Kilde +0.5m addition)
L1 train type corrections	Passenger electric: -4.6dB Diesel engine: +4.4dB Freight wagons: -6.5dB
L2 correction (dLtype engine)	-100dB (removes contribution)
Rail noise measurement distance	11m from the nearest line
Ground contours	DEM data 2015 1m (Source: ELVIS)
Floor heights	Ground: 5m, Levels 1-29: 3.1m to 3.5m
Receiver heights	1.5m above ground/floor levels
Façade correction	+2.5 dB(A)

8.2.2 Noise Model Verification

The measured rail noise levels at the monitoring location were verified in the noise model prior to modelling noise impacts at the development. Table 24 presents the results of the rail noise model verification.

Table 24: Verification of the Rail Noise Model

Location	Descriptor	Measured dB(A)	Predicted dB(A)
Noise monitor	L_{Amax}	90.4	91.1
	$L_{Aeq,24hr}$	58.6	60.6

The predicted L_{max} rail noise level was within 2dB of the measured L_{max} level, therefore no correction was required. Corrections were applied to the $L_{Aeq,24hr}$ rail noise to bring the model to within approximately +2dB of the measured level $L_{Aeq,24hr}$ level. The over prediction is considered to possibly be caused by lower average train speeds in the area.

8.3 Predicted Noise Levels

Indicative rail noise contours at various heights above ground level (AGL) are presented in the following Figures. SoundPLAN receiver point results are shown in 0.

Figure 7: Predicted Rail Noise Contour Map - Level 1

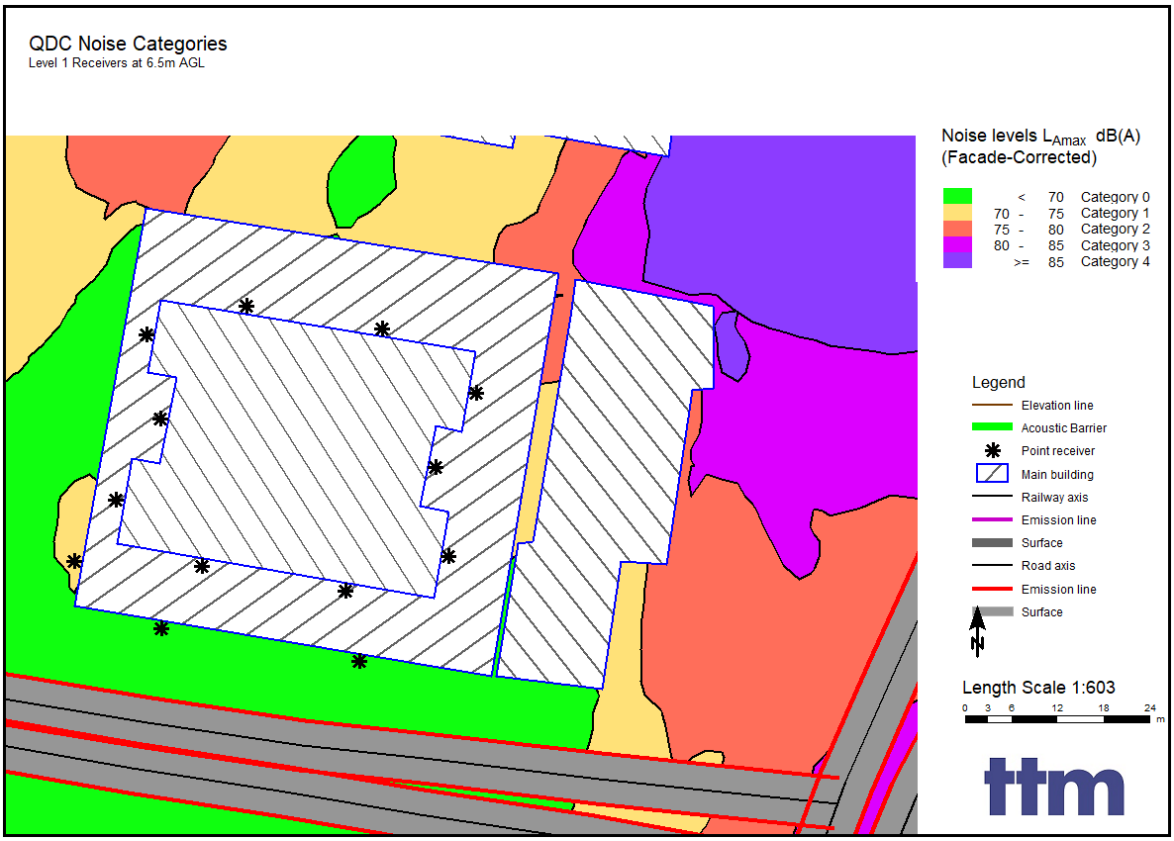
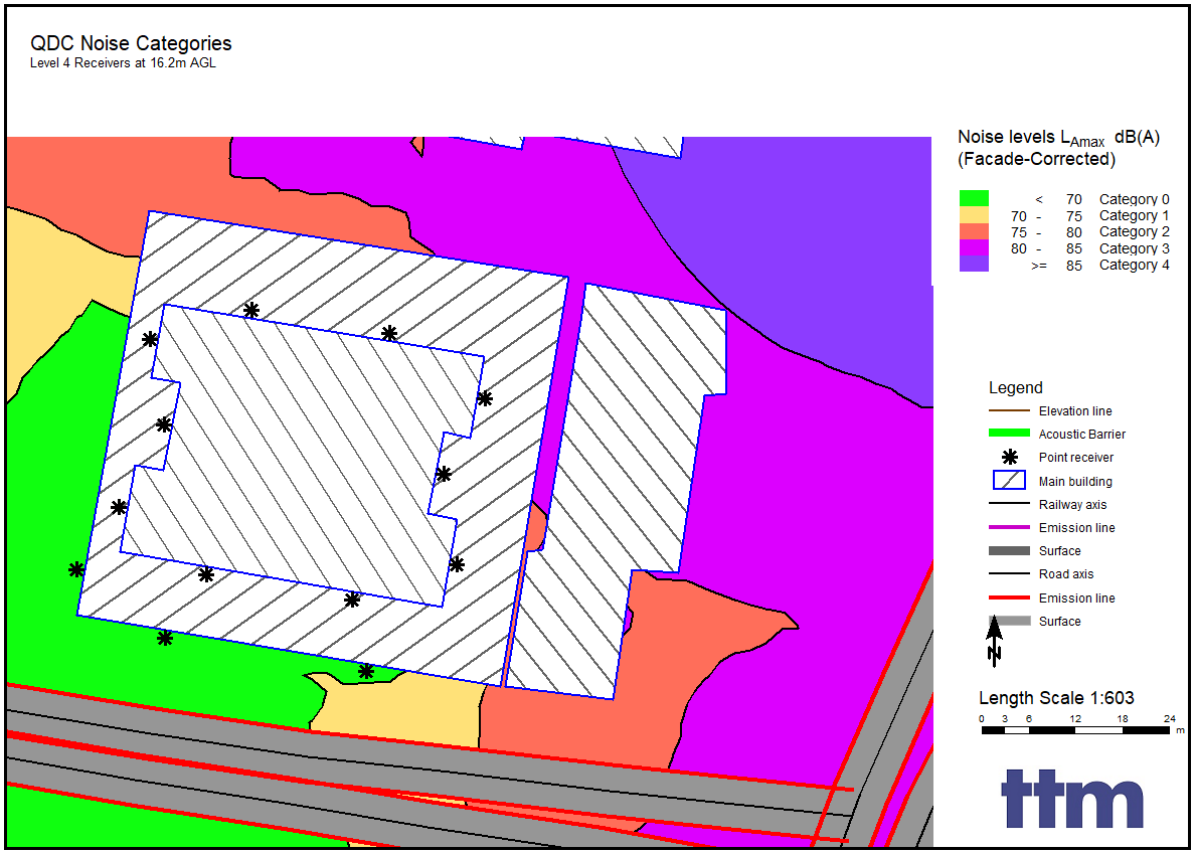


Figure 8: Predicted Rail Noise Contour Map - Level 4



Based on the receiver point modelling results presented in 0 (noise contour maps are indictive only), the development is predicted to be impacted by rail noise ranging from noise category 0 to 3.

This location is not applicable for ground level acoustic barriers. Façade treatments are recommended to achieve internal noise criteria.

The rooftop outdoor areas complies with the SDAP outdoor passive recreation criteria (L_{max} and $L_{eq,24hr}$).

Noise categories and associated acoustic treatment requirements, for each façade and floor level, for compliance with internal criteria, are detailed in Section 6.

9 Recommendations

The recommended acoustic treatments are presented in the sections below to achieve predicted compliance with the relevant assessment criteria.

9.1 Façade Treatment

9.1.1 Road Traffic and Rail Noise

9.1.1.1 Residential Accommodation

This section summarises the combined treatment required for habitable rooms for road traffic and rail noise to achieve compliance with the Queensland Development Code (QDC) MP4.4. For the purposes of the development application, the QDC provides a conservative design approach and is applied for this assessment.

In order to achieve the performance requirements of the QDC MP4.4, the external envelope of habitable rooms must comply with the minimum R_W for each building component specified in Schedule 1 to achieve a minimum transport noise reduction level for the relevant noise category by either one of the following:

a. Using materials specified in Schedule 2 of the QDC MP4.4;

OR

b. Using materials with manufacturer's specifications that achieve the minimum R_W value for the relevant building component and applicable noise category.

For application of Point (b), possible alternative constructions can be determined by the glazier (for glazing) and construction manuals such as 'The Red Book' by CSR (for walls and roof/ceiling).

Table 25 presents the road traffic and rail noise categories for habitable rooms for the residential and student accommodation uses.

Table 25: Noise Categories

Receiver	Façade Direction	Floor Level	Noise Category Habitable Rooms		
			Road Traffic	Rail	Maximum
See Noise Category Results in Appendix C					

Details regarding noise categories and associated sound reduction (R_w) requirements for habitable rooms can be found within Schedule 1 of the QDC MP4.4. QDC Schedule 1 is reproduced in Table 26.

Table 26: Façade Acoustic Treatment Requirements

Noise Category	Required Sound Reduction Rating (R_w) for Habitable Rooms			
	Glazing > 1.8m²*	Glazing ≤ 1.8m²*	External Walls	Roof and Ceiling
Category 4	R_w 43	R_w 43	R_w 52	R_w 45
Category 3	R_w 38	R_w 35	R_w 47	R_w 41
Category 2	R_w 35	R_w 32	R_w 41	R_w 38
Category 1	R_w 27	R_w 24	R_w 35	R_w 35
Category 0	None			

*Total glazing area for room

Details regarding sound reduction ratings (R_w) and acceptable forms of construction can be found within QDC MP 4.4 Schedule 2. QDC Schedule 1 and 2 are provided in Appendix E of this report.

Receiver locations are shown in Figure 9, Figure 10 and Figure 11.

