

PLANS AND DOCUMENTS
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PORTSIDE EAST – BUILDING 18

HAMILTON

REPORT

FOR

ACOUSTIC SERVICES

BROOKFIELD RESIDENTIAL PROPERTIES ON BEHALF OF

BROOKFIELD PORTSIDE EAST PTY LTD

Client

EMF GRIFFITHS

Consulting Engineers

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SECTION 1.0 SITE DESCRIPTION

1.1 INTRODUCTION

EMF Griffiths have been engaged by Brookfield Portside East Pty Ltd to provide acoustic consultancy for the architectural and building services of the proposed mixed use development at Lot 703 SP287531 Portside East, Hamilton.



Figure 1: Rendered View of Proposed Development

The development proposal comprises a fifteen (15) storey single building that rises from a podium. The site comprises:-

- Basement: Car parking is provided for retail tenants and visitors.
- Ground Level: Commercial tenancies.
- Podium: Residential units and car parking with spaces for residents.
- Tower: Multi- storey residential tower with roof top recreation deck.

The proposed unit mix is one hundred and fifty six (156) apartments in the following configuration:

- Seventy (70) x one (1) Bedroom Units
- Three (3) x one (1) Bedroom SOHO
- Eighty three (83) x two (2) Bedroom Units

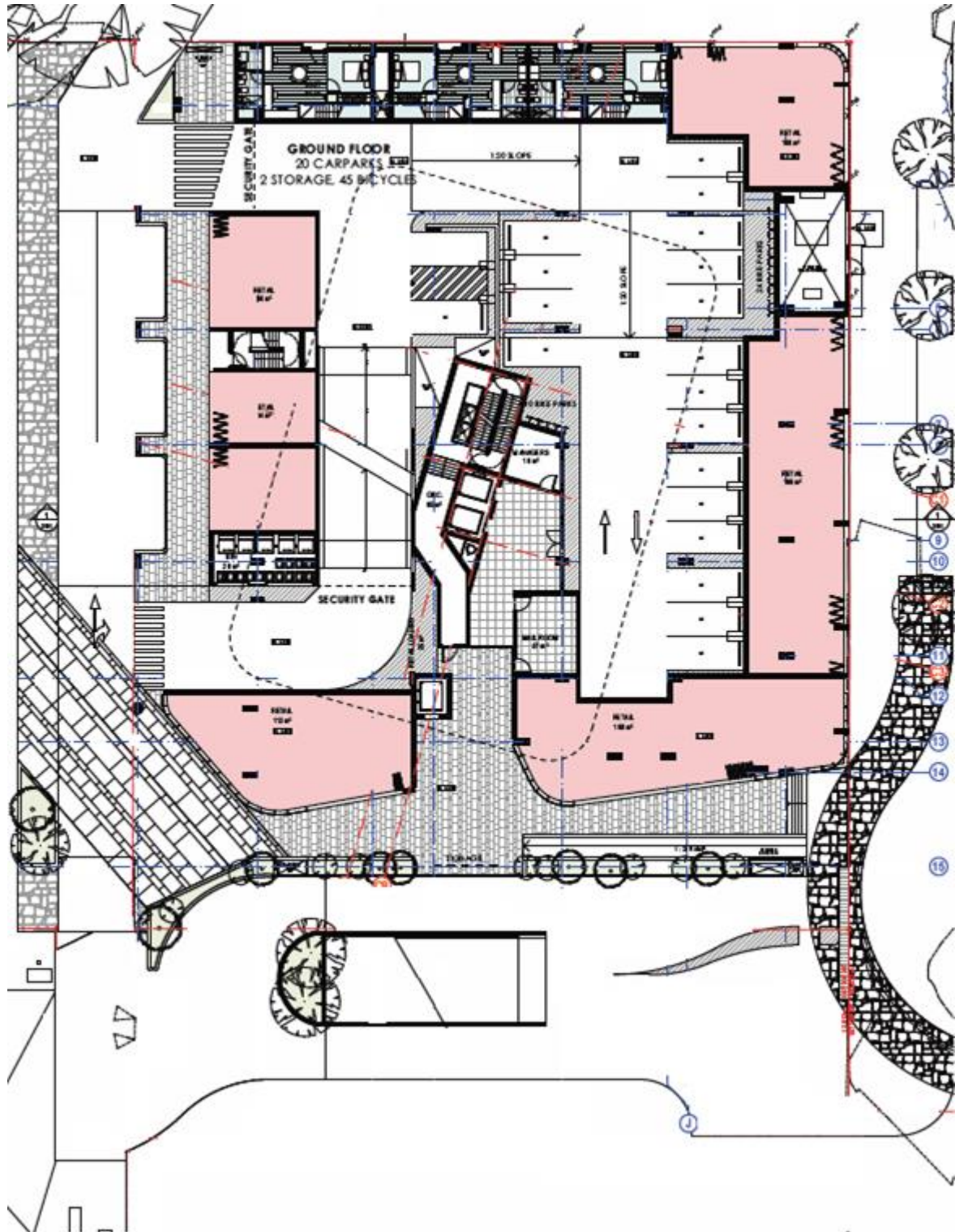


Figure 2: Site Plan

1.2 BACKGROUND

An acoustic assessment for noise intrusion to maintain appropriate levels of amenity for the building residents and users is required along with assessment of impact on adjacent noise sensitive receivers.

The assessment reviews building layout drawings, mechanical services, architectural schedules and proposes acoustic design recommendation with respect to the acoustic requirements of :-

- Local and State Regulations propose acoustic design recommendations including requirements of Brisbane City Council (BCC) Noise Impact Assessment Planning Scheme Policy (NIAPSP) and the State Environmental Protection (Noise) Policy 2008.
- The BCA 2016 section F5.
- Australian Standard AS 2107-2016: Acoustics - Recommended design sound levels and reverberation times for building interiors.
- Australian Standard AS 2021-2015 Acoustics- Aircraft noise intrusion- Building siting and construction.
- Australian Standard AS 3671-1989 Acoustics—Road traffic noise intrusion—Building siting and construction

1.3 OBJECTIVES

Acoustic study as follows:-

- Identification of target internal noise levels.
- Identification of noise emissions targets.
- Characterisation of noise emissions associated with the external mechanical plant (including pumps, fans and chiller noise) and activities (e.g. waste and on site vehicle movements, outdoor space noise emissions from site occupants) associated with the development.
- Characterisation of noise from external sounds such as nearby roads, aircraft noise and industrial sources.
- Acoustic Modelling, calculations and recommendations for appropriate noise amelioration measures to mitigate noise impact for the building residents and building users.
- Site measurement of existing noise amenity. Measurements to be in accordance with AS 1055.1-3 1997.
- Acoustic design in accordance with requirements of the Building Code of Australia, local and state regulations.
- Acoustic Design of Noise Control Measures for Mechanical Ventilation. The noise emanating from the mechanical ventilation system shall be in accordance with the requirements of Appendix B of the Australia Standard AS 1055.2-1984 (Description and Measurement of Environmental Noise).
- Acoustic design based on measured environmental noise statistical noise characterisation parameters, as defined in AS 1055.1-3 1997 accounting for:-
 - Tonality.
 - Frequency weighting.
 - Impulsive characteristics.
 - Fluctuations and temporal content.
 - Recommended maximum planning noise levels.

1.4 SUBJECT SITE - LOCATION AND DESCRIPTION

The site is located in the Northshore Hamilton Urban Renewal Area, Hamilton, Queensland. The site and location are shown in the satellite image in Figure 3.

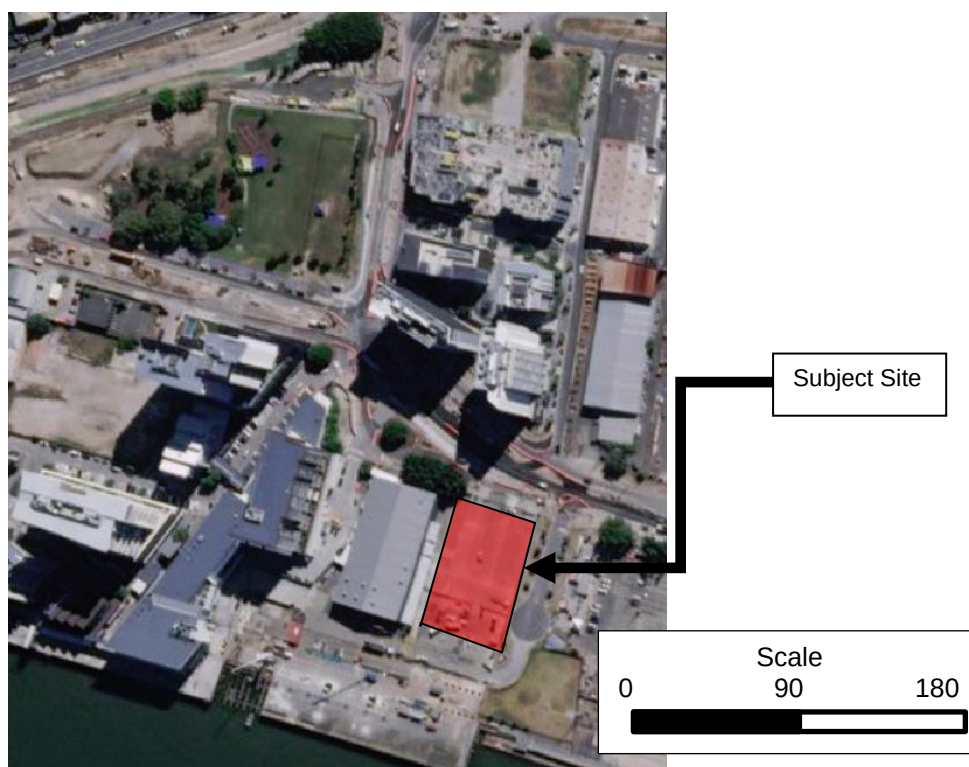


Figure 3: Aerial View of Subject Site

The site is located in the Northshore Hamilton Priority Development Area which is a mixed use area of the Northshore Urban Village as shown in the zoning map below.