Figure 9: Receiver Locations - Levels 1-3, Podium Apartments

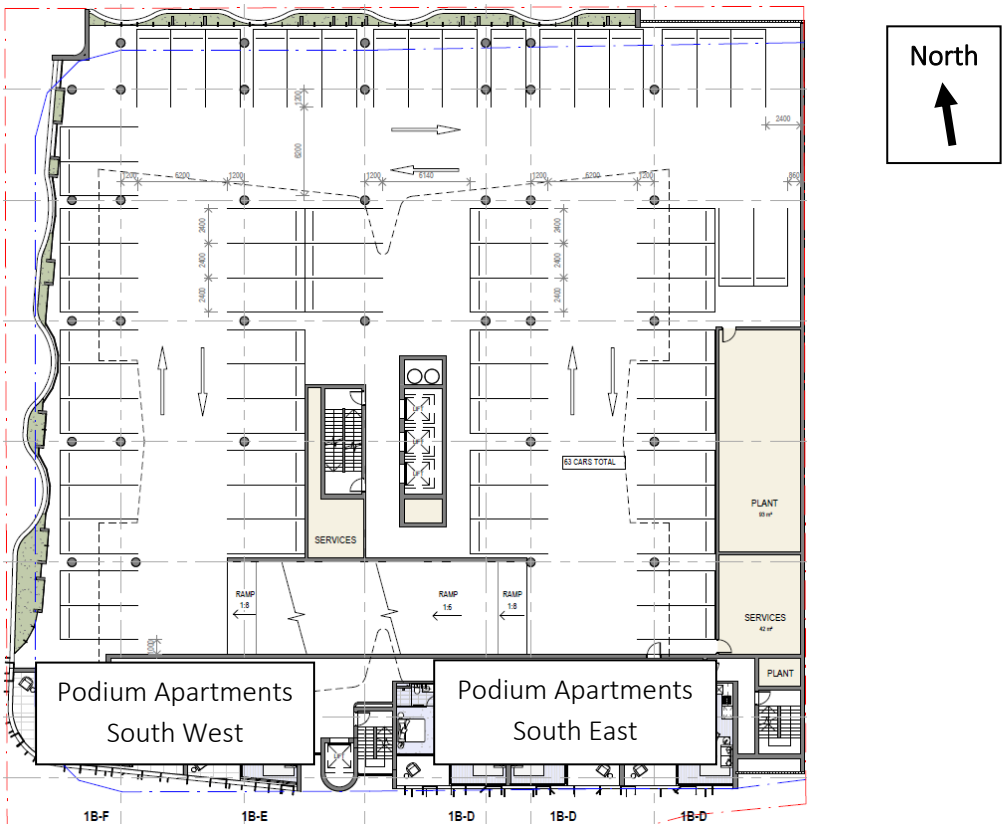


Figure 10: Receiver Locations - Levels 4-29, Apartments

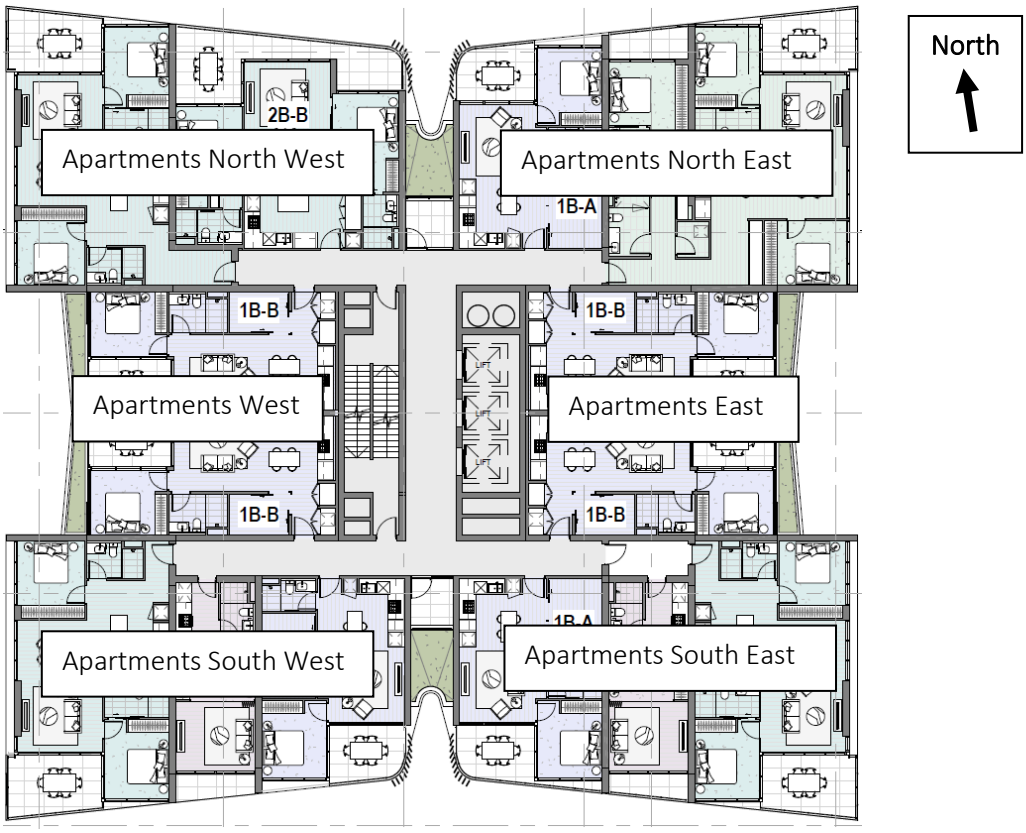


Figure 11: Receiver Locations - Rooftop

9.2 Solid Balustrades

To comply with *Performance Outcome PO1* of the *Transport Noise Corridor Overlay Code*, we recommend the adoption of *Acceptable Outcome AO1*:

> *Development ensures that each dwelling:*
>
> *a) has a balcony or outdoor recreation area shielded by the building from direct road traffic noise; or*
> *b) with a balcony exposed to road traffic noise has a solid gap free balustrade.*

Solid balustrading also achieves compliance with SDAP AO26.2/AO26.3 for rail noise.

Solid balustrades are recommended for all residential balconies and outdoor recreation areas with a road traffic or rail QDC noise category of 2 or higher (as per Table 25 and Appendix C). Examples of possible construction materials for solid balustrading are masonry, glazing or other solid material with no gaps or holes. A gap at the bottom of the balustrade may be required for drainage purposes to comply with the Building Code of Australia.

9.3 Management Strategies

The following management strategies are recommended to minimise noise annoyance:

a. Waste collection to only occur between 6am and 10pm.

b. Alfresco dining to only occur between 6am and 10pm.

c. Car parking and manoeuvring areas to have a low wheel squeal surface finish.

d. 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.

e. Speed bumps (if proposed) should be built into the finished surface of the car park / driveways and not be made of metal.

9.4 Mechanical Plant

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

To comply with planning scheme acceptable outcomes for mechanical plant, we recommend the following for plant with the potential to adversely impact nearby sensitive receivers:

> *Development ensures mechanical plant is acoustically screened from nearby sensitive uses.*

The definition of 'acoustically screened' is provided in Table SC1.2.3.B of Brisbane City Plan 2014, Schedule 1 Definitions:

The source of noise is completely screened from view of habitable rooms (including balconies, patios, decks and verandas) of an adjoining sensitive use by solid, gap free material and construction e.g. acoustic fence, building, or enclosure.

Acoustic barrier: Solid, gap free barrier with minimum surface density of 12.5kg/m^2

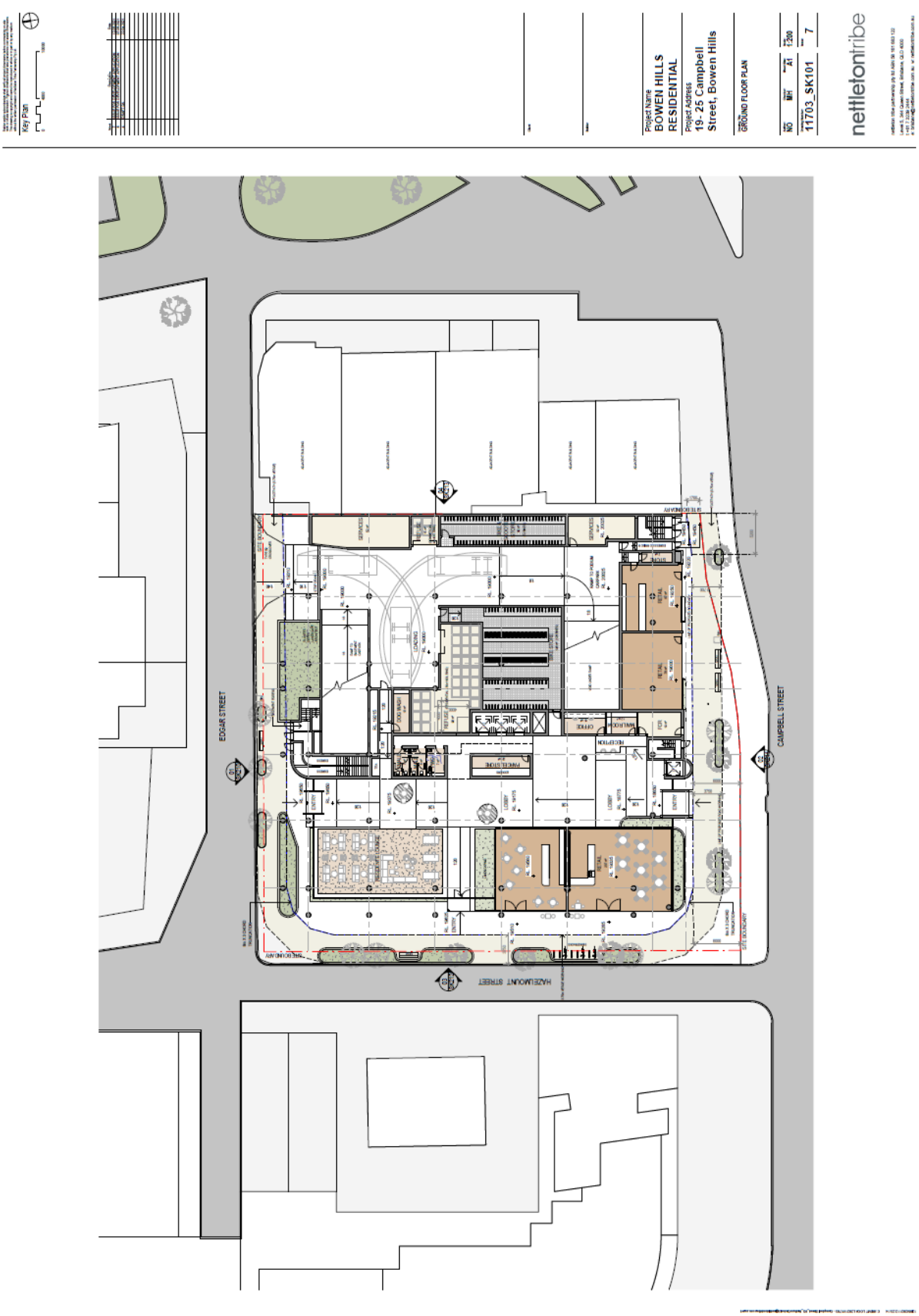
Furthermore, it is also recommended that a mechanical plant noise assessment is conducted once plant selections are finalised to ensure noise emissions comply with criteria.

10 Conclusion

TTM was engaged by Dowse Projects to undertake an acoustic assessment for the proposed mixed use development located at 19-25 Campbell Street, Bowen Hills.

Compliance with the Brisbane City Council planning scheme and State code requirements is predicted based on the implementation of the recommendations outlined in Section 9 of this report.

Appendix A Development Plans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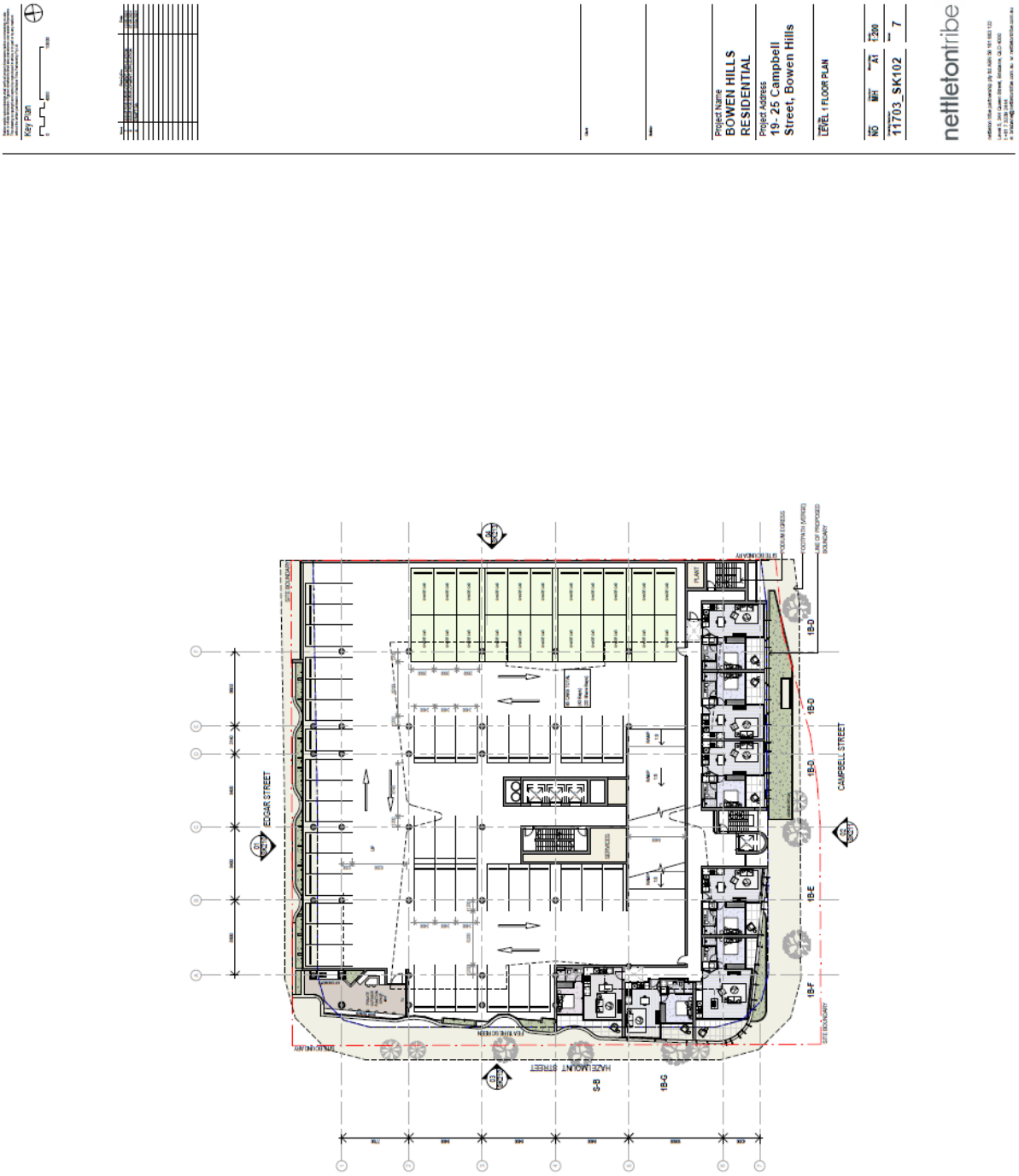
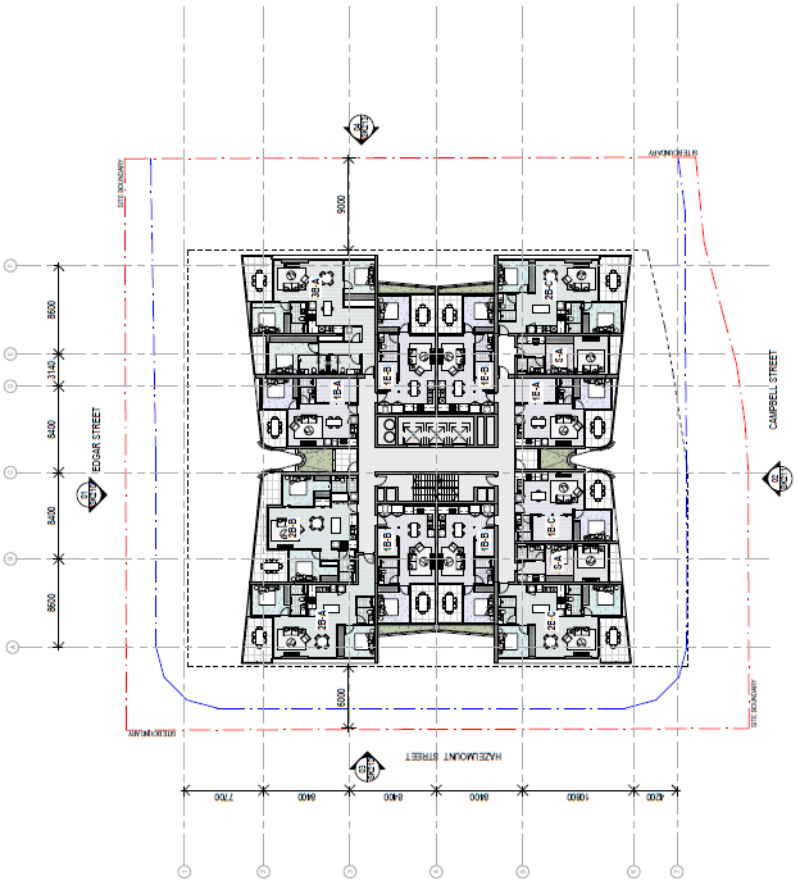
RESIDENTIAL
Project Address
19- 25 Campbell
Street, Bowen Hills
GROUND FLOOR PLAN
11703_SK101
nettletontribe
EDGAR STREET
CAMPBELL STREET
HAZELMOUNT STREET


Key Plan
Project Name
BOWEN HILLS
RESIDENTIAL
Project Address
19- 25 Campbell
Street, Bowen Hills
LEVEL 1 FLOOR PLAN
11703_SK102
nettletontribe
EDGAR STREET
CAMPBELL STREET
HAZELMONT STREET
SITE BOUNDARY
PLANT
SERVICES


Key Plan
Project Name
BOWEN HILLS
RESIDENTIAL
Project Address
19- 25 Campbell
Street, Bowen Hills
LEVEL 4 FLOOR PLAN
NO
MH
A1
1:200
11703_SK105
6
nettletontribe
EDGAR STREET
CAMPBELL STREET
HAZELMOUNT STREET
LOUNGE
2B-C
S-A
1B-C
2B-B
1B-B
2E-A
SITE BOUNDARY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CAMPBELL STREET
HAZELMOUNT STREET
SITE BOUNDARY
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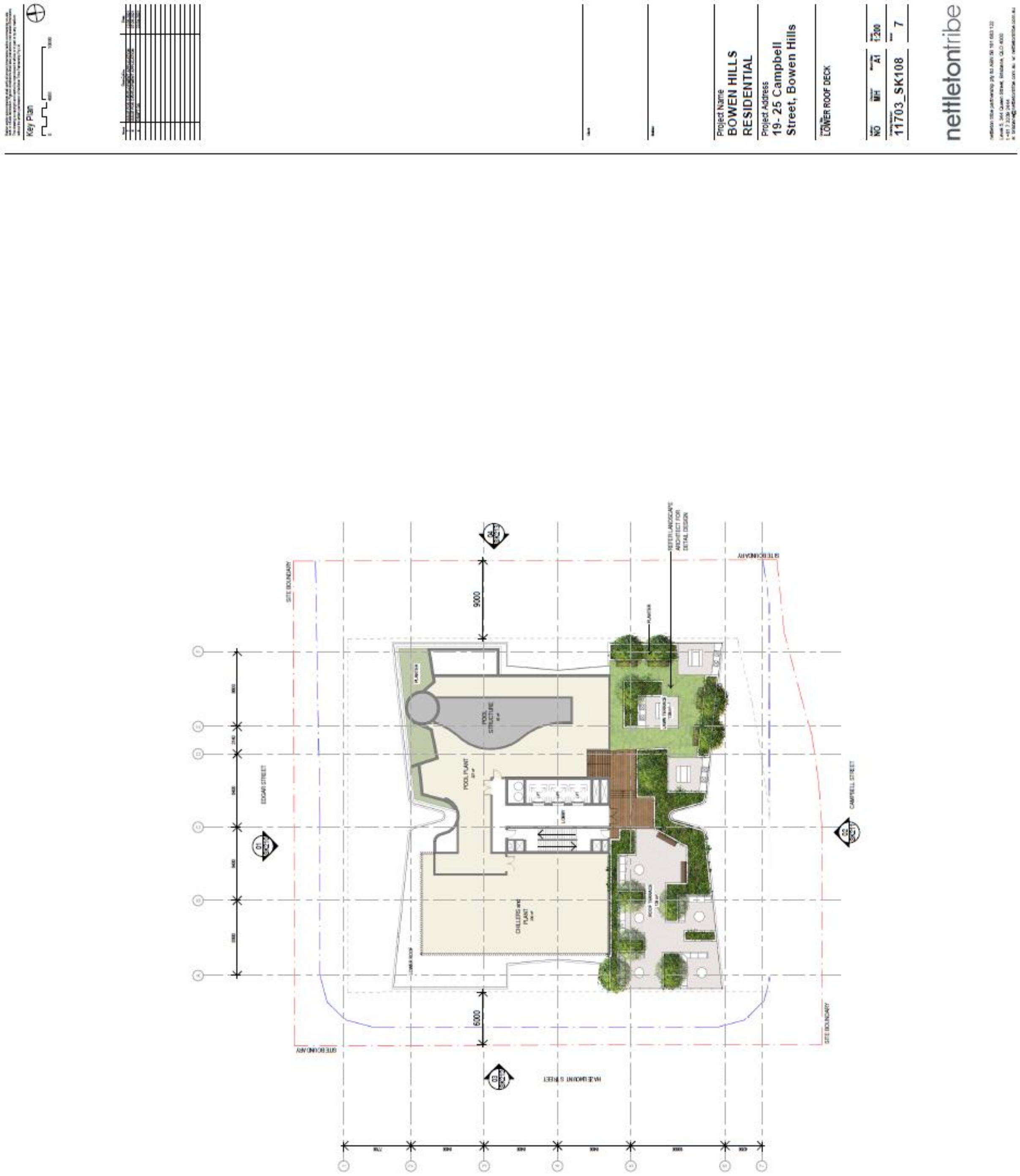
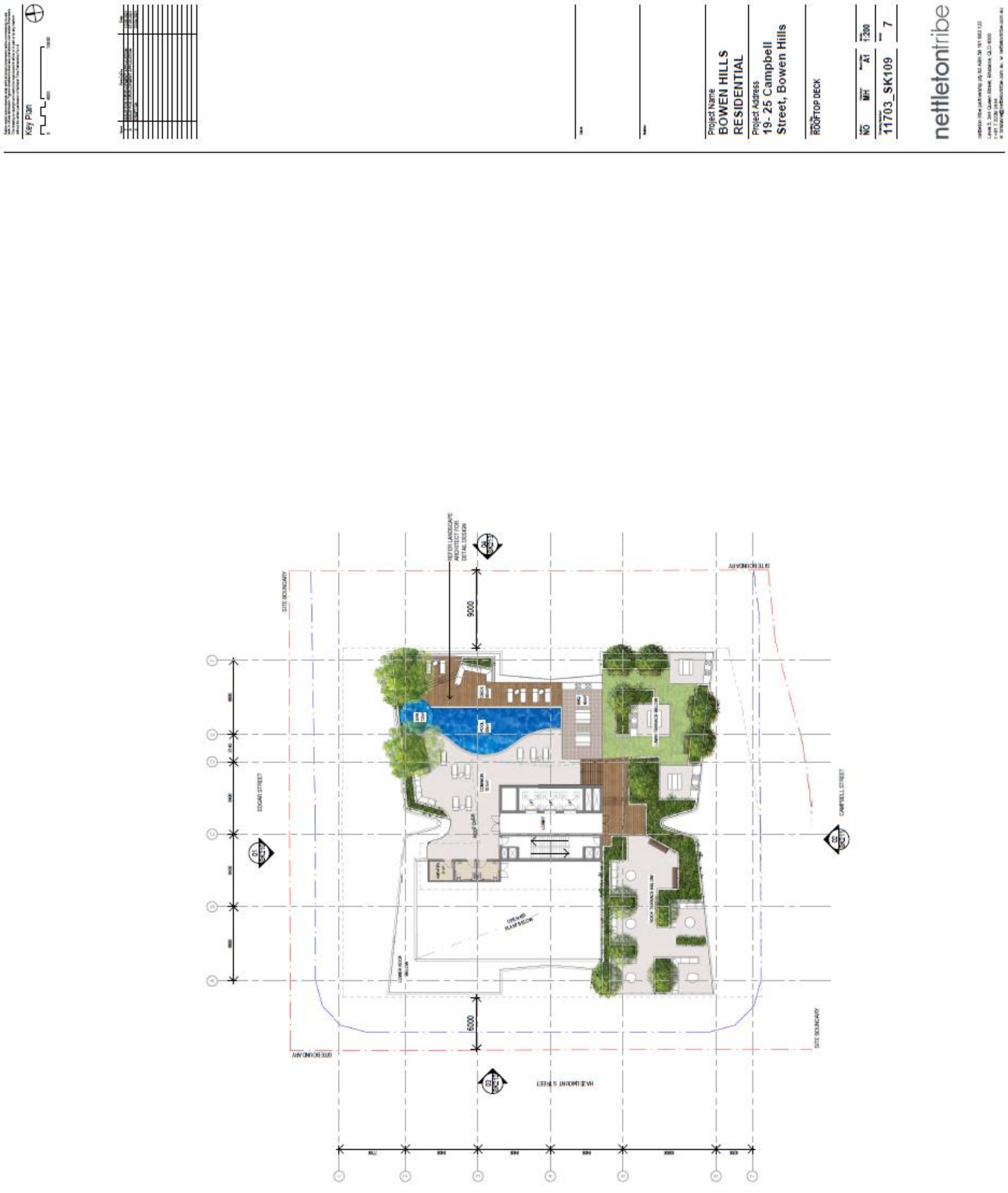
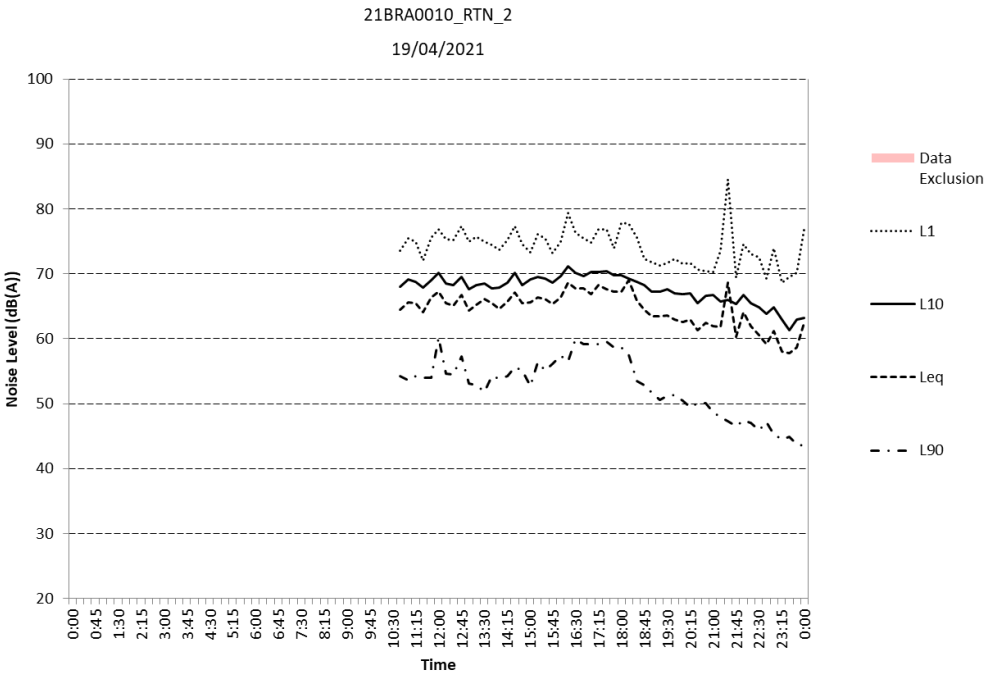
8600
3140
8400
8400
8600
6000
7700
8400
8400
10000
4200

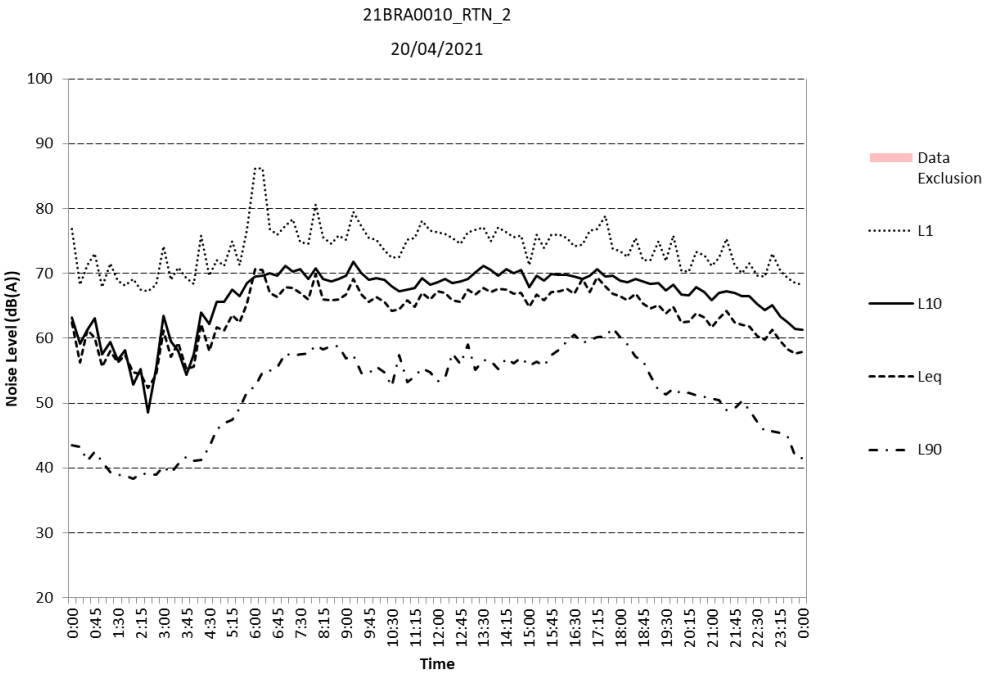

Key Plan
Project Name
BOWEN HILLS
RESIDENTIAL
Project Address
19- 25 Campbell
Street, Bowen Hills
LOWER ROOF DECK
1:200
A1
11703_SK108
7
nettletontribe
SITE BOUNDARY
EDGAR STREET
CAMPBELL STREET
REFER LANDSCAPE ARCHITECT FOR DETAIL DESIGN
9000
6000
POOL STRUCTURE
POOL PLANT
CHILLERS and PLANT