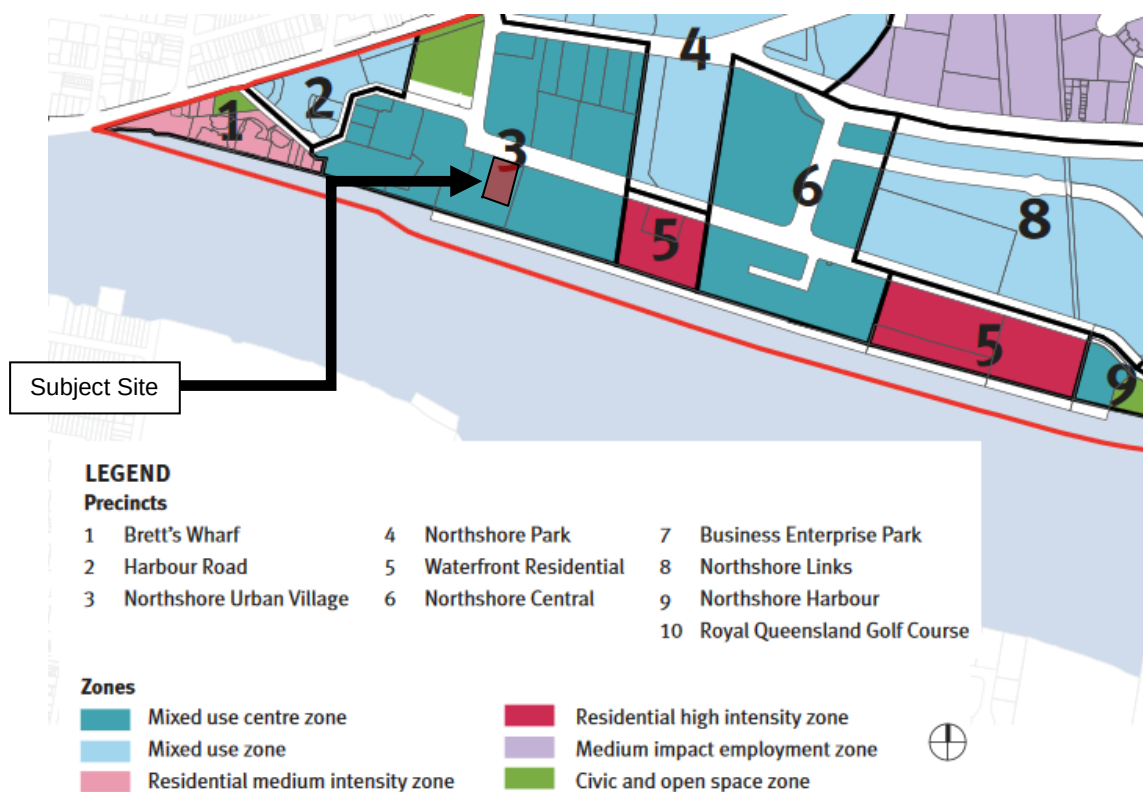


Figure 4: Extract From Northshore UDA Zoning Map

The site is located outside the designated transport corridor for Kingsford Smith Drive (Refer Appendix C) and there is significant shielding from the intervening buildings. However some of the upper levels are exposed to this road. The site is within the ANEF 20-25 zone as shown in the airport overlay (including impacts from the second runway) in Appendix E. Also, based on the Brisbane Airport N70 map there are significant (approx. 30) over aircraft noise events over 70dB(A) and hence the development is to include design elements to mitigate the impact of aircraft noise within the units.

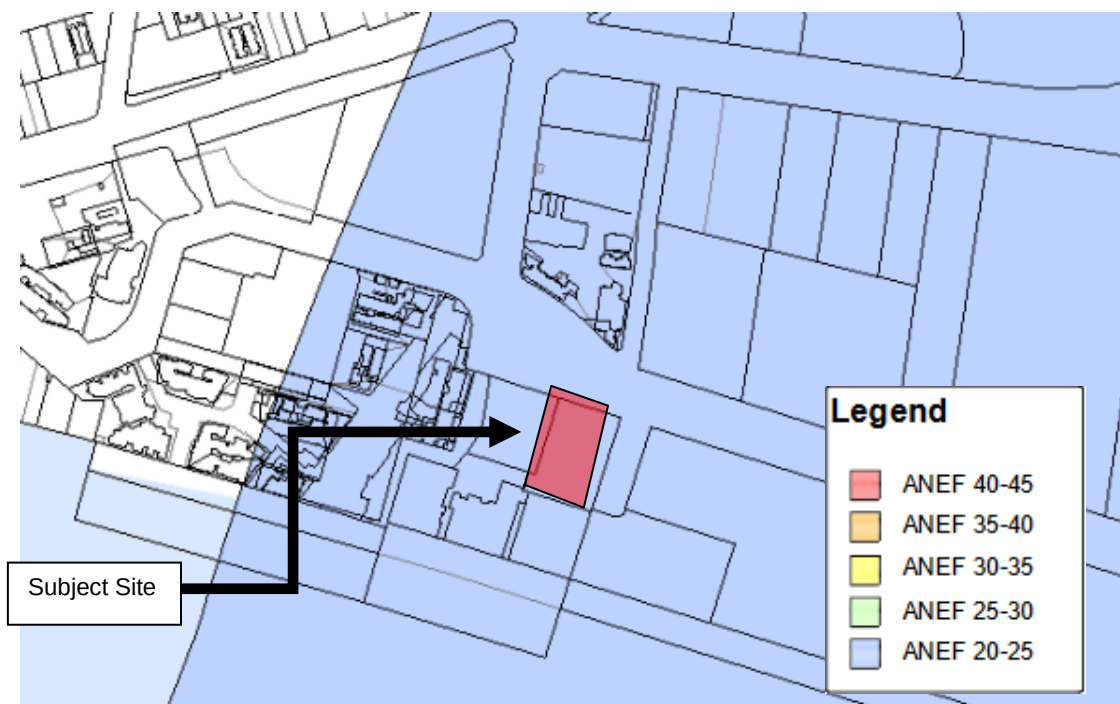


Figure 5: Location of Aircraft Noise Exposure Zones (2018)

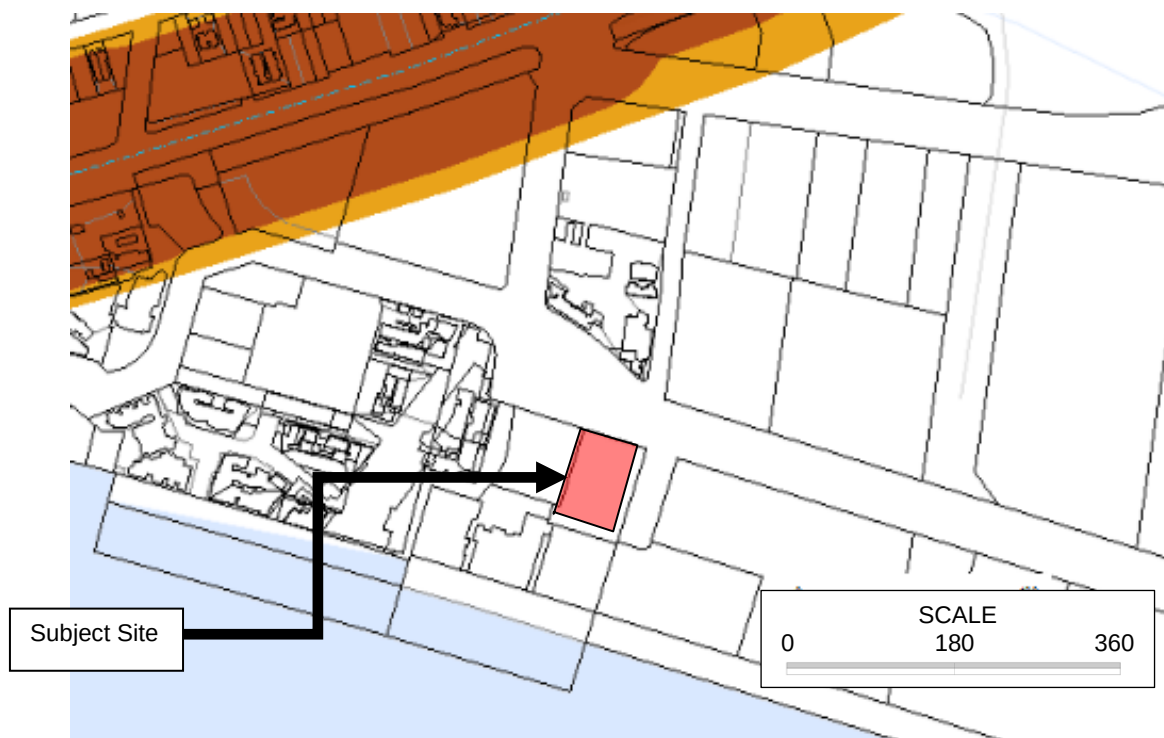


Figure 6: Location of Road Corridor

1.5 ADJACENT LAND USES

The nearest noise sensitive receivers to proposed development are the adjacent mixed use, residential and commercial developments shown below.

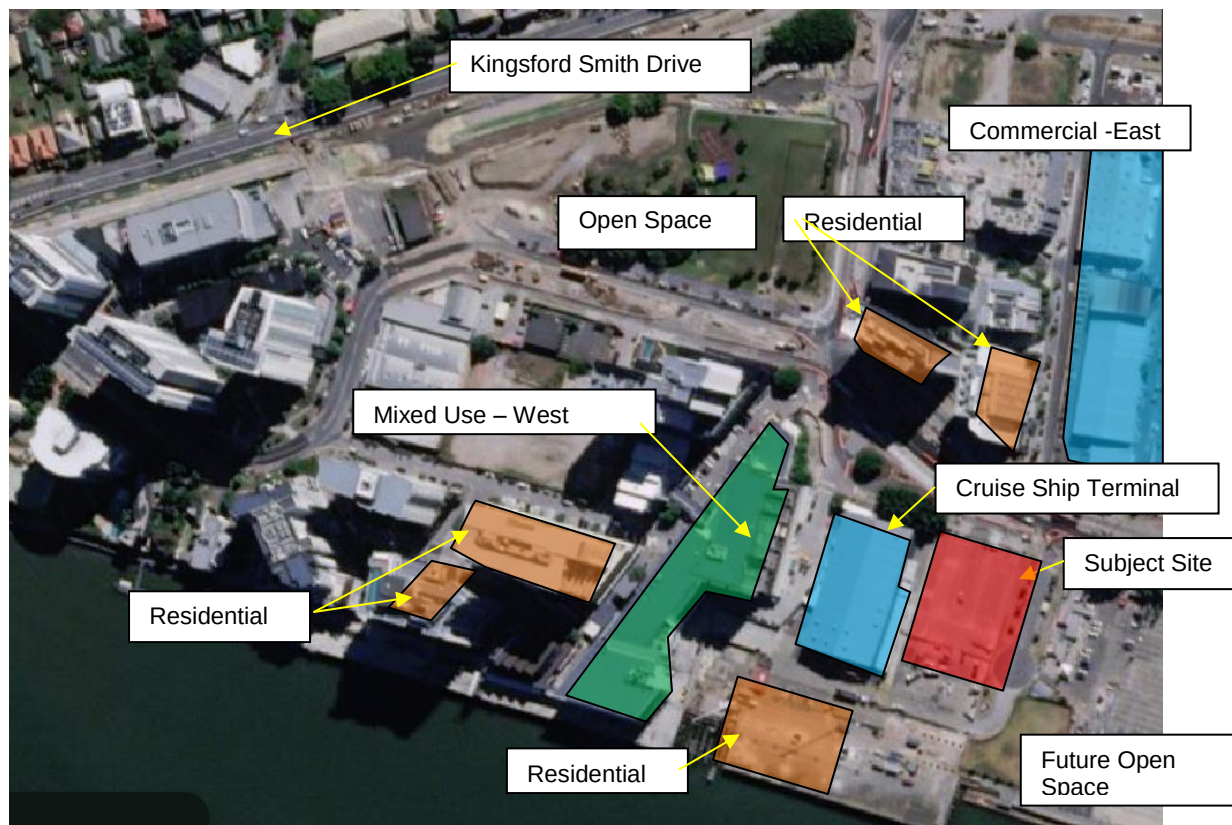


Figure 7: Adjacent Land Uses

Noise source propagation modelling has been used to assess the impact of noise sources from the proposed development on these existing adjacent noise sensitive receivers.