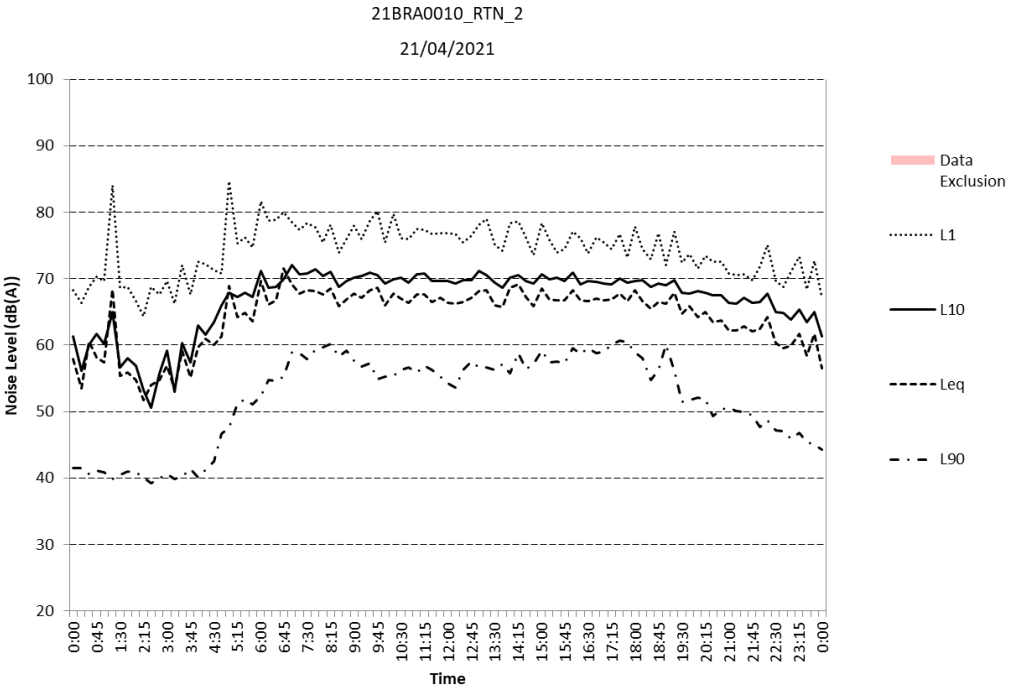

Key Plan
Project Name
BOWEN HILLS
RESIDENTIAL
Project Address
19- 25 Campbell
Street, Bowen Hills
ROOFTOP DECK
NO
MH
A1
1:200
11703_SK109
7
nettletontribe
REFER LANDSCAPE ARCHITECT FOR DETAIL DESIGN
9000
6000
SITE BOUNDARY
EDGAR STREET
CAMPBELL STREET
HAZELMOUNT STREET

Appendix B Unattended Noise Monitoring Graphs

Ambient Noise Monitor and Road Traffic Noise Monitor - Campbell Street



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80
70
60
50
40
30
20
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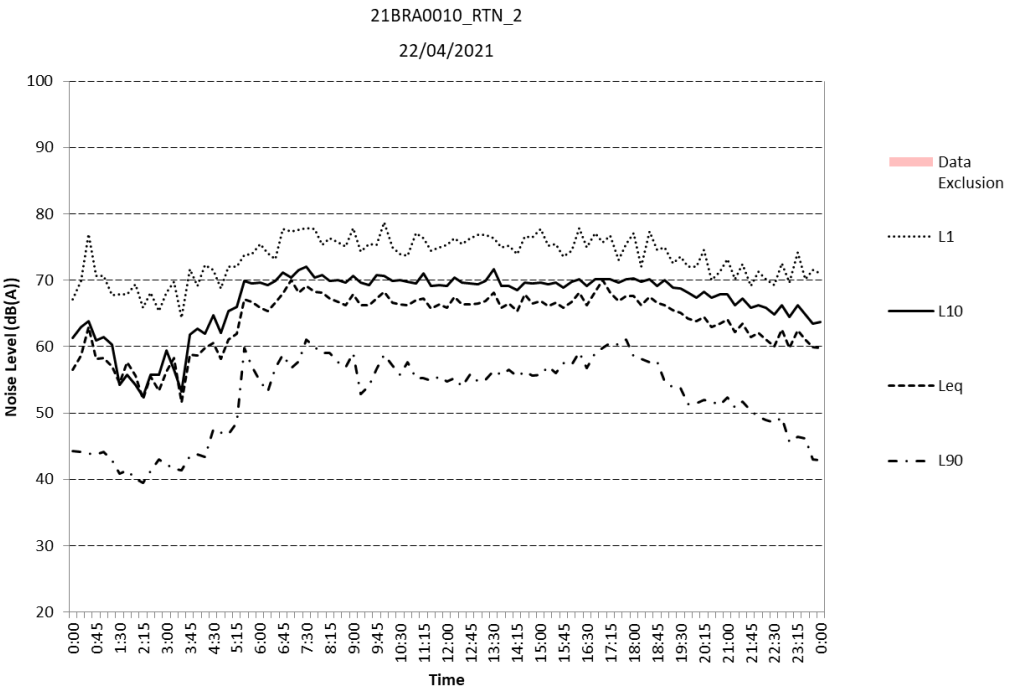
0:45
1:30
2:15
3:00
3:45
4:30
5:15
6:00
6:45
7:30
8:15
9:00
9:45
10:30
11:15
12:00
12:45
13:30
14:15
15:00
15:45
16:30
17:15
18:00
18:45
19:30
20:15
21:00
21:45
22:30
23:15
0:00
Time
Data Exclusion
L1
L10
Leq
L90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22/04/2021
Noise Level (dB(A))
100
90
80
70
60
50
40
30
20
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0:45
1:30
2:15
3:00
3:45
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6:00
6:45
7:30
8:15
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12:00
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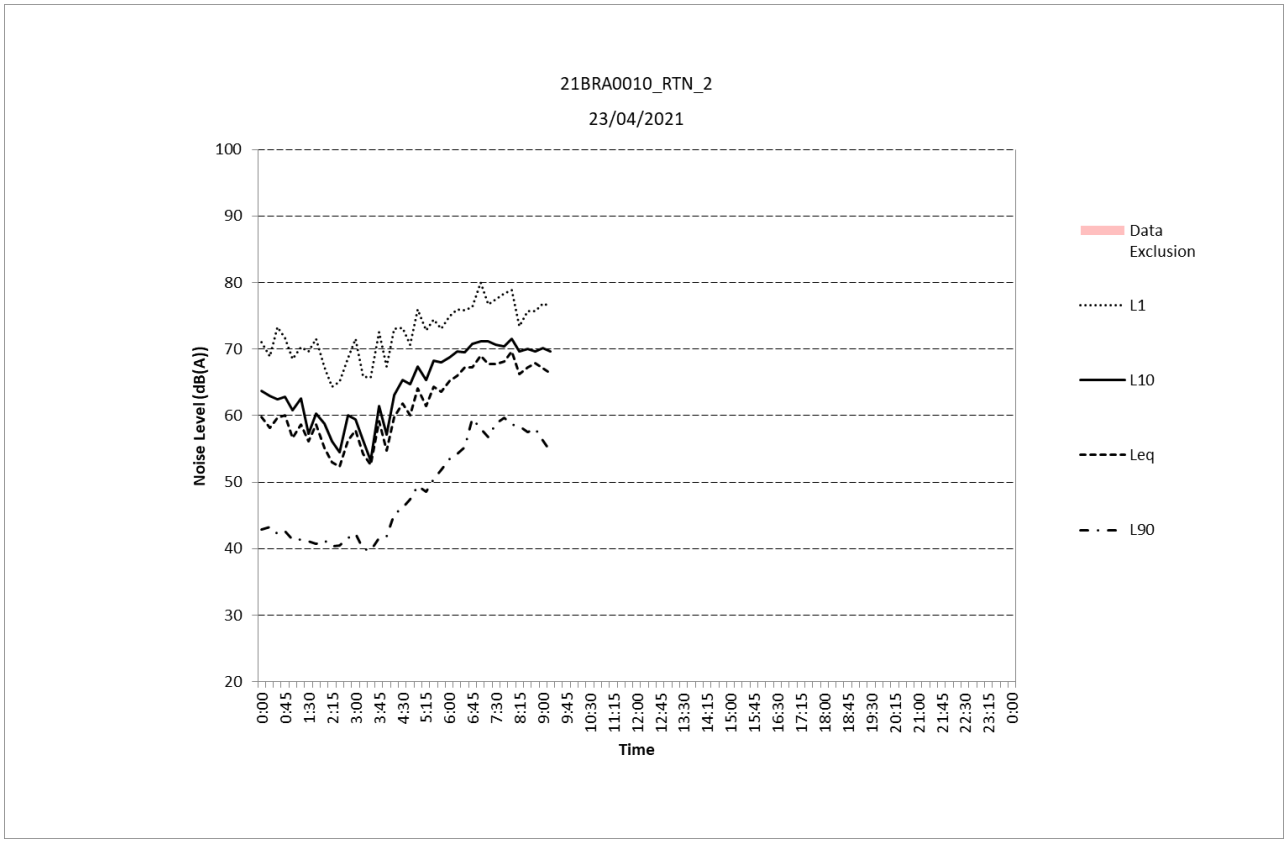
13:30
14:15
15:00
15:45
16:30
17:15
18:00
18:45
19:30
20:15
21:00
21:45
22:30
23:15
0:00
Time
Data Exclusion
L1
L10
Leq
L90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23/04/2021
Noise Level (dB(A))
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90
80
70
60
50
40
30
20
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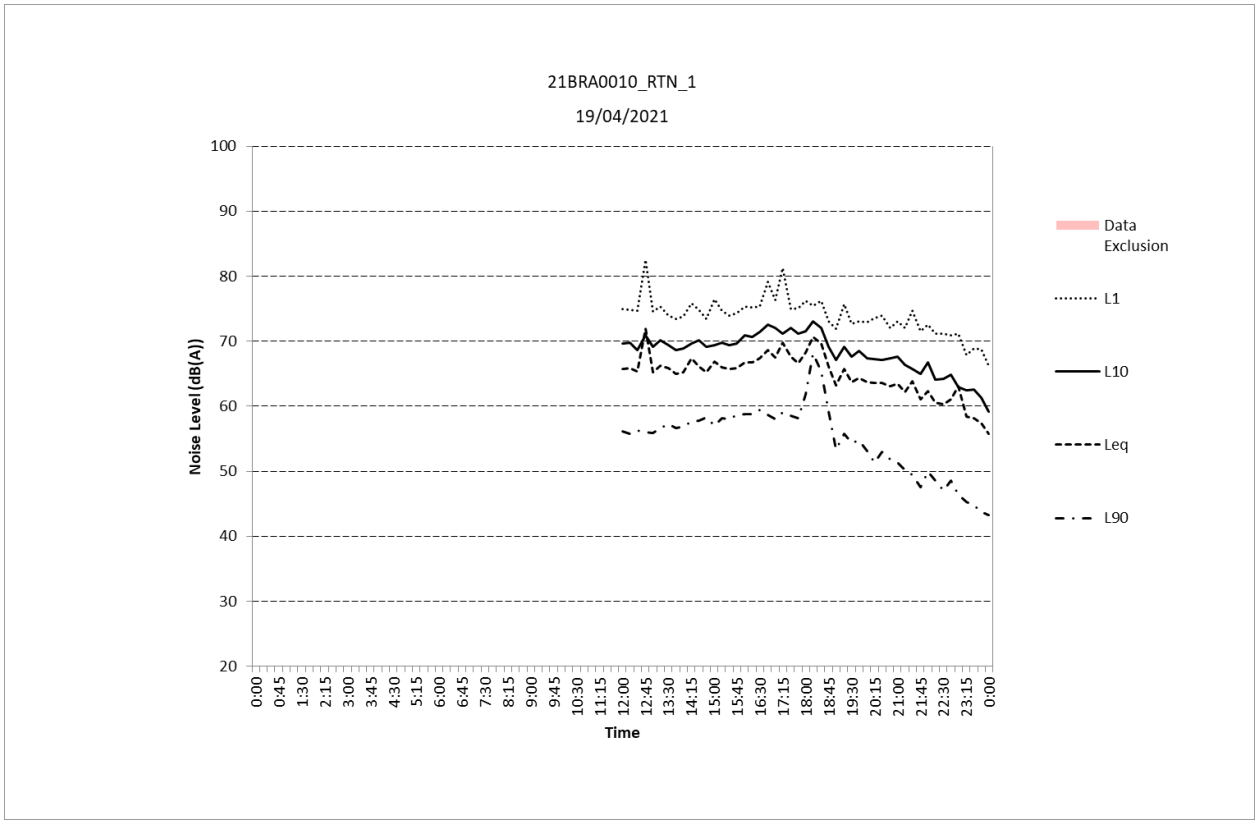
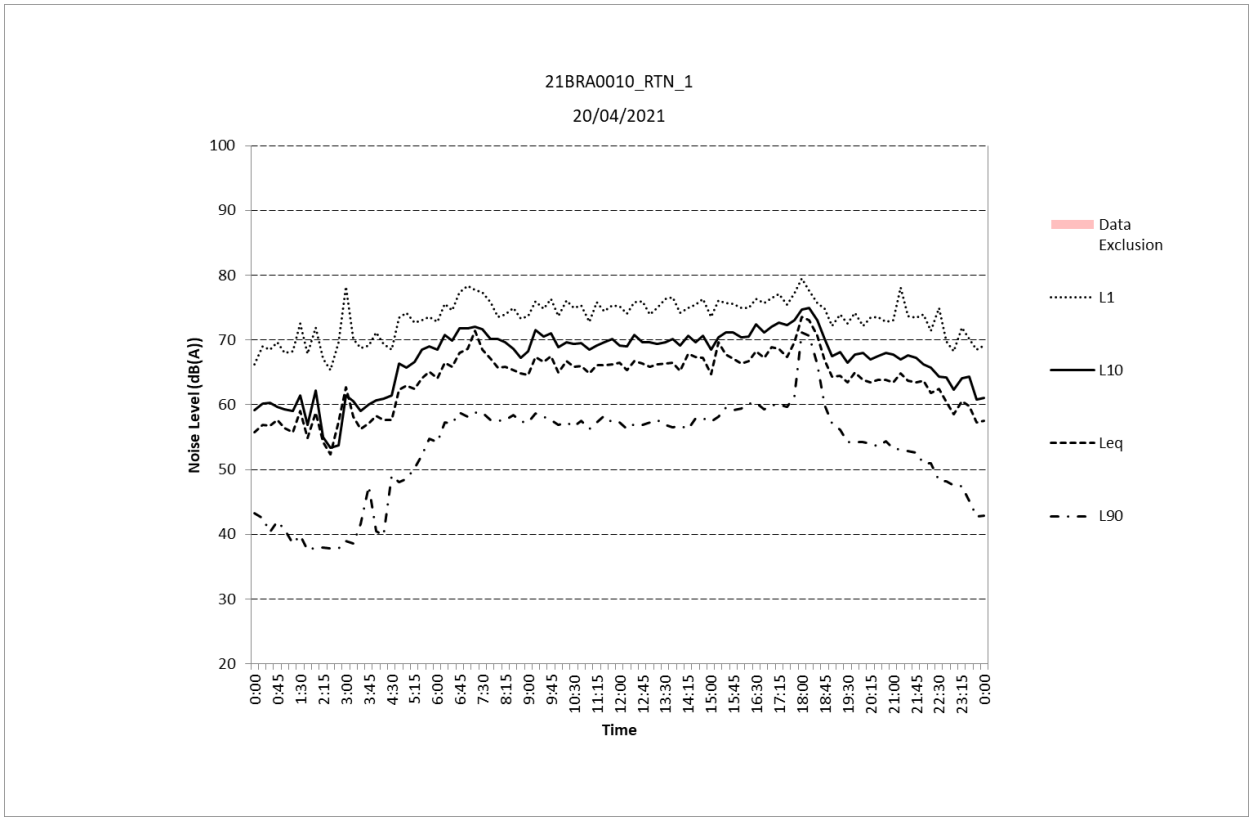
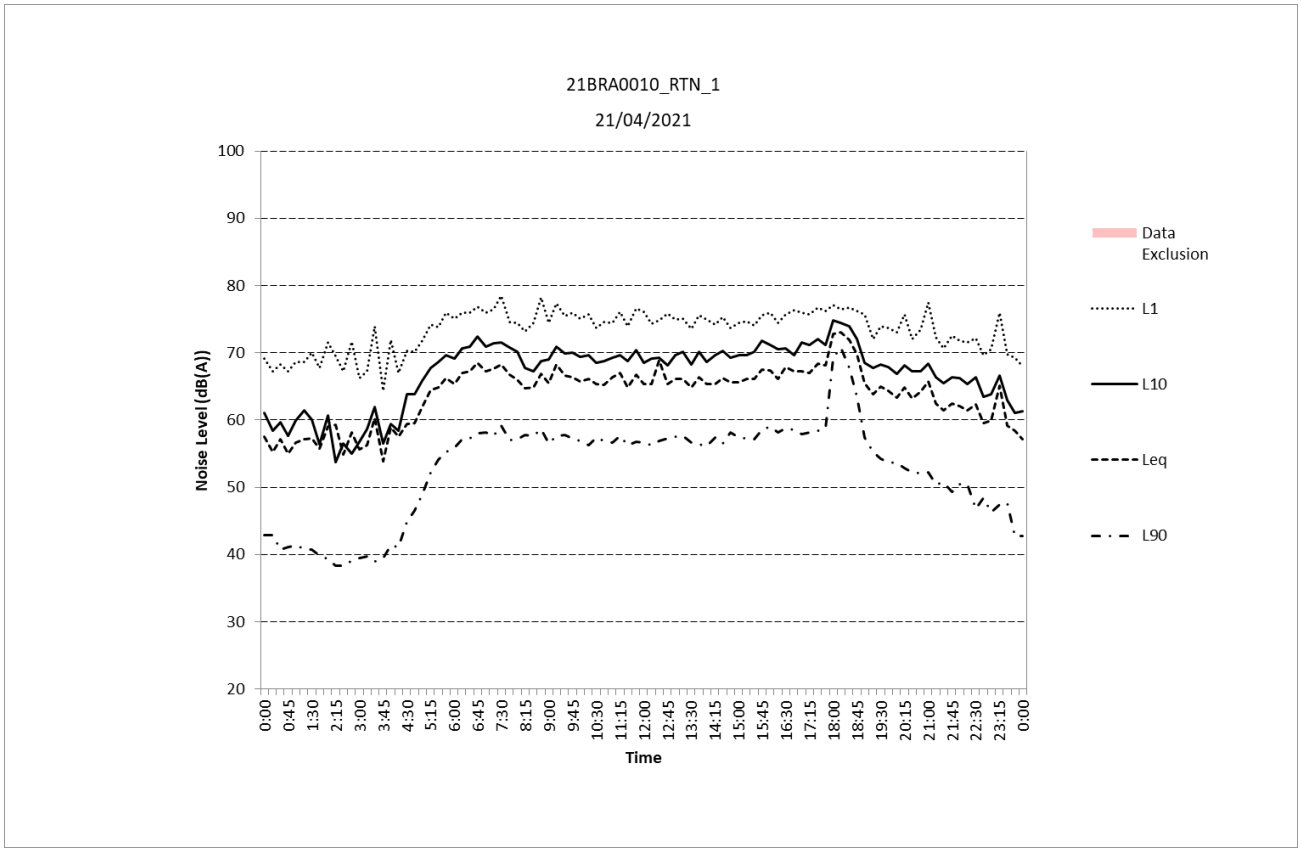
18:00
18:45
19:30
20:15
21:00
21:45
22:30
23:15
0:00
Time
Data Exclusion
L1
L10
Leq
L90