SECTION 2.0 GENERAL AMENITY ISSUES

2.1 EXISTING NOISE AMENITY

Noise sources at the subject site are:-

- Traffic Noise from adjacent roads, Kingsford Smith Drive, Remora Road and Macarthur Avenue.
- Vehicle noise from passenger and commercial vehicles entering and leaving the area.
- Noise from planes flying overhead.
- Noise from ships berthed at the wharf.
- Noise from users of the adjacent sites and commercial properties including
- Noise from waste trucks and waste management activities at the adjacent mixed use development
- Noise from vehicles using the loading docks at the adjacent mixed use development to the west.
- Building services noise (loading dock exhaust, cooling towers, kitchen exhaust, ventilation units) at adjacent development to the west as well as the cruise ship terminal.

2.2 NOISE SENSITIVE RECEIVERS

There are residential developments at the site boundaries to the north and south-west. The Cruise Ship Terminal is adjacent to the west. Commercial developments lie to the North East. Further to the west is the Portside Wharf Mixed Use Precinct. These sites represent the noise sensitive receivers used in the assessment and are shown in the aerial photo below:-



Figure 8: Nearest Noise Sensitive Receivers

The noise sensitive receiver locations are as follows:-

1. Multi-unit Residential
2. Multi-unit Residential
3. Commercial Area
4. Adjacent Development Site
5. Gallery House
6. Cruise Ship Terminal
7. Portside Wharf Retail
8. Promenade (Multi-unit residential)

2.3 EXISTING ENVIRONMENTAL NOISE LEVELS

Noise Levels were measured at the subject site over May – June 2018 (refer to the figures below showing location) to determine background noise levels around the subject site during daytime, evening and night time periods over the weekend and during week days.



Figure 9: Location of Noise Measurement Equipment (Aerial)

The operation of the sound level measuring equipment was field calibrated before and after the measurement and was found to be within 0.1 dB of the reference signal. All instrumentation used in this assessment hold a current calibration certificate from a certified NATA calibration laboratory. The following instruments were used to measure the ambient noise levels:-

- Ngara ARL Noise Logger.
- Pulsar 105 Calibrator.

Ambient sound pressure levels were measured generally in accordance with Australian Standard AS 1055.1:1997 - 'Acoustics-Description and measurement of environmental noise - Part 1: General procedures'. Ambient noise levels were recorded at fifteen (15) minute intervals over the measurement period.

The weather during the measurement was generally typical winter weather as shown in the following Bureau of Meteorology data summary from the Brisbane Airport weather station. Data from significant weather events has been removed from the analysis.

Date	Day	Temps		Rain	Wind		
		Min	Max		Dir	Speed	MSLP
		°C	°C		km/h		hPa
31	Th	7.2	21.7	0.2	SW	20	1021.2
1	Fr	7.4	21.1	0	SW	19	1020
2	Sa	7.7	22.6	0	SW	7	1018.1
3	Su	9.5	24.1	0	SW	19	1015.2
4	Mo	9.9	22.6	0	SSW	24	1016.7
5	Tu	11.3	21.5	0	SSW	19	1020.2
6	We	10.8	22.2	0	SSW	17	1022.2
7	Th	12.9	19.9	11.4	SSE	17	1024.7

Table 1: Weather Summary during Noise Survey

The fifteen (15) minute results for a typical twenty four (24) hour period are shown in Appendix E. The results are summarised below:-

Period	Time	Noise Level dB(A)		
		L _{Aeq}	L _{A90}	L _{A10}
Weekday				
Day	0700-1800	60	51	63
Evening	1800-2200	55	47	58
Night	2200-0700	51	44	52
Weekend				
Day	0700-1800	56	47	59
Evening	1800-2200	55	47	58
Night	2200-0700	49	44	51

Table 2: Noise Survey Results

2.4 NOISE SOURCES

There are a variety of noise sources at the proposed development including:-

- Mechanical Plant Noise from car park fan exhausts at the ground level.
- Noise from operation of mechanical services.
- Noise from operation of kitchen exhausts from retail area where retail areas require a kitchen. These are to be discharged horizontally at the roof level of the retail tenancy.
- Noise transmitted by internal building services and pipework.
- Noise from waste vehicles and loading vehicles at ground level.
- Noise from passenger vehicles entering and leaving the car park at Ground Level and on Level 1.
- Noise from users of the retail precinct, outdoor dining areas, common areas and private outdoor areas.
- Noise from the ships berthed at the Portside Wharf.

The following section identifies the location and levels of the significant noise sources which have been considered in the assessment. The figures below show the location of the noise sources associated with the development. Note precise locations of mechanical plant are to be determined and the locations shown are indicative only.

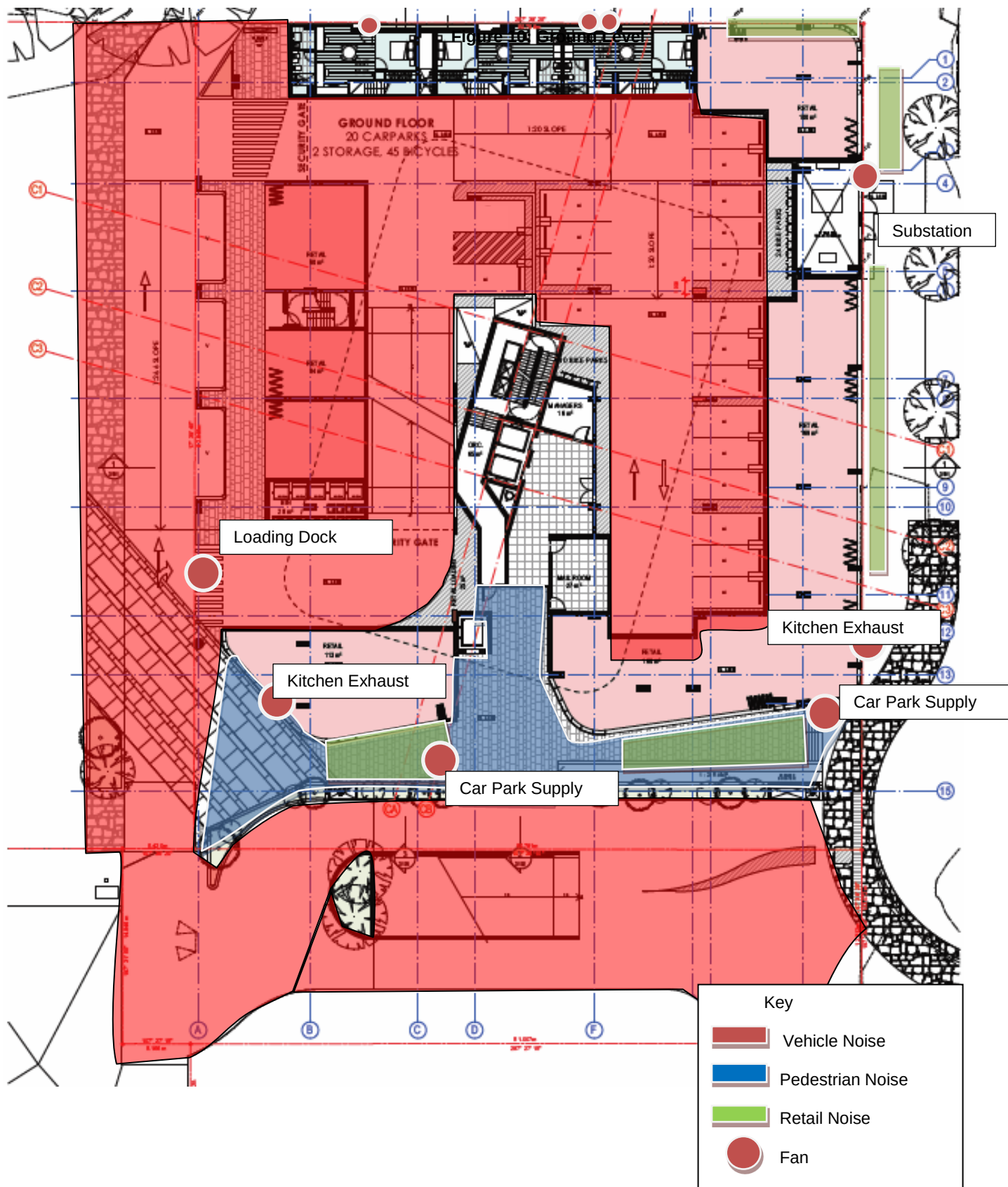


Figure 10: Ground Floor

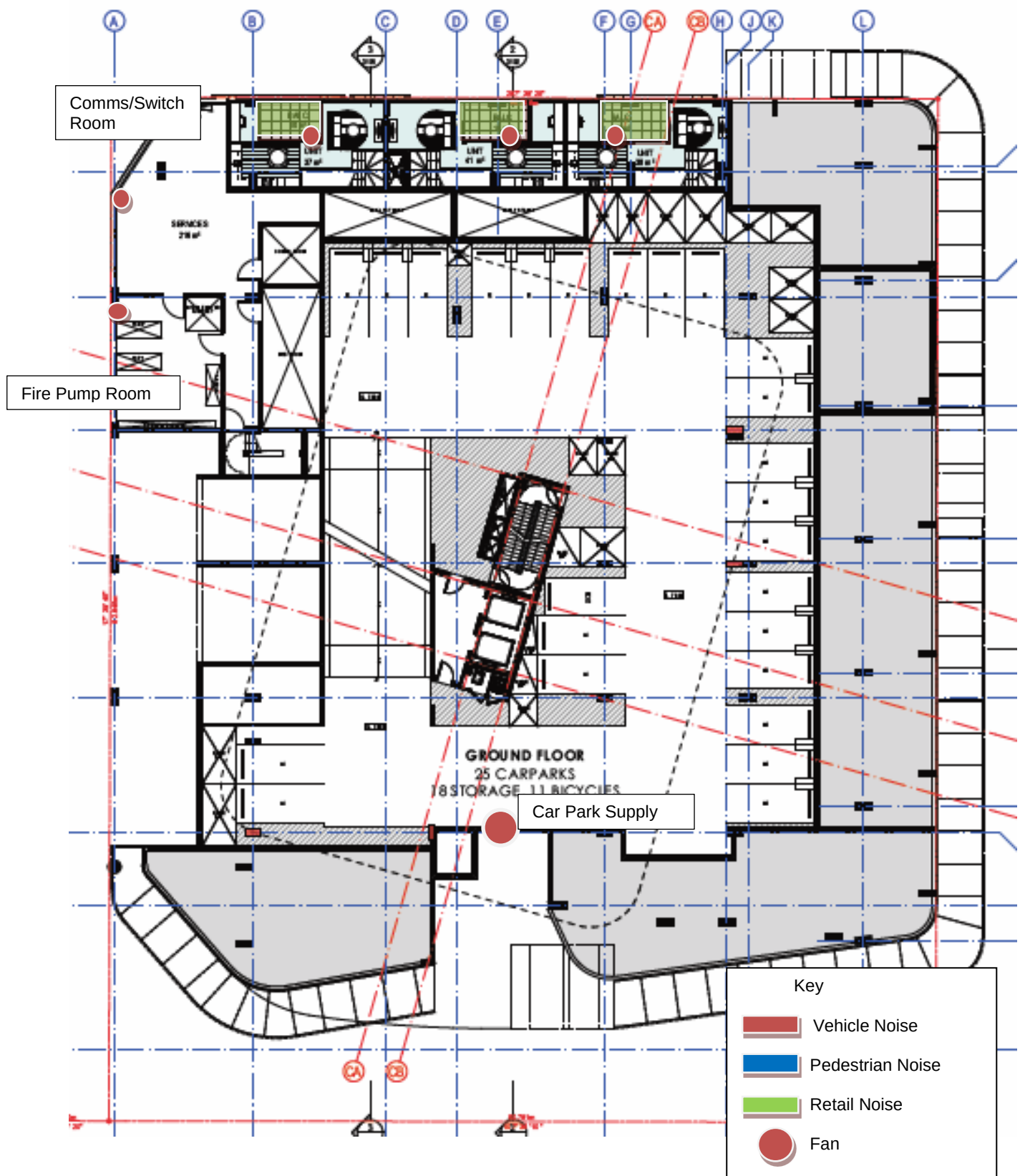


Figure 11: Mezzanine

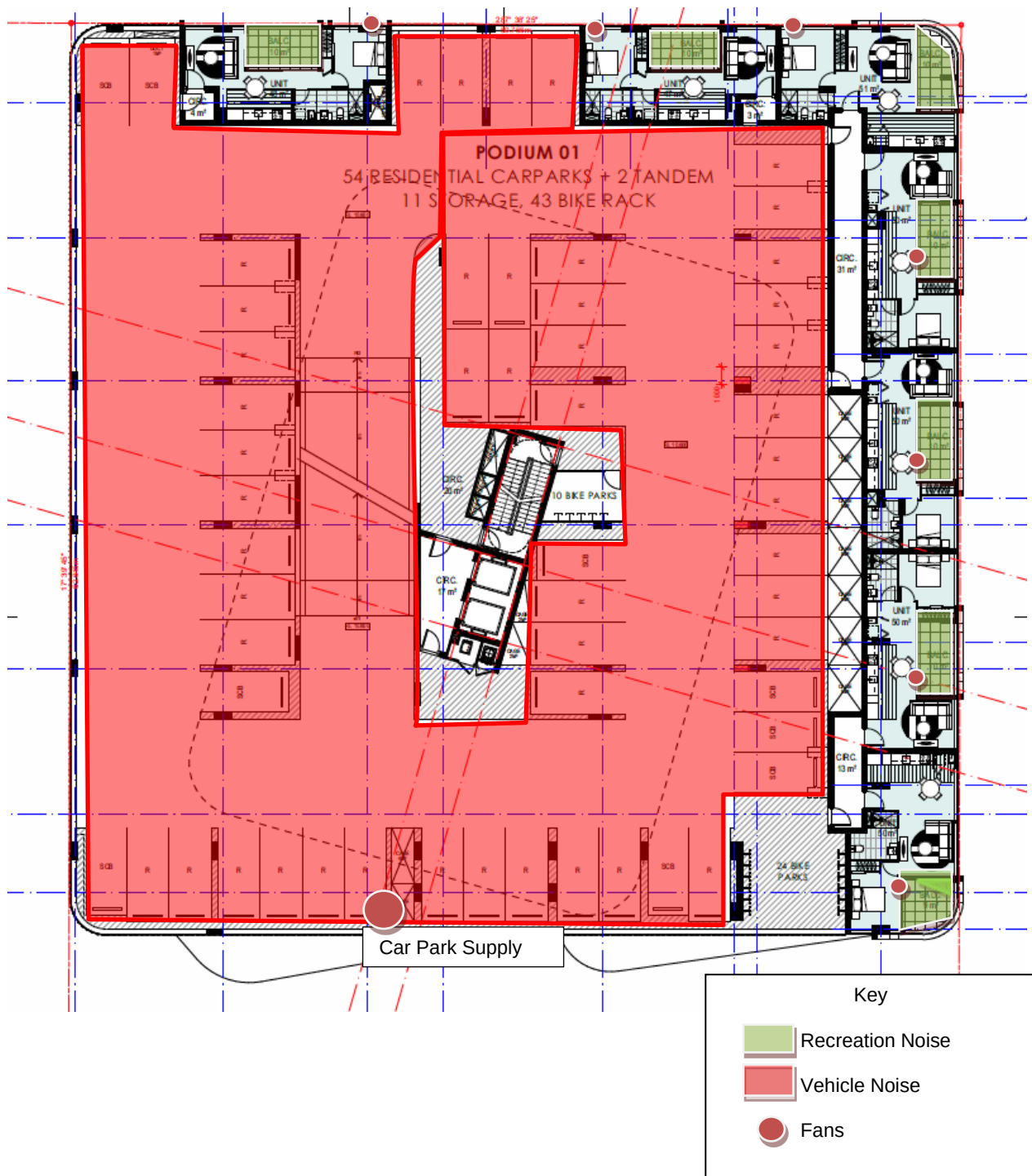


Figure 12: Podium 1/2

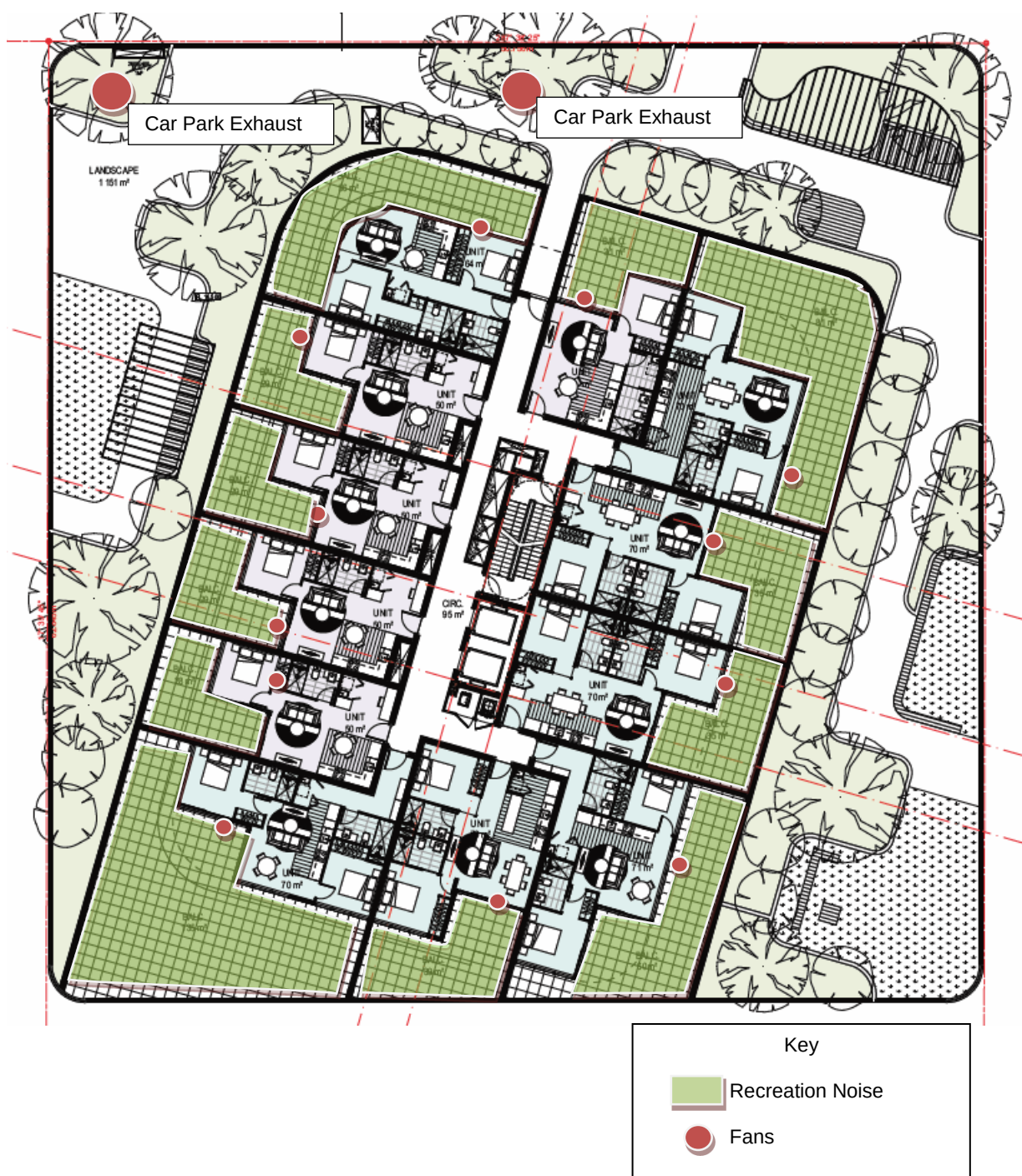


Figure 13: Podium 3



Figure 11: Unit Level 4-11



Figure 12: Unit Level 12-13

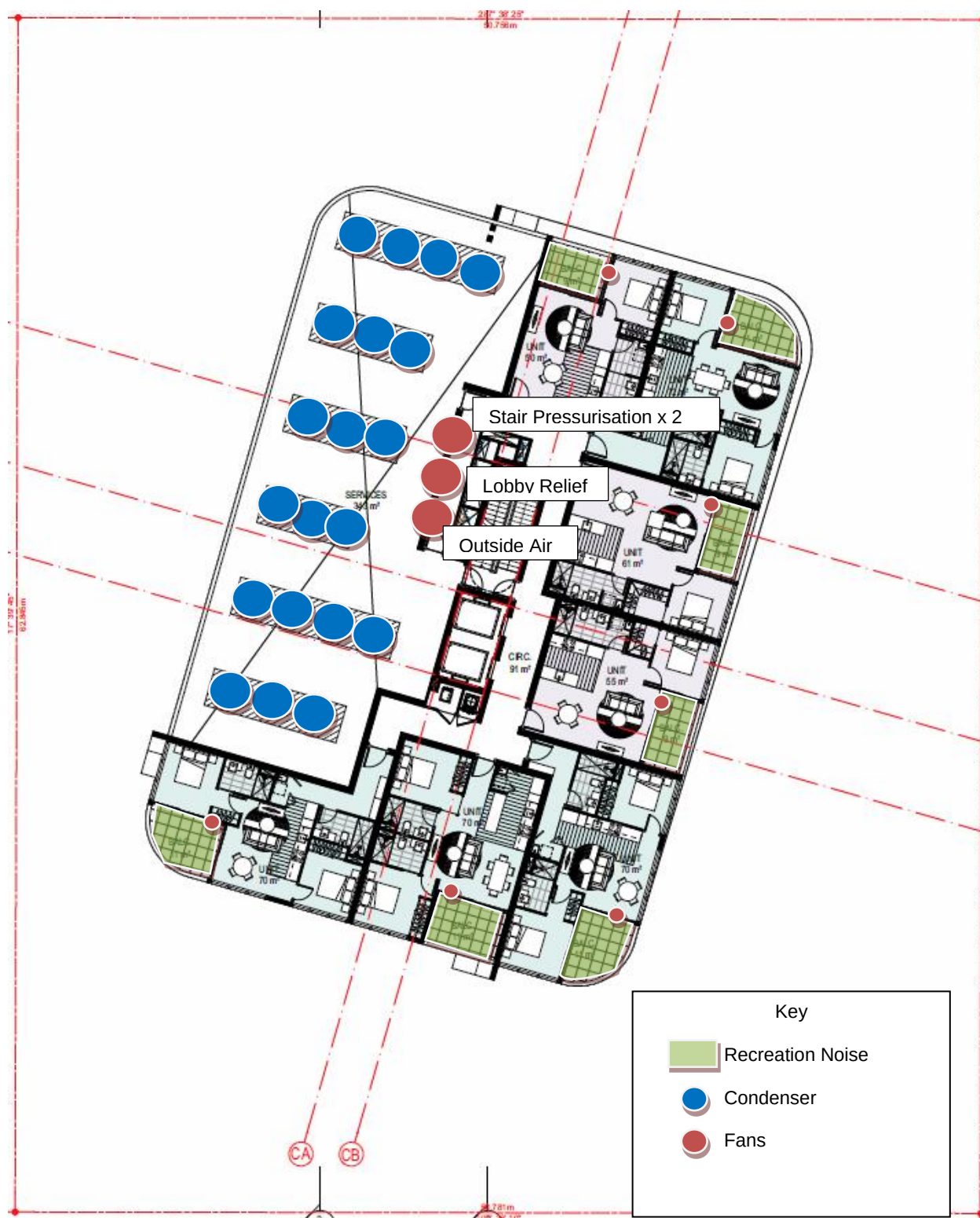


Figure 13: Level 14

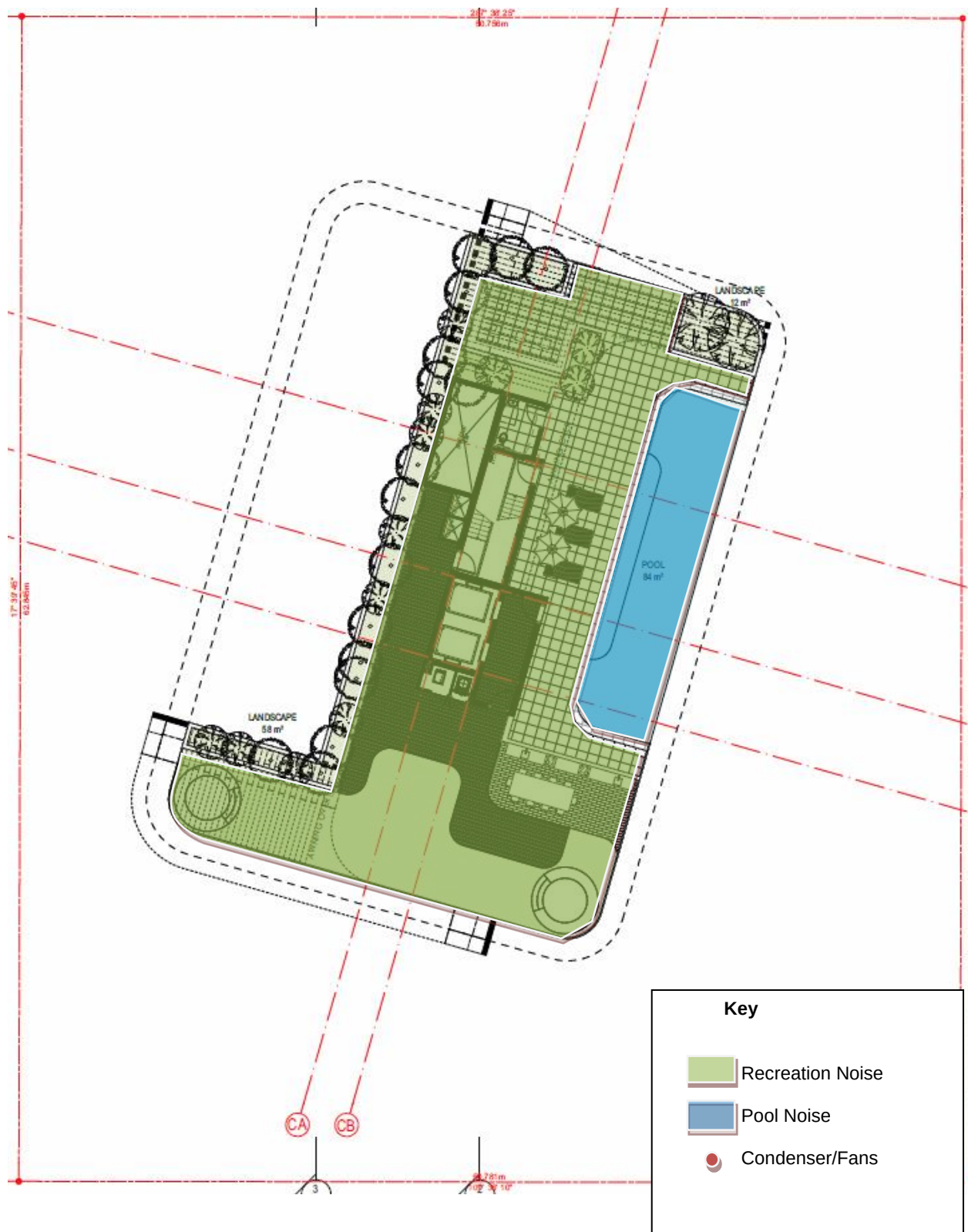


Figure 14: Recreation Deck

2.4.1 **Mechanical Plant**

External Noise Intrusion, generally from plant noise, is considered in this report. In most cases the transmission path will be via airborne noise. In some circumstances, regenerated noise as a result of vibration may also be an issue. Intrusive noise can generally be classified as either continuous or intermittent. Continuous noise, even though it might vary from time to time, is measured using a procedure to determine its equivalence over a representative time period. The continuous measurement is normally expressed as L_{Aeq} whereas intermittent noise is measured as the arithmetic average of the maximum sound level readings expressed as $L_{Amax,avg}$. Mechanical Plant Equipment comprises continuous noise sources as follows:-

				Sound Power (dB) at Octave Band (Hz)								SPL dB(A) @3m
Equipment	No.	Oper.	Loc.	63	125	250	500	1k	2k	4k	8k	
Fans												
Car Park Exhaust Fan	6 – discharge at podium	CPEF (VSDs50%6-8hrs,18-20hrs)	Podium Level 3	76	87	88	86	86	82	79		70
Car Park Supply Fan	6 -2 at each level	CPSF (VSDs50%6-8hrs,18-20hrs)	Each Parking Level	76	87	88	86	86	82	79		70
Retail Kitchen Exhaust	Each Retail Tenancy	Bus. Hrs	Ground	89	89	84	78	78	75	75	72	63
SOU Condenser (day)	Each SOU	0700-1800	Level 14/ Rec Deck	51	59	65	67	65	62	52	54	57
SOU Condenser (night)	Each SOU	1800-0700	Level 14/ Rec Deck	36	44	50	52	50	47	37	39	42
SOU Toilet Exhaust Fan	Each SOU	Switch Operated	Façade of each SOU	51	47	50	53	48	43	36	31	33
Commercial AC	Each Retail Tenancy	Bus. Hrs	Level 14/ Rec Deck	51	59	65	67	65	62	52	54	57
Sub-station Fan	1	Temp Cont. 24/7	Podium	-	83	90	82	82	80	76		67
Switch Room Fan	1	24/7	Podium		78	83	84	82	75	68		65
Comms Room Fan	1	Thermostat	Podium	51	47	50	53	48	43	36	31	33
Fire Pump Room Fan	1	During testing	Podium	51	47	50	53	48	43	36	31	33
O/A Fan	1	24/7	Roof	-	83	90	82	82	80	76		67
Stair Pressurisation Fan	2	During testing	Roof		83	89	86	85	82	78		69
Lobby Relief Fan	1	During testing	Roof		83	89	86	85	82	78		69

Table 3: Sound Power and Number of Major Items of Mechanical Plant

Note the above noise levels are based on typical selections for the application and are maximum values. Once final selections have been made the required acoustic treatments are to be reviewed to confirm compliance with the relevant design noise levels.

2.4.2 Waste and Car Park Vehicle Movements

The car parks are located in the basement car park, and at Level 1 and Level 2. Waste collection is by an 8.8m medium rigid rear loading waste truck at the waste storage area on ground level.

The collection of recycling and general waste (domestic) would be up to three (3) times per week. 1100l bulk plastic bins and trailer are to be used to reduce the noise this part of the waste management process.

The commercial impacts from the additional development would be relatively minimal: The collection of recycling and general waste (commercial) would be up to three times per week.