Road Traffic Noise Monitor - Markwell Street



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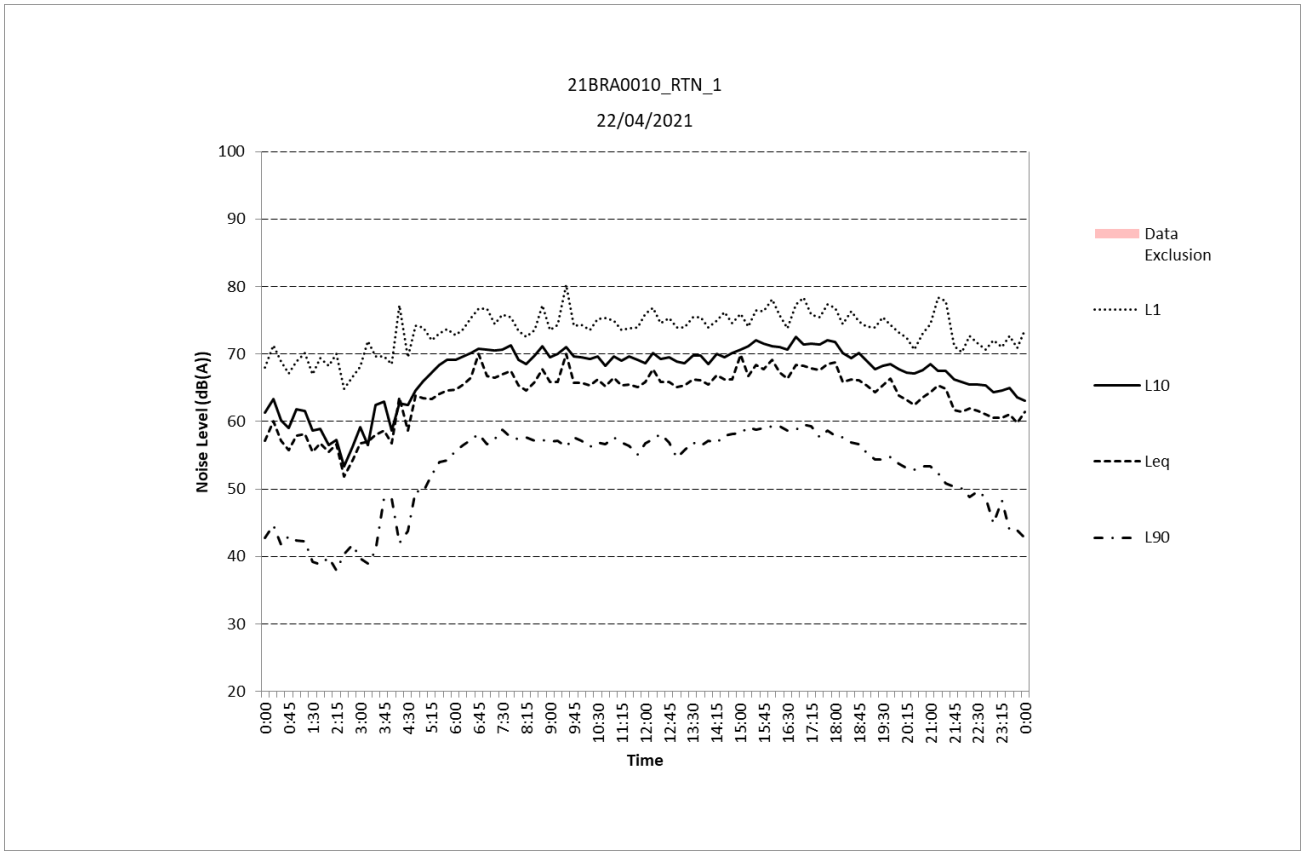
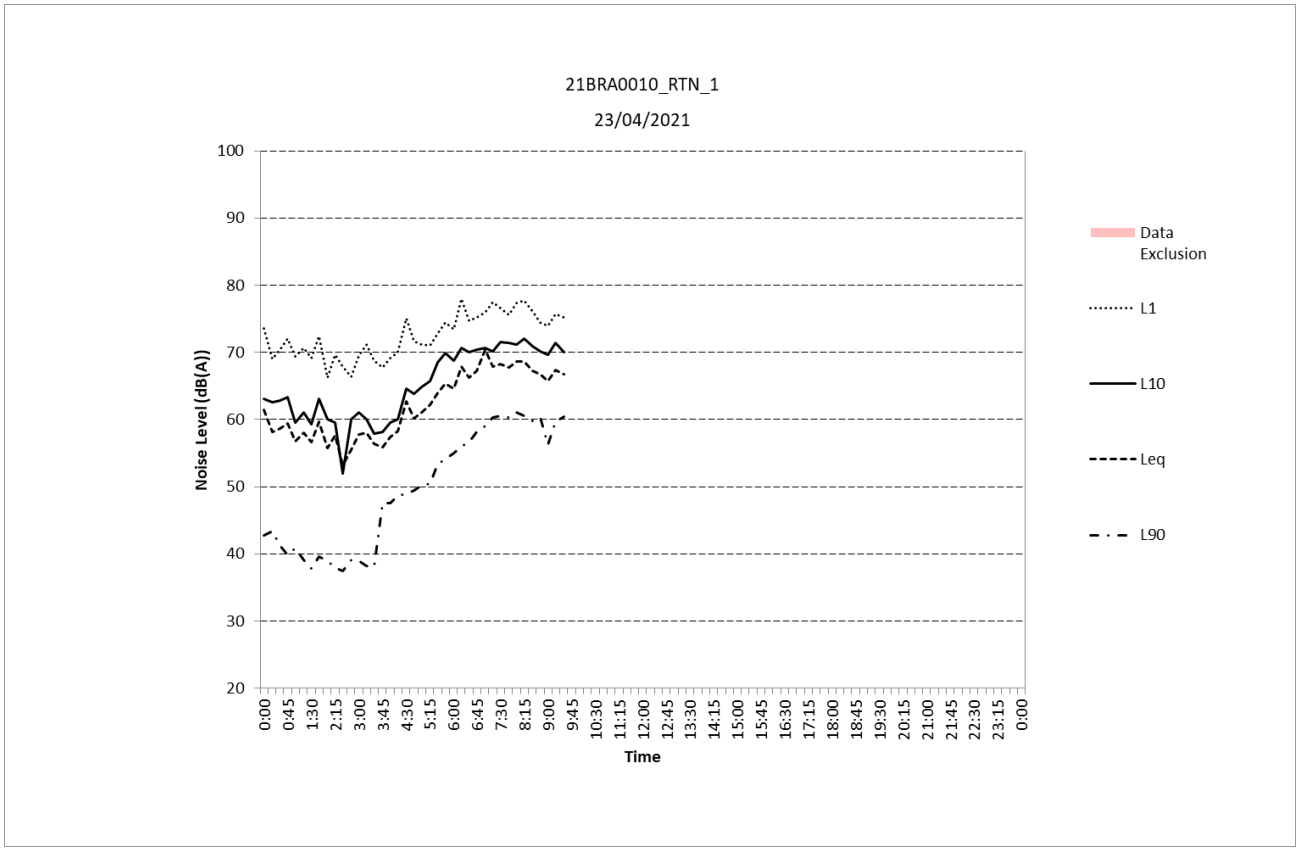
21/04/2021
Noise Level (dB(A))
Time
Data Exclusion
L1
L10
Leq
L90