The noise due to entrance and exiting of the vehicles (reversing alarms, vehicles accelerating and starting) has been modelled. These noise sources are intermittent and typical sound levels from these events are shown below:-

Description	L _{Amax}
Waste Vehicle Movement* for ¼ hour between 7am and 8am	100dB(A)
Internal Car Movement (entering/leaving) For the generation of site – based upon 0.4vph/ unit and 2ph per retail space, the site is expected to generate one hundred and forty two (142) vehicles during peak hours, and one thousand four hundred and twenty (1420) vehicles daily.	94dB(A)

* Truck and loading noise on operating ground of cargo centres, delivery warehouses and haulage contractors, Hessische Landesanstalt für Umwelt, 16.05.1995 Heft 192

Table 4: Sound Levels of Waste and Internal Car Park Movements

2.4.3 Common Area Use and Private Outdoor Spaces

The associated intermittent noise sources from use of the common areas and commercial outdoor areas and private outdoor spaces associated with each unit are detailed in the table below:-

Description	L _{Aeq}
People talking (loud conversation)*	70dB(A)

* Technischer Überwachungs-Verein Norddeutschland e.V., 1987

Table 5: Sound Levels of Common Area Noise Sources

2.4.4 Traffic Noise

The traffic noise levels, within an ultimate planning horizon of twenty (20) years from the establishment of the proposed development (year 2016), were predicted using the noise prediction model SoundPLAN. Calculations are based on the procedures developed by the U.K. Department of Transport, Welsh Office, issued as “*Calculation of Road Traffic Noise*” in 1988 (CoRTN’88). The dominant traffic noise source is Kingsford Smith Drive. Current typical week day traffic volumes on Kingsford Smith Drive are approximately 60,000 vehicles per day and approximately 15 per cent of this is commercial vehicles.

Brisbane City Council’s traffic modelling predicts that typical week day traffic volumes will increase to approximately seventy five thousand (75,000) vehicles per day by 2031. The traffic model takes into account known proposed upgrades to the traffic network and proposed developments in the area the data is summarised in the table below:-

Year	Traffic Flow AADT	Traffic Speed (kph)	Heavy Vehicles (%)
2000	57,000	60	15%
2031	71,250	60	15%

The local roads of Remora Road, MacArthur Avenue and Hercules Street have been modelled with flows based on the data supplied from the project Traffic Engineer

Year 2031	Traffic Flow AADT	Traffic Speed (mph)	Heavy Vehicles (%)
Remora Road	5000	40	5%
Hercules Street	5000	40	5%
MacArthur Avenue	5000	40	5%

The predicted traffic flows were scaled down by a factor of 0.95, to represent the 95-percentile traffic flow in an eighteen (18)-hour period between 6:00 a.m. and 12:00 midnight.

Table 6: Traffic Flows

2.4.5 **Aircraft Noise**

The site is with the ANEF 20 boundary as shown in the airport overlay (including impacts from the second runway) in Appendix C. Also, based on the Brisbane Airport N70 (see Appendix D) map there are a significant number of aircraft noise events (over thirty (30) between 0600hrs and 1800hrs) over 70dB (A) and hence the development is to include design elements to mitigate the impact within the residential component. The commercial areas of the development do not require acoustic design for aircraft noise. The reference noise level for large passenger aircraft landing/ascending at is L_{max} 84dB(A).

2.4.6 **Cruise Ships**

Noise sources due to the operation of the facility are predominantly loading equipment and cruise ship generators.

Description	L_{Amax}
Operations of Cruise Ship Generator	90dB(A)
Operations of Cruise Ship Loading Equipment	85dB(A)

Table 7: Cruise Ship Terminal Noise Sources

SECTION 3.0 ACOUSTIC DESIGN CRITERIA

3.1 NOISE LEVELS AND REVERBERATION TARGETS

Under performance criteria of the BCC city plan high density design code the development is required to comply with the requirements of the noise impact assessment planning scheme policy (NIAPSP) the NIAPSP criteria are summarised in the table below:-

Methodology	Applicable Noise Level and Criteria
Comparisons of like parameters	Waste collection vehicles, Noise from development not exceed the L_{A10} parameter describing the ambient noise by more than 3dB(A).
Application of AS 2107	Refer Tables 9 and 10 for applicable levels for steady state noise such as from air A/C condensers and continuous road noise.
Sleep Awakening	Sound Exposure Level L_{AE} to be less than 65dB(A) at Bedroom facades from noise from other residents.
Background Creep	Not to exceed existing L_{A90} level at site.

Table 8: NIAPSP and Methodologies

The site is outside the zones requiring specific treatment required by MP4.4 buildings in a Transport Noise Corridor – Refer map in Appendix C. Noise intrusion criteria applicable to the residential areas of the development as required by the EPP (2008) have been summarised in Table 9 below:-

Authority	Item	Applicable Area	Descriptor	Noise Goal,dB(A)
The Environmental Protection (Noise) Policy 2008	Acoustic Quality Objective in private outdoor space	Outdoor Space of Dwelling	$L_{Aeq,adj,1hr}$	50
			$L_{A10,adj,1hr}$	55
			$L_{A1,adj,1hr}$	65
	Acoustic Quality Objective in dwelling during daytime (0700-1800) and evening (1800-2200)	Indoor	$L_{Aeq,adj,1hr}$	35
			$L_{A10,adj,1hr}$	40
			$L_{A1,adj,1hr}$	45
	Acoustic Quality Objective in dwelling during night (2200-0700)	Indoor	$L_{Aeq,adj,1hr}$	30
			$L_{A10,adj,1hr}$	35
			$L_{A1,adj,1hr}$	40

Table 9: Noise Intrusion Criteria

In addition, the Australian Standard AS/NZS 2107:2016 recommends the following interior noise level targets for residential areas:-

Authority		Applicable Area	Descriptor	Noise Goal,dB(A)
AS/NZS 2107:2016	Acoustic Quality Objective in dwelling during day	Living Areas	L_{Aeq} (1-hour max)	35-45
	Acoustic Quality Objective in dwelling during night (2200-0700)	Sleeping areas	L_{Aeq} (1-hour max)	35-40

Table 10: Additional Noise Intrusion Criteria

The Australian Standard AS/NZS 2107:2016 recommends the following interior noise level and reverberation targets for the common areas:-

Authority	Sensitive Use Area	Descriptor	Noise Goal,dB(A)
AS/NZS 2107:2016	Foyers	L_{Aeq} (8-hour)	45-50
	Enclosed Car Parks	L_{Aeq} (8-hour)	<65
	Apartment Common Areas	L_{Aeq} (8-hour)	45-50
	Retail Areas (incl/ restaurants)	L_{Aeq} (8-hour)	45-50

Table 11: Recommended Internal Noise Levels

The Australian Standard AS/NZS 2021:2015 recommends the following interior noise level due to aircraft noise:-

Authority	Sensitive Use Area	Descriptor	Noise Goal,dB(A)
AS/NZS 2021:2015	Residential - Sleeping areas	L _{Max}	50
	Residential – Other habitable spaces	L _{Max}	55
	Residential – Bathrooms, Toilets, Laundries	L _{Max}	60
	Retail Areas (incl/ restaurants)	L _{Max}	75

Table 12: Recommended Internal Noise Levels due to Aircraft Noise

3.2 ACOUSTIC SEPARATION TARGETS

The design criteria for the apartments are governed by the provisions of the acoustic requirements of BCA 2016 section F5.1 to F5.6 for a Class 2 building. The deemed to satisfy provisions for parts F5.3 to F5.5 are detailed below:-

BCA Clause	Item	Criteria
F5.3	Determination of impact sound insulation rating for walls.	A wall in a building required to have an impact sound insulation rating must be discontinuous construction. Discontinuous construction means a wall having a minimum 20mm cavity between two (2) separate leaves, and (i) For masonry, where wall tiles are required to connect leaves, the ties are of the resilient type; and (ii) For other than masonry, there is no mechanical linkage between leaves except at the periphery.
F5.4 (a) (i)	Sound insulation of floors between units.	A floor separating sole occupancy units must have an $R_w + C_{tr}$ (airborne) of not less than fifty (50) and a $L_{n,w} + C_i$ (impact) of not more than sixty two (62).
F5.4 (a) (ii)	Sound insulation of floors between units and stairways, public corridors, public lobbies or the like.	A floor separating sole occupancy units from stairways, public corridors, public lobbies, lift shaft or the like must have an $R_w + C_{tr}$ (airborne) of not less than fifty (50) and a $L_{n,w} + C_i$ (impact) of not more than sixty two (62).
F5.5 (a) (i) and (ii)	Sound Insulation of walls between units	A wall must have an $R_w + C_{tr}$ (airborne) of not less than fifty (50) if it separates sole occupancy units; A wall must have an R_w (airborne) of not less than fifty (50) if it separates a sole occupancy unit from a plant room, lift shaft, stairway, public corridor, hallway or the like.
F5.5 (a) (iii)	Sound insulation of walls between a bathroom, sanitary compartment, laundry or kitchen and a bedroom or habitable room in adjoining room of SOU from a plant room or lift shaft	Walls must be of discontinuous construction (e.g. 20mm unconnected cavity, no linkage between leaves other than at periphery)
F5.5 (b)	Doors to apartments from public corridors and public lobbies.	Doors to the apartments are to achieve an R_w of not less than thirty (30).
F5.5 (e)	Sound insulation of walls with floors above	Wall to continue to the underside of the floor above or to have a ceiling that provides the sound insulation required for the wall.
F5.5 (f)	Sound insulation of walls with roofs above	Wall to continue to the underside of the roof above or to have a ceiling that provides the sound insulation required for the wall.

BCA Clause	Item	Criteria
F5.6	Sound Insulation Rating of Services	If a duct, soil, waste or water supply pipe, including a duct or pipe that is located in a wall or floor cavity, serves or passes through more than one sole-occupancy unit, the duct or pipe must be separated from the rooms of any sole-occupancy unit by construction with an $R_w + C_{tr}$ (airborne) not less than (i) Forty (40) if the adjacent room is a habitable room (other than a kitchen); or (ii) Twenty five (25) if the adjacent room is a kitchen or non-habitable room. If a storm water pipe passes through a sole-occupancy unit it must be separated in accordance with (i) and (ii).
F5.7	Sound Isolation of Pumps	Flexible couplings to be used at the point of connection between the service pipes in the build and any circulating or other pump.

Table 13: BCA 2016 Acoustic Design Criteria

All forms of construction detailed in the table above must be installed as follows:-

- a) Masonry – Units must be laid with all joints filled solid, including those between the masonry and any adjoining construction.
- b) Concrete slabs – Joints between concrete slabs or panels and any adjoining construction must be filled solid.
- c) Sheeting materials:-
 - (i) If one (1) layer is required on both sides of a wall, it must be fastened to the studs with joints staggered on opposite sides.
 - (ii) If two (2) layers are required the second layer must be fastened over the first layer so that the joints do not coincide with those of the first layer.
 - (iii) Joints between sheets or between sheets and any adjoining construction must be taped and filled solid.
- d) Timber or steel-framed construction – perimeter framing members must be securely fixed to the adjoining structure and:-
 - (i) Bedded in resilient compound.
 - (ii) The joints must be caulked so that there are no voids between the framing members and the adjoining structure.
- e) Services:-
 - (i) Services must not be chased into concrete or masonry elements.
 - (ii) A door or panel required to have a certain $R_w + C_{tr}$ that provides access to a duct, pipe or other services must:-
 - Not open into any habitable room (other than a kitchen); and
 - Be firmly fixed so as to overlap the frame or rebate of the frame by not less than 10mm, be fitted with a sealing gasket along all edges and be constructed of:-
 - Wood, particleboard or blockboard not less than 33mm thick; or
 - Compressed fibre reinforced cement sheeting not less than 9mm thick; or
 - Other suitable material with a mass per unit area not less than 24.2 kg/m².
- f) A water supply pipe must –
 - Only be installed in the cavity of discontinuous construction; and
 - In the case of pipe that serves only one sole-occupancy unit, not be fixed to the wall leaf on the side adjoining any other sole-occupancy unit and have a clearance not less than 10mm to the other wall leaf.
- g) Electrical outlets must be offset from each other –
 - In masonry walling, not less than 100mm; and
 - In timber or steel framed walling, not less than 300mm.

3.3 SERVICES ACOUSTIC TARGETS

Hydraulic and Mechanical Services Risers to be acoustically treated give $L_{Amax,avg}$ 50.

NR levels are as below for noise levels due to operation of building services:-

Use Area	Noise Goal, NR
Reception Foyer	45
Bedrooms	35
Living Rooms/ Lounges	45
Kitchen /Dining Rooms	45
Bathroom	45
Retail Areas	40

Table 14: Recommended Service Acoustic Targets

Recommended maximum noise level within plant rooms is L_{Amax} 75dB(A) to minimise airborne transmission through the building fabric. Bounding fabric to common areas to be R_w 45 minimum.

SECTION 4.0 NOISE INTRUSION ASSESSMENT (FACADE CALCULATION)

4.1 NOISE CALCULATION METHODOLOGY

4.1.1 Computer Modelling Method

A three (3) dimensional model was created using SoundPLAN noise propagation software. The noise sources identified in Section 2 were added to the model in the appropriate locations. A three (3) dimensional noise map of the noise levels due to the sources was calculated. In addition, noise levels were calculated at designated locations the building facades, common areas and private outdoor spaces.

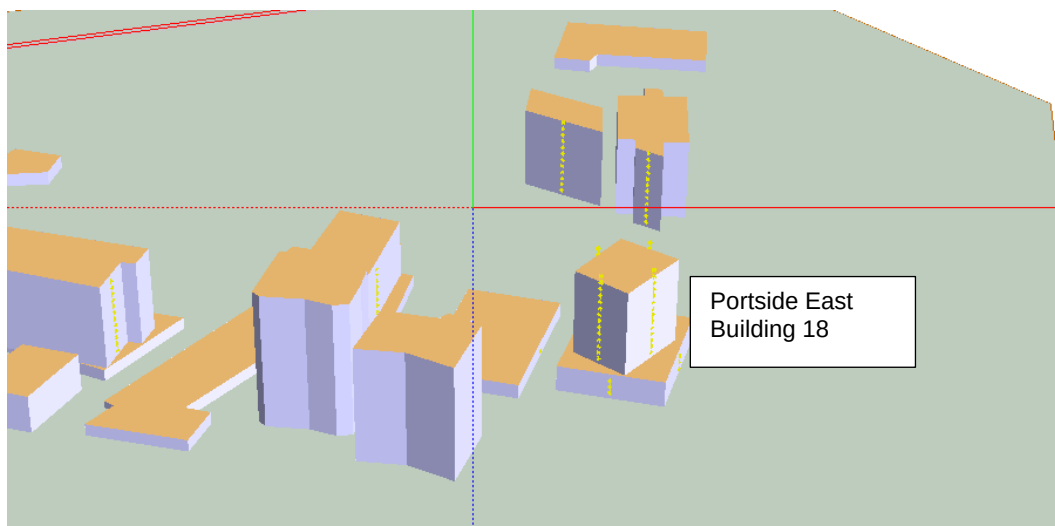


Figure 15: View of Propagation Model

4.1.2 Sound Power Levels of the Main Noise Sources

Sound Power Levels of the main sources, as detailed in Section 2 were input into the model at the proposed locations.