21BRA0010_RTN_1
22/04/2021
Noise Level (dB(A))
Time
Data Exclusion
L1
L10
Leq
L90


21BRA0010_RTN_1
23/04/2021
Noise Level (dB(A))
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90
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70
60
50
40
30
20
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15:45
16:30
17:15
18:00
18:45
19:30
20:15
21:00
21:45
22:30
23:15
0:00
Time
Data Exclusion
L1
L10
Leq
L90

Appendix C Road Traffic and Rail Noise Category Results

Receiver	Façade Direction	Floor	QDC MP4.4 Noise Category		
			Road Traffic	Rail	Maximum
Apartments East	E	F 4	0	0	**0**
		F 5	2	1	**2**
		F 6	2	2	**2**
		F 7	2	3	**3**
		F 8	2	3	**3**
		F 9	2	3	**3**
		F 10	2	3	**3**
		F 11	2	3	**3**
		F 12	2	3	**3**
		F 13	2	3	**3**
		F 14	2	3	**3**
		F 15	2	3	**3**
		F 16	2	3	**3**
		F 17	2	3	**3**
		F 18	2	3	**3**
		F 19	2	2	**2**
		F 20	2	2	**2**
		F 21	2	2	**2**
		F 22	2	2	**2**
		F 23	2	2	**2**
		F 24	2	2	**2**
		F 25	2	2	**2**
		F 26	2	2	**2**
		F 27	2	2	**2**
		F 28	2	2	**2**
		F 29	2	2	**2**
Apartments North East	E	F 4	1	0	**1**
		F 5	2	2	**2**
		F 6	2	3	**3**
		F 7	2	3	**3**
		F 8	2	3	**3**
		F 9	2	3	**3**
		F 10	2	3	**3**
		F 11	2	3	**3**
		F 12	2	3	**3**
		F 13	2	3	**3**
		F 14	2	3	**3**
		F 15	2	3	**3**
		F 16	2	3	**3**
		F 17	2	3	**3**
		F 18	2	3	**3**
		F 19	2	3	**3**
		F 20	2	3	**3**
		F 21	2	2	**2**
		F 22	2	2	**2**
		F 23	2	2	**2**
		F 24	2	2	**2**
		F 25	2	2	**2**
		F 26	2	2	**2**
		F 27	2	2	**2**
		F 28	2	2	**2**
		F 29	2	2	**2**

Receiver	Façade Direction	Floor	QDC MP4.4 Noise Category		
			Road Traffic	Rail	Maximum
Apartments North East	N	F 4	0	1	**1**
		F 5	0	2	**2**
		F 6	1	3	**3**
		F 7	1	3	**3**
		F 8	1	3	**3**
		F 9	1	3	**3**
		F 10	1	3	**3**
		F 11	1	3	**3**
		F 12	1	3	**3**
		F 13	1	3	**3**
		F 14	1	3	**3**
		F 15	1	3	**3**
		F 16	1	3	**3**
		F 17	1	3	**3**
		F 18	1	3	**3**
		F 19	1	3	**3**
		F 20	1	2	**2**
		F 21	1	2	**2**
		F 22	1	2	**2**
		F 23	1	2	**2**
		F 24	1	2	**2**
		F 25	1	2	**2**
		F 26	1	2	**2**
		F 27	1	2	**2**
		F 28	1	2	**2**
		F 29	1	2	**2**
Apartments North West	N	F 4	0	1	**1**
		F 5	0	2	**2**
		F 6	0	2	**2**
		F 7	0	2	**2**
		F 8	1	2	**2**
		F 9	1	3	**3**
		F 10	1	3	**3**
		F 11	1	3	**3**
		F 12	1	3	**3**
		F 13	1	2	**2**
		F 14	1	2	**2**
		F 15	1	2	**2**
		F 16	1	2	**2**
		F 17	1	2	**2**
		F 18	1	2	**2**
		F 19	1	2	**2**
		F 20	1	2	**2**
		F 21	1	2	**2**
		F 22	1	2	**2**
		F 23	1	2	**2**
		F 24	1	2	**2**
		F 25	0	2	**2**
		F 26	0	2	**2**
		F 27	0	2	**2**
		F 28	0	2	**2**
		F 29	0	2	**2**

Receiver	Façade Direction	Floor	QDC MP4.4 Noise Category		
			Road Traffic	Rail	Maximum
Apartments North West	W	F 4	0	0	**0**
		F 5	0	0	**0**
		F 6	0	0	**0**
		F 7	0	1	**1**
		F 8	1	1	**1**
		F 9	1	1	**1**
		F 10	1	1	**1**
		F 11	1	1	**1**
		F 12	1	1	**1**
		F 13	1	1	**1**
		F 14	1	1	**1**
		F 15	1	1	**1**
		F 16	1	1	**1**
		F 17	1	1	**1**
		F 18	1	1	**1**
		F 19	1	1	**1**
		F 20	1	1	**1**
		F 21	1	1	**1**
		F 22	1	1	**1**
		F 23	1	1	**1**
		F 24	0	1	**1**
		F 25	0	1	**1**
		F 26	0	1	**1**
		F 27	0	1	**1**
		F 28	0	1	**1**
		F 29	0	1	**1**
Apartments South East	E	F 4	1	0	**1**
		F 5	2	2	**2**
		F 6	2	2	**2**
		F 7	3	3	**3**
		F 8	3	3	**3**
		F 9	3	3	**3**
		F 10	3	3	**3**
		F 11	3	3	**3**
		F 12	3	3	**3**
		F 13	2	2	**2**
		F 14	2	2	**2**
		F 15	2	2	**2**
		F 16	2	2	**2**
		F 17	2	2	**2**
		F 18	2	2	**2**
		F 19	2	2	**2**
		F 20	2	2	**2**
		F 21	2	2	**2**
		F 22	2	2	**2**
		F 23	2	2	**2**
		F 24	2	2	**2**
		F 25	2	2	**2**
		F 26	2	2	**2**
		F 27	2	2	**2**
		F 28	2	2	**2**
		F 29	2	2	**2**

Receiver	Façade Direction	Floor	QDC MP4.4 Noise Category		
			Road Traffic	Rail	Maximum
Apartments South East	S	F 4	1	0	**1**
		F 5	2	1	**2**
		F 6	2	1	**2**
		F 7	2	2	**2**
		F 8	2	2	**2**
		F 9	2	2	**2**
		F 10	2	2	**2**
		F 11	2	2	**2**
		F 12	2	2	**2**
		F 13	2	2	**2**
		F 14	2	2	**2**
		F 15	2	2	**2**
		F 16	2	2	**2**
		F 17	2	2	**2**
		F 18	2	2	**2**
		F 19	2	2	**2**
		F 20	2	2	**2**
		F 21	2	2	**2**
		F 22	2	2	**2**
		F 23	2	2	**2**
		F 24	2	2	**2**
		F 25	2	2	**2**
		F 26	2	2	**2**
		F 27	2	2	**2**
		F 28	2	2	**2**
		F 29	2	2	**2**
Apartments South West	S	F 4	0	0	**0**
		F 5	1	0	**1**
		F 6	1	0	**1**
		F 7	2	1	**2**
		F 8	2	1	**2**
		F 9	2	2	**2**
		F 10	2	2	**2**
		F 11	2	2	**2**
		F 12	2	2	**2**
		F 13	1	2	**2**
		F 14	1	2	**2**
		F 15	1	2	**2**
		F 16	1	2	**2**
		F 17	1	2	**2**
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		F 22	1	2	**2**
		F 23	1	2	**2**
		F 24	1	2	**2**
		F 25	1	2	**2**
		F 26	1	2	**2**
		F 27	1	2	**2**
		F 28	1	2	**2**
		F 29	1	2	**2**

Receiver	Façade Direction	Floor	QDC MP4.4 Noise Category		
			Road Traffic	Rail	Maximum
Apartments South West	W	F 4	0	0	**0**
		F 5	1	0	**1**
		F 6	2	0	**2**
		F 7	3	0	**3**
		F 8	3	1	**3**
		F 9	3	1	**3**
		F 10	3	1	**3**
		F 11	3	1	**3**
		F 12	2	1	**2**
		F 13	2	1	**2**
		F 14	2	1	**2**
		F 15	2	1	**2**
		F 16	2	1	**2**
		F 17	2	1	**2**
		F 18	2	1	**2**
		F 19	2	1	**2**
		F 20	2	1	**2**
		F 21	2	1	**2**
		F 22	2	1	**2**
		F 23	2	1	**2**
		F 24	2	1	**2**
		F 25	2	1	**2**
		F 26	2	1	**2**
		F 27	2	1	**2**
		F 28	2	1	**2**
		F 29	2	1	**2**
Apartments West	W	F 4	0	0	**0**
		F 5	0	0	**0**
		F 6	0	0	**0**
		F 7	1	0	**1**
		F 8	1	0	**1**
		F 9	1	0	**1**
		F 10	1	0	**1**
		F 11	1	0	**1**
		F 12	1	0	**1**
		F 13	1	0	**1**
		F 14	1	0	**1**
		F 15	1	1	**1**
		F 16	1	1	**1**
		F 17	1	1	**1**
		F 18	1	1	**1**
		F 19	1	1	**1**
		F 20	0	1	**1**
		F 21	0	1	**1**
		F 22	0	1	**1**
		F 23	0	1	**1**
		F 24	0	1	**1**
		F 25	0	1	**1**
		F 26	0	1	**1**
		F 27	0	1	**1**
		F 28	0	1	**1**
		F 29	0	1	**1**

Receiver	Façade Direction	Floor	QDC MP4.4 Noise Category		
			Road Traffic	Rail	Maximum
Podium Apartments South East	S	F 1	3	0	**3**
		F 2	3	0	**3**
		F 3	3	0	**3**
Podium Apartments South West	S	F 1	2	0	**2**
		F 2	2	0	**2**
		F 3	2	0	**2**
	W	F 1	3	0	**3**
		F 2	3	0	**3**
		F 3	3	0	**3**
Roof Lower	S	F 30	0	0	**0**
Roof Upper	E	F 31	0	0	**0**

Appendix D SoundPLAN Noise Modelling

19-25 Campbell Street, Bowen Hills
RTN Assessment
"Verification RTN.sit"

Receiver	Fl	L10(18h) Free Field dB(A)	
Logger Abbotsford Road (69.3dBA)	GF	70.1	
Logger Campbell Street (68.9dBA)	GF	69.8	

TTM Consulting Pty Ltd

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SoundPLAN 8.2

19-25 Campbell Street, Bowen Hills
Road Traffic Noise Assessment
"Prediction RTN.sit"

Receiver	Direction	Floor	L10(18h) Facade Corrected dB(A)
Apartments East	E	F 4	56.6
		F 5	64.0
		F 6	66.0
		F 7	66.3
		F 8	66.3
		F 9	66.2
		F 10	66.1
		F 11	66.0
		F 12	65.9
		F 13	65.8
		F 14	65.7
		F 15	65.5
		F 16	65.3
		F 17	65.2
		F 18	65.0
		F 19	64.9
		F 20	64.7
		F 21	64.5
		F 22	64.4
		F 23	64.2
		F 24	64.0
		F 25	63.9
		F 26	63.7
		F 27	63.5
		F 28	63.4
		F 29	63.2
Apartments North East	E	F 4	58.6
		F 5	66.0
		F 6	66.7
		F 7	66.8
		F 8	66.8
		F 9	66.7
		F 10	66.6
		F 11	66.6
		F 12	66.5
		F 13	66.4
		F 14	66.3
		F 15	66.2
		F 16	66.1
		F 17	66.0
		F 18	65.8
		F 19	65.7
		F 20	65.5

19-25 Campbell Street, Bowen Hills
Road Traffic Noise Assessment
"Prediction RTN.sit"

Receiver	Direction	Floor	L10(18h) Facade Corrected dB(A)
Apartments North East	N	F 21	65.4
		F 22	65.2
		F 23	65.1
		F 24	64.9
		F 25	64.8
		F 26	64.6
		F 27	64.5
		F 28	64.3
		F 29	64.1
		F 4	50.4
		F 5	56.2
		F 6	60.0
		F 7	60.7
		F 8	60.8
		F 9	60.8
		F 10	60.6
		F 11	60.5
		F 12	60.4
		F 13	60.3
		F 14	60.3
		F 15	60.1
		F 16	60.0
		F 17	59.9
		F 18	59.8
		F 19	59.7
		F 20	59.5
		F 21	59.4
		F 22	59.3
		F 23	59.1
		F 24	59.0
		F 25	58.9
		F 26	58.7
		F 27	58.6
		F 28	58.4
		F 29	58.3
Apartments North West	W	F 4	48.8
		F 5	54.7
		F 6	56.8
		F 7	57.5
		F 8	58.1
		F 9	58.6
		F 10	59.0
		F 11	59.3

19-25 Campbell Street, Bowen Hills
Road Traffic Noise Assessment
"Prediction RTN.sit"

Receiver	Direction	Floor	L10(18h) Facade Corrected dB(A)
		F 12	59.4
		F 13	59.5
		F 14	59.5
		F 15	59.5
		F 16	59.4
		F 17	59.3
		F 18	59.1
		F 19	59.0
		F 20	58.8
		F 21	58.6
		F 22	58.4
		F 23	58.2
		F 24	58.0
		F 25	57.8
		F 26	57.6
		F 27	57.4
		F 28	57.2
		F 29	57.0
Apartments North West	N	F 4	48.5
		F 5	53.5
		F 6	56.3
		F 7	57.9
		F 8	58.9
		F 9	59.1
		F 10	59.2
		F 11	59.1
		F 12	59.1
		F 13	59.0
		F 14	58.9
		F 15	58.8
		F 16	58.7
		F 17	58.6
		F 18	58.5
		F 19	58.5
		F 20	58.4
		F 21	58.3
		F 22	58.1
		F 23	58.0
		F 24	57.9
		F 25	57.8
		F 26	57.7
		F 27	57.6
		F 28	57.5

19-25 Campbell Street, Bowen Hills
Road Traffic Noise Assessment
"Prediction RTN.sit"

Receiver	Direction	Floor	L10(18h) Facade Corrected dB(A)
		F 29	57.4
Apartments South East	S	F 4	58.2
		F 5	63.1
		F 6	67.0
		F 7	68.7
		F 8	69.1
		F 9	69.0
		F 10	68.7
		F 11	68.5
		F 12	68.2
		F 13	67.9
		F 14	67.7
		F 15	67.5
		F 16	67.2
		F 17	67.0
		F 18	66.8
		F 19	66.6
		F 20	66.3
		F 21	66.1
		F 22	65.9
		F 23	65.7
		F 24	65.5
		F 25	65.3
		F 26	65.1
		F 27	64.9
		F 28	64.7
		F 29	64.6
Apartments South East	E	F 4	59.4
		F 5	66.6
		F 6	67.4
		F 7	67.7
		F 8	67.9
		F 9	67.9
		F 10	67.9
		F 11	67.8
		F 12	67.6
		F 13	67.4
		F 14	67.2
		F 15	67.0
		F 16	66.8
		F 17	66.7
		F 18	66.5
		F 19	66.3

19-25 Campbell Street, Bowen Hills
Road Traffic Noise Assessment
"Prediction RTN.sit"

Receiver	Direction	Floor	L10(18h) Facade Corrected dB(A)
		F 20	66.1
		F 21	65.9
		F 22	65.7
		F 23	65.5
		F 24	65.4
		F 25	65.2
		F 26	65.0
		F 27	64.8
		F 28	64.7
		F 29	64.5
Apartments South West	W	F 4	54.8
		F 5	61.4
		F 6	62.9
		F 7	63.4
		F 8	63.7
		F 9	63.8
		F 10	63.7
		F 11	63.5
		F 12	63.2
		F 13	62.9
		F 14	62.6
		F 15	62.3
		F 16	62.0
		F 17	61.7
		F 18	61.4
		F 19	61.1
		F 20	60.9
		F 21	60.6
		F 22	60.3
		F 23	60.1
		F 24	59.8
		F 25	59.6
		F 26	59.3
		F 27	59.1
		F 28	58.9
		F 29	58.7
Apartments South West	S	F 4	57.0
		F 5	61.9
		F 6	66.2
		F 7	68.1
		F 8	68.6
		F 9	68.6
		F 10	68.3

19-25 Campbell Street, Bowen Hills
Road Traffic Noise Assessment
"Prediction RTN.sit"

Receiver	Direction	Floor	L10(18h) Facade Corrected dB(A)
		F 11	68.1
		F 12	67.8
		F 13	67.5
		F 14	67.3
		F 15	67.0
		F 16	66.8
		F 17	66.6
		F 18	66.4
		F 19	66.2
		F 20	66.0
		F 21	65.8
		F 22	65.6
		F 23	65.4
		F 24	65.2
		F 25	65.0
		F 26	64.8
		F 27	64.6
		F 28	64.5
		F 29	64.3
Apartments West	W	F 4	47.8
		F 5	52.4
		F 6	56.7
		F 7	58.2
		F 8	58.9
		F 9	59.2
		F 10	59.4
		F 11	59.4
		F 12	59.3
		F 13	59.2
		F 14	59.1
		F 15	58.9
		F 16	58.7
		F 17	58.5
		F 18	58.3
		F 19	58.0
		F 20	57.8
		F 21	57.6
		F 22	57.4
		F 23	57.2
		F 24	57.0
		F 25	56.8
		F 26	56.5
		F 27	56.3

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SoundPLAN 8.2

19-25 Campbell Street, Bowen Hills
Road Traffic Noise Assessment
"Prediction RTN.sit"

Receiver	Direction	Floor	L10(18h) Facade Corrected dB(A)
		F 28	56.1
		F 29	55.9
Podium South East	S	F 1	72.5
		F 2	72.2
		F 3	71.8
Podium South West	W	F 1	67.2
		F 2	67.0
		F 3	66.9
Podium South West	S	F 1	72.2
		F 2	71.8
		F 3	71.4
Roof Lower	S	F 30	45.3
Roof Upper	E	F 31	43.6

19-25 Campbell Street, Bowen Hills
"Verification Rail.sit"

Receiver	Floor Level	Lmax dB(A)	Leq,24hr dB(A)
logger	GF	91.1	61.6

19-25 Campbell Street, Bowen Hills
Rail Noise Assessment
"Prediction Rail.sit"

Receiver Location	Facade Orientation	Floor Level	Lmax dB(A)	Leq,24hr dB(A)
Apartments East	E	F 4	66.3	39.3
		F 5	72.4	42.1
		F 6	79.4	45.9
		F 7	80.2	48.5
		F 8	80.3	50.1
		F 9	80.3	50.7
		F 10	80.4	51.2
		F 11	80.4	51.4
		F 12	80.3	51.6
		F 13	80.2	51.7
		F 14	80.0	51.8
		F 15	79.9	51.8
		F 16	79.8	52.1
		F 17	79.7	52.1
		F 18	79.5	52.2
		F 19	79.4	52.3
		F 20	79.3	52.4
		F 21	79.1	52.4
		F 22	79.0	52.3
		F 23	78.8	52.3
		F 24	78.7	52.2
		F 25	78.5	52.1
		F 26	78.4	52.0
		F 27	78.2	51.9
		F 28	78.1	51.8
		F 29	78.0	51.8
Apartments North East	E	F 4	67.0	41.1
		F 5	76.6	47.0
		F 6	81.0	50.2
		F 7	81.1	51.9
		F 8	81.1	52.3
		F 9	81.1	52.5
		F 10	81.0	52.6
		F 11	80.9	52.8
		F 12	80.8	52.9
		F 13	80.6	53.1
		F 14	80.5	53.3
		F 15	80.4	53.4
		F 16	80.2	53.5
		F 17	80.0	53.6
		F 18	79.9	53.6
		F 19	79.7	53.6

19-25 Campbell Street, Bowen Hills
Rail Noise Assessment
"Prediction Rail.sit"

Receiver Location	Facade Orientation	Floor Level	Lmax dB(A)	Leq,24hr dB(A)
		F 20	79.6	53.5
		F 21	79.4	53.4
		F 22	79.3	53.3
		F 23	79.1	53.2
		F 24	78.9	53.1
		F 25	78.7	53.0
		F 26	78.6	52.9
		F 27	78.4	52.8
		F 28	78.2	52.7
		F 29	78.1	52.7
Apartments North East	N	F 4	69.7	40.9
		F 5	77.9	46.3
		F 6	79.8	47.5
		F 7	80.5	49.0
		F 8	80.6	51.0
		F 9	80.6	51.6
		F 10	80.6	51.7
		F 11	80.6	51.9
		F 12	80.4	51.9
		F 13	80.3	52.0
		F 14	80.2	51.9
		F 15	80.1	51.9
		F 16	79.9	52.1
		F 17	79.8	52.1
		F 18	79.6	52.1
		F 19	79.5	52.2
		F 20	79.4	52.2
		F 21	79.3	52.3
		F 22	79.2	52.3
		F 23	79.0	52.3
		F 24	78.8	52.2
		F 25	78.7	52.1
		F 26	78.5	52.0
		F 27	78.4	51.9
		F 28	78.3	51.9
		F 29	78.1	51.8
Apartments North West	N	F 4	69.9	40.8
		F 5	75.9	45.3
		F 6	76.7	46.1
		F 7	78.5	47.4
		F 8	79.4	48.5
		F 9	79.5	49.4

19-25 Campbell Street, Bowen Hills
Rail Noise Assessment
"Prediction Rail.sit"

Receiver Location	Facade Orientation	Floor Level	Lmax dB(A)	Leq,24hr dB(A)
		F 10	79.5	49.9
		F 11	79.5	50.8
		F 12	79.5	51.1
		F 13	79.4	51.2
		F 14	79.3	51.3
		F 15	79.2	51.4
		F 16	79.0	51.4
		F 17	79.0	51.4
		F 18	78.9	51.3
		F 19	78.8	51.3
		F 20	78.8	51.3
		F 21	78.7	51.4
		F 22	78.6	51.4
		F 23	78.5	51.4
		F 24	78.4	51.4
		F 25	78.3	51.5
		F 26	78.1	51.5
		F 27	78.0	51.5
		F 28	77.4	51.5
		F 29	77.3	51.5
Apartments North West	W	F 4	59.6	33.1
		F 5	62.5	33.3
		F 6	67.3	35.6
		F 7	71.5	38.4
		F 8	71.7	39.2
		F 9	71.9	39.6
		F 10	72.0	39.9
		F 11	72.1	40.3
		F 12	72.1	40.5
		F 13	72.2	40.7
		F 14	72.2	40.9
		F 15	72.2	41.0
		F 16	72.2	41.2
		F 17	72.1	41.4
		F 18	72.1	41.7
		F 19	72.1	42.1
		F 20	72.0	42.3
		F 21	72.4	42.4
		F 22	72.6	42.6
		F 23	72.5	42.9
		F 24	72.5	43.3
		F 25	72.4	43.4

19-25 Campbell Street, Bowen Hills
Rail Noise Assessment
"Prediction Rail.sit"

Receiver Location	Facade Orientation	Floor Level	Lmax dB(A)	Leq,24hr dB(A)
		F 26	71.0	42.3
		F 27	71.0	42.4
		F 28	71.0	42.6
		F 29	70.9	42.7
Apartments South East	E	F 4	67.7	39.7
		F 5	74.8	43.3
		F 6	79.3	47.0
		F 7	79.5	49.2
		F 8	79.6	50.2
		F 9	79.6	51.0
		F 10	79.6	51.3
		F 11	79.6	51.7
		F 12	79.5	52.0
		F 13	79.4	52.1
		F 14	79.3	52.3
		F 15	79.2	52.5
		F 16	79.1	52.6
		F 17	78.9	52.8
		F 18	78.8	52.9
		F 19	78.7	53.0
		F 20	78.5	53.0
		F 21	78.4	53.0
		F 22	78.3	52.9
		F 23	78.1	52.9
		F 24	78.0	52.8
		F 25	77.8	52.7
		F 26	77.7	52.6
		F 27	77.6	52.5
		F 28	77.5	52.5
		F 29	77.3	52.4
Apartments South East	S	F 4	67.2	35.5
		F 5	70.5	36.7
		F 6	73.4	38.2
		F 7	75.8	39.3
		F 8	76.7	40.9
		F 9	76.8	42.7
		F 10	77.2	44.8
		F 11	77.5	46.4
		F 12	78.1	47.1
		F 13	78.3	47.5
		F 14	78.3	48.0
		F 15	78.2	48.3

19-25 Campbell Street, Bowen Hills
Rail Noise Assessment
"Prediction Rail.sit"

Receiver Location	Facade Orientation	Floor Level	Lmax dB(A)	Leq,24hr dB(A)
		F 16	78.1	48.5
		F 17	78.0	48.6
		F 18	77.9	48.6
		F 19	77.8	48.7
		F 20	77.7	48.8
		F 21	77.6	48.8
		F 22	77.5	48.9
		F 23	77.4	49.0
		F 24	77.3	49.1
		F 25	77.1	49.1
		F 26	77.0	49.1
		F 27	76.9	49.2
		F 28	76.8	49.2
		F 29	76.7	49.2
Apartments South West	S	F 4	64.5	33.8
		F 5	66.0	34.6
		F 6	68.0	35.6
		F 7	70.4	36.3
		F 8	72.8	37.2
		F 9	74.8	38.0
		F 10	76.1	39.1
		F 11	76.3	40.8
		F 12	76.4	43.3
		F 13	76.4	45.2
		F 14	76.7	46.2
		F 15	77.2	46.7
		F 16	77.2	47.1
		F 17	77.1	47.4
		F 18	77.0	47.6
		F 19	76.9	47.8
		F 20	76.9	47.9
		F 21	76.8	47.9
		F 22	76.7	48.0
		F 23	76.6	48.0
		F 24	76.5	48.2
		F 25	76.4	48.2
		F 26	76.3	48.2
		F 27	76.3	48.2
		F 28	76.2	48.3
		F 29	76.1	48.3
Apartments South West	W	F 4	61.8	31.9
		F 5	62.4	31.6

19-25 Campbell Street, Bowen Hills
Rail Noise Assessment
"Prediction Rail.sit"

Receiver Location	Facade Orientation	Floor Level	Lmax dB(A)	Leq,24hr dB(A)
		F 6	62.6	31.9
		F 7	66.5	33.1
		F 8	70.1	34.6
		F 9	70.8	35.0
		F 10	71.2	35.4
		F 11	71.8	36.0
		F 12	72.2	36.6
		F 13	72.5	37.2
		F 14	72.8	37.8
		F 15	72.9	38.5
		F 16	73.0	39.1
		F 17	73.0	39.8
		F 18	72.9	40.2
		F 19	72.9	40.5
		F 20	72.9	40.7
		F 21	72.9	40.9
		F 22	73.0	41.3
		F 23	73.1	41.8
		F 24	73.0	42.1
		F 25	73.0	42.3
		F 26	72.5	42.4
		F 27	72.6	41.1
		F 28	72.6	41.5
		F 29	72.6	41.8
Apartments West	W	F 4	58.1	31.2
		F 5	58.5	31.9
		F 6	62.1	33.2
		F 7	66.8	35.6
		F 8	68.2	37.3
		F 9	68.3	37.8
		F 10	68.4	38.1
		F 11	68.5	38.4
		F 12	68.6	38.9
		F 13	68.7	39.1
		F 14	68.7	39.7
		F 15	69.5	39.9
		F 16	70.3	40.0
		F 17	70.7	40.2
		F 18	70.8	40.5
		F 19	71.1	40.7
		F 20	72.1	40.8
		F 21	72.8	41.1