4.1.3 Tonality and Impulsiveness Adjustment

Where tonal components are significant, 5dB has been added to the calculated noise level to account for the increased intrusiveness of tonal noise levels.

4.2 NOISE CALCULATION RESULTS

Methodology	Applicable Noise Level and Criteria
Application of AS 2107	Applicable levels for steady state noise such as from air A/C condensers and continuous road noise.
Background Creep	Noise associated with development not to exceed existing L_{A90} level at site.
Comparisons of like parameters	Waste collection vehicles, Noise from development not to exceed the L_{A10} parameter describing the ambient noise by more than 3dB(A).

Table 15: Methodology and Application

4.2.1 Noise Intrusion Calculations - Application of AS 2107

Based on all steady state noise sources identified in Section 2.2 of this report, the noise intrusion calculation results at on site noise sensitive receivers are shown in the table below. Internal noise levels have been calculated based on façade attenuation measures identified in section 5.

Facade	Day (0700-1800hrs)	Evening (1800-2200hrs)	Night (2200-0700hrs)
L_{Aeq} dB(A)			
Podium			
North	56	56	50
East	52	52	44
South	57	57	47
West	63	55	50
Tower			
North-East	58	58	52
North West	58	58	52
South-West	53	53	46
South-East	52	52	43

Table 16: Noise Intrusion Levels for all Noise Sources

Noise levels due to all general noise emissions are unlikely to be intrusive over typical background noise levels provided the recommended façade attenuation measures (refer Section 5 of this report) are integrated into the design.

4.2.2 Noise Intrusion Calculations – Traffic Noise Application of CTRN

Based on all noise sources identified in Section 2.2 of this report, the noise intrusion calculation results at on site noise sensitive receivers are shown in the table below:-

Facade	Noise Level(at Facade) L _{A10} -18hr dB(A) *	Noise Level (at Facade) L _{Aeq} -1hr-day dB(A) *	Noise Level (at Facade) L _{Aeq} -1hr-night dB(A) *
Podium			
North	64	64	57
East	57	57	50
South	39	39	39
West	60	60	53
Tower			
North-East	64	64	57
South-East	56	56	49
South-West	52	52	45
North-West	63	63	56

*L_{Aeq}-1hour,day = L_{A10}-18hour and L_{Aeq}-1hour,night = L_{A10}-18hour -7dB from measured data

Table 17: Traffic Noise Intrusion Levels for all Noise Sources

Noise levels due to traffic noise are unlikely to be intrusive over typical background noise levels provided the recommended façade attenuation measures (refer Section 5 of this report) are integrated into the design to meet L_{Aeq}-1hr 40dB(A) during the night and L_{Aeq}-1hr 45dB(A) during the day.

4.2.3 Noise Emissions Calculations - Application of AS 2107

Based on all development related noise sources identified in Section 2.2 of this report, the noise intrusion calculation results at adjacent noise sensitive receivers due to steady state noise sources associated with the site development are shown in the table below. Correction for internal calculation has used a minimum 10dB(A) allowance for façade attenuation :-

Location	Maximum Design Levels				Pass/Fail
	Daytime Maximum	Result	Night time Maximum	Result	
	dB(A)				
1. Multi-unit Residential	45	33	40	19	Pass
2. Multi-unit Residential	45	35	40	24	Pass
4. Adjacent Development Site	45	30	40	20	Pass
5. Gallery House	45	43	40	32	Pass
6. Portside Wharf Residential (Flare)	45	34	40	21	Pass
7. Promenade (Multi-unit residential)	45	41	40	20	Pass

Table 18: Noise Intrusion Levels for all Noise Sources

Noise levels due to all general noise emissions from the site are unlikely to be intrusive at the nearest noise sensitive receivers.

4.2.4 Noise Emissions Calculations – Background Creep

Based on all development related noise sources identified in Section 2.2 of this report, the noise intrusion calculation results at adjacent noise sensitive receivers are shown in the table below:-

Location	dB(A) day		dB(A) evening		dB(A) night	
	L _{Aeq} Max Design Level*	Result	L _{Aeq} Max Design Level*	Result	L _{Aeq} Max Design Level*	Result
1. Multi-unit Residential	47	43	47	42	44	32
2. Multi-unit Residential		45		44		34
3. Commercial Area		38		36		27
4. Adjacent Development Site		45		45		33
5. Gallery House		45		45		33
6. Cruise Ship Terminal		-		-		-
7. Portside Wharf Residential (Flare)		44		44		32
8. Promenade (Multi-unit residential)		41		40		31

*Less than Ambient L_{A90}

Table 19: Noise Intrusion Levels for all Noise Sources

4.2.5 **Noise Emissions Calculations – Comparison of Like Parameters**

A comparison of like parameters at adjacent noise sensitive receivers has been used to assess the impact of waste noise during the morning period.

Location	dB(A)1hr $L_{A10-1hr}$		Pass/Fail
	Maximum Design Levels*	Result	
1. Multi-unit Residential	52 night-time (2200hrs-0700hrs)	47	Pass
2. Multi-unit Residential		46	Pass
3. Commercial Area		42	Pass
4. Adjacent Development Site		38	Pass
5. Gallery House		52	Pass
6. Cruise Ship Terminal		-	-
7. Portside Wharf Residential (Flare)		50	Pass
8. Promenade (Multi-unit residential)		28	Pass

*Less $L_{A10}+3dB(A)$

Table 20: Noise Intrusion Levels for all Noise Sources

Noise levels due to all general noise emissions are unlikely to be intrusive at the nearest noise sensitive receivers over current noise levels provided the recommended attenuation measures (refer Section 5 of this report) are integrated into the design.

SECTION 5.0 AIRCRAFT NOISE INTRUSION ASSESSMENT**5.1 ACOUSTIC DESIGN CRITERIA**

Australian Standard AS 2021 - 2015 “Acoustics – Aircraft Noise Intrusion – Building Siting and Construction” provides the following indoor sound level design criteria for dwellings: -

Building Type and Activity	Indoor Design Sound Level, dB(A)
Sleeping Areas, Dedicated Lounges	50
Other Habitable Spaces	55
Bathrooms, Toilets, Laundries	60

Table 21: Recommended Aircraft Noise Indoor Design Sound Levels (IDSL)
(Source: AS 2021 – 2015 Table 3.3)

5.2 ACOUSTIC ASSESSMENT

The impact of noise at the site is estimated using the tabulated aircraft noise levels presented in AS 2021:2016 from aircraft arriving and departing from Brisbane Airport.

5.2.1 Location

The reference airport co-ordinates and elevation details are shown below based on airport data from Air Services Australia.

The Ground Floor level of the subject site is at AHD 5m approx. and the upper level at AHD 50m approx.

The predicted aircraft noise impact levels at the subject site are based upon the following distances of the site from the airport runway:-

- Distance from closer end of runway (DL) of 7,650m.
- Distance from further end of runway(DT) of 10,250m and
- Perpendicular side distance (DS) from site to runway centreline of 500m.
- Airport Elevation AHD 5m.



Figure 16: Location of Runway with Respect to Site

Land Height correction: As the runway is at a similar height to the runway no land height correction has been applied.

The aircraft types forecast are shown below:-

A380		PASSENGERS – 525 RANGE – 15,700 KM	START OF SERVICE – 2006
B747-400		PASSENGERS – 416 RANGE – 14,205 KM	START OF SERVICE – 2002
B787-800		PASSENGERS – 242 RANGE – 14,500 KM	START OF SERVICE – 2011
B777-300		PASSENGERS – 365 RANGE – 13,427 KM	START OF SERVICE – 2003
A330		PASSENGERS – 295 RANGE – 10,500 KM	START OF SERVICE – 1993
B767-300		PASSENGERS – 269 RANGE – 10,195 KM	START OF SERVICE – 1986
A320		PASSENGERS – 179 RANGE – 5,676 KM	START OF SERVICE – 1987
A320neo¹		PASSENGERS – 164 RANGE – 6,900 KM	START OF SERVICE – 2015
B737-800		PASSENGERS – 162 RANGE – 5,765 KM	START OF SERVICE – 1998
B737MAX¹		PASSENGERS – 162 RANGE – 6,667 KM	START OF SERVICE – 2017
DASH 8-400		PASSENGERS – 74 RANGE – 3,334 KM	START OF SERVICE – 1998

Figure 17: Aircraft Types at Brisbane Airport (Extract from BAC Noise Information)

The estimated impact noise levels are determined from the procedures set out in the Australian Standard AS 2021 for the typical types of aircraft types that use the Brisbane Airport: An aircraft noise impact level of 84 dB(A) emanating from a Boeing 747 is the worst case noise level and is used as the worst case scenario noise source level in this assessment

5.2.2 **Acoustic Design of Building Fabric Elements**

Based on the above, the Aircraft Noise Reduction Level (ANR) is calculated as below:-

Bedroom ANR	= ANL- IDSL = 83 – 50 =	<u>33 dB</u>
Kitchen/Living ANR	= ANL- IDSL = 83 – 55 =	<u>29 dB</u>
Bathroom ANR	= ANL- IDSL = 83 – 60 =	<u>23 dB</u>

The Aircraft Noise Attenuation (ANA_c) for each external façade and exposed floor or roof component of the residential areas of the development are to be designed to be meet the above ANR levels; as derived from the procedure set out in AS 2021.

As it is necessary for the windows and doors to remain closed to comply with AS 2021:2015 ventilation compliant with the National Construction Code/ Building Code of Australia will need to be installed.

5.2.3 **Facade Treatments**

Glazing treatments have been recommended based on the noise calculated at each facade and the noise target within the spaces affected by facade performance. Please refer to mark- up plan drawings in Appendices for the glazing and wall performance requirements.

SECTION 6.0 RECOMMENDATIONS

6.1 FACADE TREATMENTS

Glazing treatments have been recommended based on the noise calculated at each facade and the noise target within the spaces affected by facade performance. Please refer to mark- up plan drawings in Appendices for the glazing and wall performance requirements.