19-25 Campbell Street, Bowen Hills
Rail Noise Assessment
"Prediction Rail.sit"

Receiver Location	Facade Orientation	Floor Level	Lmax dB(A)	Leq,24hr dB(A)
		F 22	73.0	41.3
		F 23	73.0	41.9
		F 24	73.2	42.3
		F 25	73.1	42.5
		F 26	72.5	42.7
		F 27	70.0	42.2
		F 28	70.1	42.5
		F 29	70.2	42.7
Podium Apartments South East	S	F 1	63.6	35.7
		F 2	65.2	35.8
		F 3	67.0	36.6
Podium Apartments South West	S	F 1	61.6	33.9
		F 2	62.7	34.2
		F 3	63.9	34.9
Podium Apartments South West	W	F 1	59.5	32.2
		F 2	61.9	32.5
		F 3	62.9	33.7
Roof Lower	S	F 30	61.9	35.1
Roof Upper	E	F 31	63.8	36.4

Appendix E QDC MP4.4 Schedules 1 and 2

Schedule 1

Noise category	Minimum *transport noise reduction* (dB (A)) required for *habitable rooms*	Component of building's *external envelope*	Minimum R_w required for each component
Category 4	40	Glazing	43
		External walls	52
		Roof	45
		Floors	51
		Entry doors	35
Category 3	35	Glazing	38 (where total area of glazing for a *habitable room* is greater than 1.8m²)
			35 (where total area of glazing for a *habitable room* is less than or equal to 1.8m²)
		External walls	47
		Roof	41
		Floors	45
		Entry doors	33

Noise category	Minimum *transport noise reduction* (dB (A)) required for *habitable rooms*	Component of building's *external envelope*	Minimum R_w required for each component
Category 2	30	Glazing	35 (where total area of glazing for a *habitable room* is greater than 1.8m²)
			32 (where total area of glazing for a *habitable room* is less than or equal to 1.8m²)
		External walls	41
		Roof	38
		Floors	45
		Entry doors	33
Category 1	25	Glazing	27 (where total area of glazing for a *habitable room* is greater than 1.8m²)
			24 (where total area of glazing for a *habitable room* is less than or equal to 1.8m²)
		External walls	35
		Roof	35
		Entry Doors	28
Category 0	No additional acoustic treatment required – standard building assessment provisions apply.		

Schedule 2

Component of building's *external envelope*	Minimum R_w	Acceptable forms of construction
Glazing	43	Double glazing consisting of two panes of minimum 5mm thick glass with at least 100mm air gap and full perimeter *acoustically rated seals*.
	38	Minimum 14.38mm thick laminated glass, with full perimeter *acoustically rated seals*; OR Double glazing consisting of one pane of minimum 5mm thick glass and one pane of minimum 6mm thick glass with at least 44mm air gap, and full perimeter *acoustically rated seals*
	35	Minimum 10.38mm thick laminated glass, with full perimeter *acoustically rated seals*.
	32	Minimum 6.38mm thick laminated glass with full perimeter *acoustically rated seals*.
	27	Minimum 4mm thick glass with full perimeter *acoustically rated seals*
	24	Minimum 4mm thick glass with standard weather seals

Component of building's *external envelope*	Minimum R_w	Acceptable forms of construction
External walls	52	Two leaves of clay brick masonry, at least 270mm in total, with subfloor vents fitted with noise attenuators.
	47	Two leaves of clay brick masonry at least 110mm thick with: (i) cavity not less than 50mm between leaves; and (ii) 50mm thick mineral insulation or 50mm thick glass wool insulation with a density of 11kg/m³ or 50mm thick polyester insulation with a density of 20kg/m³ in the cavity. OR Two leaves of clay brick masonry at last 110mm thick with: (i) cavity not less than 50mm between leaves; and (ii) at least 13mm thick cement render on each face OR Single leaf of clay brick masonry at least 110mm thick with: (i) a row of at least 70mm x 35mm timber studs or 64mm steel studs at 600mm centres, spaced at least 20mm from the masonry wall; and (ii) Mineral insulation or glass wool insulation at least 50mm thick with a density of at least 11 kg/m³ positioned between studs; and (iii) One layer of plasterboard at least 13mm thick fixed to outside face of studs. OR Single leaf of minimum 150mm thick masonry of hollow, dense concrete blocks, with mortar joints laid to prevent moisture bridging.

Component of building's *external envelope*	Minimum R_w	Acceptable forms of construction
	41	Two leaves of clay brick masonry at least 110mm thick with cavity not less than 50mm between leaves OR Single leaf of clay brick masonry at last 110mm thick with: (i) a row of at least 70mm x 35mm timber studs or 64mm steel studs at 600mm centres, spaced at least 20mm from the masonry wall; and (ii) mineral insulation or glass wool insulation at least 50mm thick with a density of at least 11 kg/m³ positioned between studs; and (iii) One layer of plasterboard at least 10mm thick fixed to outside face of studs OR Single leaf of brick masonry at least 110mm thick with at least 13mm thick render on each face OR Concrete brickwork at least 110mm thick OR In-situ concrete at least 100mm thick OR Precast concrete at least 100mm thick and without joints.

Component of building's *external envelope*	Minimum R_w	Acceptable forms of construction
	35	Single leaf of clay brick masonry at least 110mm thick with: (i) a row of at least 70mm x 35mm timber studs or 64mm steel studs at 600mm centres, spaced at least 20mm from the masonry wall; and (ii) One layer of plasterboard at least 10mm thick fixed to outside face of studs OR Minimum 6mm thick fibre cement sheeting or weatherboards or plank cladding externally, minimum 90mm deep timber stud or 92mm metal stud, standard plasterboard at least 13mm thick internally.
Roof	45	Concrete or terracotta tile or sheet metal roof with sarking, *acoustically rated plasterboard* ceiling at least 13mm thick fixed to ceiling joists, cellulose fibre insulation at least 100mm thick with a density of at least 45kg/m³ in the cavity. OR Concrete or terracotta tile or sheet metal roof with sarking, 2 layers of *acoustically rated plasterboard* at least 16mm thick fixed to ceiling joists, glass wool insulation at least 50mm thick with a density of at least 11kg/m³ or polyester insulation at least 50mm thick with a density of at least 20kg/m³ in the cavity.
	41	Concrete or terracotta tile or metal sheet roof with sarking, plasterboard ceiling at least 10mm thick fixed to ceiling joists, glass wool insulation at least 50mm thick with a density of at least 11kg/m³ or polyester insulation at least 50mm thick with a density of at least 20kg/m³ in the cavity. OR Concrete suspended slab at least 100mm thick.
	38	Concrete or terracotta tile or metal sheet roof with sarking, plasterboard ceiling at least 10mm thick fixed to ceiling cavity, mineral insulation or glass wool insulation at least 50mm thick with a density of at least 11 kg/m³.

Component of building's *external envelope*	Minimum R_w	Acceptable forms of construction
	35	Concrete or terracotta tile or metal sheet roof with sarking, plasterboard ceiling at least 10mm thick fixed to ceiling cavity.
Floors	51	Concrete slab at least 150mm thick.
	45	Concrete slab at least 100mm thick OR Tongued and grooved boards at least 19mm thick with: (i) timber joists not less than 175mm x 50mm; and (ii) mineral insulation or glass wool insulation at least 75mm thick with a density of at least 11kg/m³ positioned between joists and laid on plasterboard at least 10mm thick fixed to underside of joists; and (iii) mineral insulation or glass wool insulation at least 25mm thick with a density of at least 11kg/m³ laid over entire floor, including tops of joists before flooring is laid; and (iv) secured to battens at least 75mm x 50mm; and (v) the assembled flooring laid over the joists, but not fixed to them, with battens lying between the joists.
Entry Doors	35	Solid core timber not less than 45mm thick, fixed so as to overlap the frame or rebate of the frame by not less than 10mm, with full perimeter *acoustically rated seals*.
	33	Fixed so as to overlap the frame or rebate of the frame by not less than 10mm, fitted with full perimeter *acoustically rated seals* and constructed of - (i) solid core, wood, particleboard or blockboard not less than 45mm thick; and/or (ii) acoustically laminated glass not less than 10.38mm thick.

Component of building's *external envelope*	Minimum R_w	Acceptable forms of construction
	28	Fixed so as to overlap the frame or rebate of the frame, constructed of - (i) Wood, particleboard or blockboard not less than 33mm thick; or (ii) Compressed fibre reinforced sheeting not less than 9mm thick; or (iii) Other suitable material with a mass per unit area not less than 24.4kg/m²; or (iv) Solid core timber door not less than 35mm thick fitted with full perimeter *acoustically rated seals*.

Appendix F Calculations

Noise Source	Duration	Leq	Leq Level	Distance to Receivers: R1	R2	R3	R4
Car door closure	2	75	32	17	14	3	35
Car bypass	6	69	31	22	19	8	35
Car engine ignition	3	72	31	17	14	3	35
Conversation	900	65	49	25	24	12	40
Alfresco dining	900	75	59	22	50	35	44
Gymnasium activities	900	74	58	46	39	20	50
Truck passby / deliveries	30	80	49	50	12	15	60
Waste collection	40	93	63	50	25	15	60

Noise Level after Distance Loss	R1	R2	R3	R4
Car door closure	7	9	22	1
Car bypass	4	5	13	0
Car engine ignition	6	8	21	0
Conversation	21	21	27	17
Alfresco dining	32	25	28	26
Gymnasium activities	24	26	32	24
Truck passby / deliveries	15	27	25	13
Waste collection	29	35	40	27
0	#NUM!	#NUM!	#NUM!	#NUM!
0	#NUM!	#NUM!	#NUM!	#NUM!

Shielding	R1	R2	R3	R4
Car door closure	0	0	20	20
Car bypass	0	0	20	20
Car engine ignition	0	0	20	20
Conversation	0	0	0	0
Alfresco dining	0	0	20	0
Gymnasium activities	20	20	20	20
Truck passby / deliveries	20	0	20	20
Waste collection	20	0	20	20
0	0	0	0	0
0	0	0	0	0

SubTotal - Noise Level at Receiver	R1	R2	R3	R4
Car door closure	7	9	2	-19
Car bypass	4	5	-7	-20
Car engine ignition	6	8	1	-20
Conversation	21	21	27	17
Alfresco dining	32	25	8	26
Gymnasium activities	4	6	12	4
Truck passby / deliveries	-5	27	5	-7
Waste collection	9	35	20	7
0	#NUM!	#NUM!	#NUM!	#NUM!
0	#NUM!	#NUM!	#NUM!	#NUM!

CALC based on number of events over the period

Activity	Events	Duration	R1	R2	R3	R4
Car door closure	4114	2	22735	33523	7301	54
Car bypass	2057	6	5115	6858	387	20
Car engine ignition	2057	3	8546	12601	2744	20
Conversation	44	900	5060	5243	21960	1976
Alfresco dining	44	900	65336	12649	258	16334
Gymnasium activities	44	900	119	165	628	100
Truck passby / deliveries	33	30	10	17361	111	7
Waste collection	33	40	266	106414	2956	185
0	0	0	#NUM!	#NUM!	#NUM!	#NUM!
0	0	0	#NUM!	#NUM!	#NUM!	#NUM!

Noise Level at the Receiver	R1	R2	R3	R4
Car door closure	44	45	39	17
Car bypass	37	38	26	13
Car engine ignition	39	41	34	13
Conversation	37	37	43	33
Alfresco dining	48	41	24	42
Gymnasium activities	21	22	28	20
Truck passby / deliveries	10	42	20	8
Waste collection	24	50	35	23

				Distance to Receivers			
Noise Source	**Duration**	**Lmax**	**Lmax Level**	**R1**	**R2**	**R3**	**R4**
				0	0	0	0
Car door closure	2	83	83	17	14	3	35
Car bypass	6	N/A	N/A	22	19	8	35
Car engine ignition	3	74	74	17	14	3	35
Conversation	900	N/A	N/A	25	24	12	40
Alfresco dining	900	N/A	N/A	22	50	35	44
Gymnasium activities	900	85	85	46	39	20	50
Truck passby / deliveries	30	N/A	N/A	50	12	15	60
Waste collection	40	105	105	50	25	15	60
0	0			0	0	0	0
Noise Level after Distance Loss				**R1**	**R2**	**R3**	**R4**
Car door closure				58	60	73	52
Car bypass				#VALUE!	#VALUE!	#VALUE!	#VALUE!
Car engine ignition				49	51	64	43
Conversation				#VALUE!	#VALUE!	#VALUE!	#VALUE!
Alfresco dining				#VALUE!	#VALUE!	#VALUE!	#VALUE!
Gymnasium activities				52	53	59	51
Truck passby / deliveries				#VALUE!	#VALUE!	#VALUE!	#VALUE!
Waste collection				71	77	81	69
0				#NUM!	#NUM!	#NUM!	#NUM!
Shielding				**R1**	**R2**	**R3**	**R4**
Car door closure				0	0	20	20
Car bypass				0	0	20	20
Car engine ignition				0	0	20	20
Conversation				0	0	0	0
Alfresco dining				0	0	20	0
Gymnasium activities				20	20	20	20
Truck passby / deliveries				20	0	20	20
Waste collection				20	0	20	20
0				0	0	0	0
Noise Level at Receiver				**R1**	**R2**	**R3**	**R4**
Car door closure				58	60	53	32
Car bypass				#VALUE!	#VALUE!	#VALUE!	#VALUE!
Car engine ignition				49	51	44	23
Conversation				#VALUE!	#VALUE!	#VALUE!	#VALUE!
Alfresco dining				#VALUE!	#VALUE!	#VALUE!	#VALUE!
Gymnasium activities				32	33	39	31
Truck passby / deliveries				#VALUE!	#VALUE!	#VALUE!	#VALUE!
Waste collection				51	77	61	49
0				#NUM!	#NUM!	#NUM!	#NUM!