The following minimum construction elements or equivalent are recommended:-

Construction Element (Residential Areas)	R _w
Wall	
Wall – 150mm Concrete blockwork (245 kg/m ²)	≥50
Wall – 200mm Precast (245 kg/m ²)	≥50
Windows / Glazed Doors	
6.38mm laminated glass generally	32
10.38mm laminated glass with acoustic seals where exposed to aircraft noise And northern façade of podium units and north-eastern façade of tower units exposed to road noise.	35
Glazed Doors	
6.38mm laminated glass with acoustic seals where shielded from aircraft noise	32
10.38mm laminated glass with acoustic seals where exposed to aircraft noise	35
Roof	
Concrete Roof 200mm with suspended pb ceiling and 75mm glass wool insulation above	50

Table 22: Weighted Sound Reduction Index of Recommended Building Elements

6.2 ACOUSTIC SEPARATION TREATMENTS

Based on space types identified in the layouts the following constructions or equivalent are recommended for adequate acoustic separation for elements within the building:-

Clause	Item	Proposed Minimum Construction
F5.4	Sound Insulation of floors between units	200 mm thick concrete slab with carpet on underlay or 200mm thick concrete slab (ideally floating floor construction) with ceramic floor tiles on high performance resilient layer (5mm thick impactamat or equivalent) to insulated plasterboard ceiling on underside.
F5.5 (a) (i)	Sound Insulation of walls between units.	At core: one (1) x 13mm Plasterboard daub fixed wall lining at 500mm centres. Single 150mm min. thickness pre-cast/ In-situ concrete panel. 28mm furring channels at 600mm centres Impact clips/ isolation mounts Polyester insulation in cavity. One (1) x 13mm Plasterboard screw fixed over 16mm Plasterboard Sheet Lightweight walls: Double studs with 16mm firerated plasterboard (13kg/m ²) on both sides mounted at 600mm centres (max.) to 64mm studs with 45mm gap between studs and two (2) layers of 75mm thick earthwool insulation both at 14kg/m ³ glass wool insulation in cavity or equivalent.
F5.5 (a) (ii)	Sound Insulation of walls between units and plant rooms, stairways, public corridors, hallways or the like.	At core: One (1) x 13mm Plasterboard daub fixed wall lining at 500mm centres. Single 150mm min. thickness pre-cast/ In-situ concrete panel. 28mm furring channels at 600mm centres Impact clips/ isolation mounts Polyester insulation in cavity. One (1) x 13mm Plasterboard screw fixed over 16mm Plasterboard Sheet Lightweight walls: 16mm firerated plasterboard on both sides mounted at 600mm centres (max) to 92mm Rondo quiet stud or equivalent with 75mm/14kg/m ³ glass wool insulation in cavity

Clause	Item	Proposed Minimum Construction
F5.5 (a) (iii)	Walls between a bathroom, sanitary compartment, laundry or kitchen and a bedroom or habitable room in adjoining room or SOU from a plant room or lift shaft	At core: Discontinuous 150mm min. thickness pre-cast/ In-situ concrete panel with: a) A row of 64mm steel studs at 600mm centres spaced 20mm from the masonry wall; and b) 50mm thick mineral insulation or glass wool insulation with a density of 11kg/m ³ positioned between studs; and c) One (1) layer of 6mm fibre cement sheet fixed to outside face of studs d) Lightweight walls: Double studs with 16mm firerated plasterboard (13kg/m ²) on both sides and additional 6mm fibre cement sheet to wet side(s) mounted at 600mm centres (max.) to 64mm studs with 45mm gap between studs and two (2) layers of 75mm thick earthwool insulation both at 14kg/m ³ glass wool insulation in cavity or equivalent.
F5.5 (b)	Doors to apartments from public corridors and public lobbies.	Single leaf door with acoustic perimeter seal and tread seal to R _w 30 rating for public lobbies/ corridors. Not required for private lobbies.
F5.5 (e)	Sound Insulation of walls with floors above	Wall to continue to the underside of the floor above or to have a ceiling that provides the sound of insulation required for the wall. Or Between bathrooms and habitable room in sole occupancy units and between bedrooms and public areas:- a) Concrete slab soffit with 200mm minimum cavity depth. b) 30mm plasterboard barrier with 50mm Glasswool seal. c) One (1) layer of 13mm fibre-protective grade plasterboard. d) Wall with required sound rating, to underside of ceiling
F5.5 (f)	Sound Insulation of walls with roofs above	Wall between units to continue to the underside of the roof. Wall between units and public corridors to continue to the underside of the roof above or to have a ceiling that provides the sound insulation required for the wall.
F5.6	Sound Insulation Rating of Services	Generally recommend duct, soil, waste or water supply pipes located in SOU's are lagged (e.g. CSR Acoustilag 45 or equivalent.) Services in Ceiling/Floor/Wall Cavities, Kitchens and Non Habitable Areas. Where duct, soil, waste or water supply pipes are located in the ceiling space and pass through more than on sole occupancy unit: - Acoustically sealed ceiling penetrations with surface mounted fittings at to be used or acoustically treated recessed light fittings - Ceiling to comprise minimum single layer of 13mm plasterboard. - Risers to comprise minimum layer of 13mm plasterboard. - Where lagged stormwater pipes pass through ceiling cavities of sole occupancy units ceilings to comprise minimum single layer of 13mm plasterboard. - Unlagged pipes in risers to comprise minimum outer layer of 13mm plasterboard with 75mm thick, 11kg/m³ glass wool insulation in riser cavity. Habitable Areas: Where duct, soil, waste or water supply pipes are located in the ceiling space and pass through more than one sole occupancy unit: - Acoustic sealed ceiling penetrations with surface mounted fittings are to be used or acoustically treated recessed light fittings. - Ceilings to comprise minimum layer of 13mm plasterboard with 90mm thick, 10.5kg/m³ glass- wool insulation blanket. - Where stormwater pipes pass through sole occupancy units ceiling cavities, ceilings to comprise minimum layer of 13mm plasterboard with minimum 90mm thick, 10.5kg/m³ glass wool insulation blanket. - risers containing unlagged pipes to comprise minimum outer layer of 13mm plasterboard with 75mm thick, 11 kg/m³ glass wool insulation blanket in wall cavity and 13mm plasterboard inner layer and 50mm, 11 kg/m³ glass wood insulation in riser cavity.
F5.7	Sound Isolation of Pumps	Flexible couplings to be used at the point of connection between the service pipes in a building and any circulating or other pump.

Table 23: Recommended Acoustic Separation Construction Performance

6.3 SERVICES TREATMENTS

All mechanical and hydraulic services installations shall comply with the following requirements to ensure that noise and vibration from the plant installed is reduced to a minimum:

All large fans/plant to be attenuated through attenuators / to give 60dB(A) measured at 1m from point of discharge when operating at duty.

External pumps to have maximum noise level less than 55 dB(A) measured at 1m.

All rotary machinery shall be accurately balanced both statically and dynamically. Motor impeller rotors shall be balanced to International Standard ISO 1940 -"Balance Quality of Rotating Rigid Bodies" and shall be free from vibration at all operating speeds and during starting and stopping.

- a) Centrifugal and reciprocating rotating equipment shall be mounted on vibration absorbing mountings.
- b) All connections to rotating machinery, or assemblies containing machinery shall be rendered flexible by vibration hangers supporting ducting and piping systems, flexible connections between ductwork and fans, and in critical installations with flexible hose between pipes and pumps. If flexible hose is not installed, adequate provision shall be made to take up vibration in bends and pipe runs.
- c) Acoustic lining and/or attenuators shall be applied to critical sections of ducts and air handling units unless otherwise specified. Attenuators shall be selected to ensure not more than 35pa resistance is imposed to any system (exhausts and AHU's).
- d) Acoustic seals shall be provided where all pipes, ducts and conduits penetrate plantrooms or acoustic walls.
- e) All static equipment in major plant areas shall be mounted on 18mm Mason Super W isolation pads, loaded to between 250kPa and 400kPa.
- f) Duct connections to vibrating mechanical plant shall be isolated by flexible PVC connections not less than 100mm long when fully stretched out.

Element	Requirement	Typical Construction
Treatment of Condenser Units	NR40	Resilient mounts. Flexible couplings to be used at the point of connection between the service pipes.
Treatment of mechanical services ductwork	NR35 in bedrooms NR45 in all other areas	Internally lined ductwork and attenuators as detailed in mechanical specification.
Risers	$L_{Amax, avg} < 50dB(A)$	Un-lagged pipes in risers to comprise minimum outer layer of 13mm plasterboard with 75mm thick, 11 kg/m ³ glass wool insulation blanket in wall cavity and 13mm plasterboard inner layer and 50mm, 11 kg/m ³ glass wool insulation in riser cavity.
Pumps	Flexible couplings to be used at the point of connection between the service pipes in a building and any circulating or other pump.	Install flexible coupling

Table 24: Recommended Services Performance

6.4 LIFT CORE TREATMENTS

Recommend noise control measures for minimising lift core noise is:

1. Maximise stiffness of lift cores to minimum vibration levels. Minimum 150mm thick in-situ concrete or 190mm thick core filled wall.
2. Locate lift rail mounts on stiffest part of lift core structure: i.e. where shaft wall and floor slabs meet. Fixings to be located on the centre line of the floor slab.
3. Discontinuous floor, wall and ceiling construction Typical Construction types are detailed below:

Item	Typical Construction
Floor	200mm thick concrete slab (floating floor construction) with tiles on resilient layer to minimise transmission of noise from operation of lift and car park lift roller shutters.
Ceiling	Isolation mounted with insulated (75mm acoustic insulation) and suspended plasterboard. Downlights to be acoustically treated.
Wall	Two (2) layers of 13mm fire rated plasterboard on 76mm steel studs with 40mm gap to shaft wall. 75mm insulation in cavity.

Table 25: Proposed Construction for Apartments Adjacent to/above Lift Cores

6.5 SWIMMING POOL TREATMENTS

	Requirement	Typical Construction
Spa Pump	55dB(A) max @ 1m	Spa shell to be mounted on resilient pads. Flexible couplings to be used at the point of connection between the service pipes and pump. Pump to be mounted on resilient pads/ anti-vibration mount Preferably use a dedicated one-speed pump to drive the jets and a smaller circulation pump to heat and filter to reduce noise during heating and filtering modes.
Spa Operation (noise due blower operation)	55dB(A) max @ 1m	Flexible couplings to be used at the point of connection between the service pipes and pump.
Pool Pumps	55dB(A) max @ 1m	Flexible couplings to be used at the point of connection between the service pipes and pump.
Pool Room Extraction fan	55dB(A) max @ 1m	Flexible couplings to be used at the point of connection between the service pipes in a building and pump.
Swimming Pool Shell		Mechanical spring isolators to base and elastomeric isolation to shell sides.

Table 26: Recommended Services Performance

SECTION 7.0 RECOMMENDATIONS

The noise levels due to the noise sources associated with the development within the apartments, at the private open spaces and at the adjacent noise sensitive receivers are acceptable provided the building design incorporates the attenuation measures as specified in this report or equivalent. Key Recommendations are summarised below:-

- For residential component the façade glazing is to be a minimum Rw32 to habitable areas. For the aircraft noise exposed areas of the façade Rw35 minimum is required to control exposure to aircraft noise to residential habitable areas.
- A Noise Management Plan to be developed to ensure noise from operations of commercial/retail areas do not affect residences above – including provision to limit noise sources after 10pm to 7am.
- All low level fans to be attenuated to 60dB(A) measured at 1m from exit grille/louvre.
- Large fans located at Level 14 and recreation deck to incorporate noise control attenuation measures to give 65dB(A) measured at 1m from discharge.
- External mechanical plant and fans to meet design noise levels identified in Table 3 of this report.

SECTION 8.0 CONCLUSION

The noise levels due to the noise sources associated with the development within the apartments, within the commercial areas, at the private open spaces and at the adjacent noise sensitive receivers are acceptable provided the building design incorporates the attenuation measures as specified in this report or equivalent.

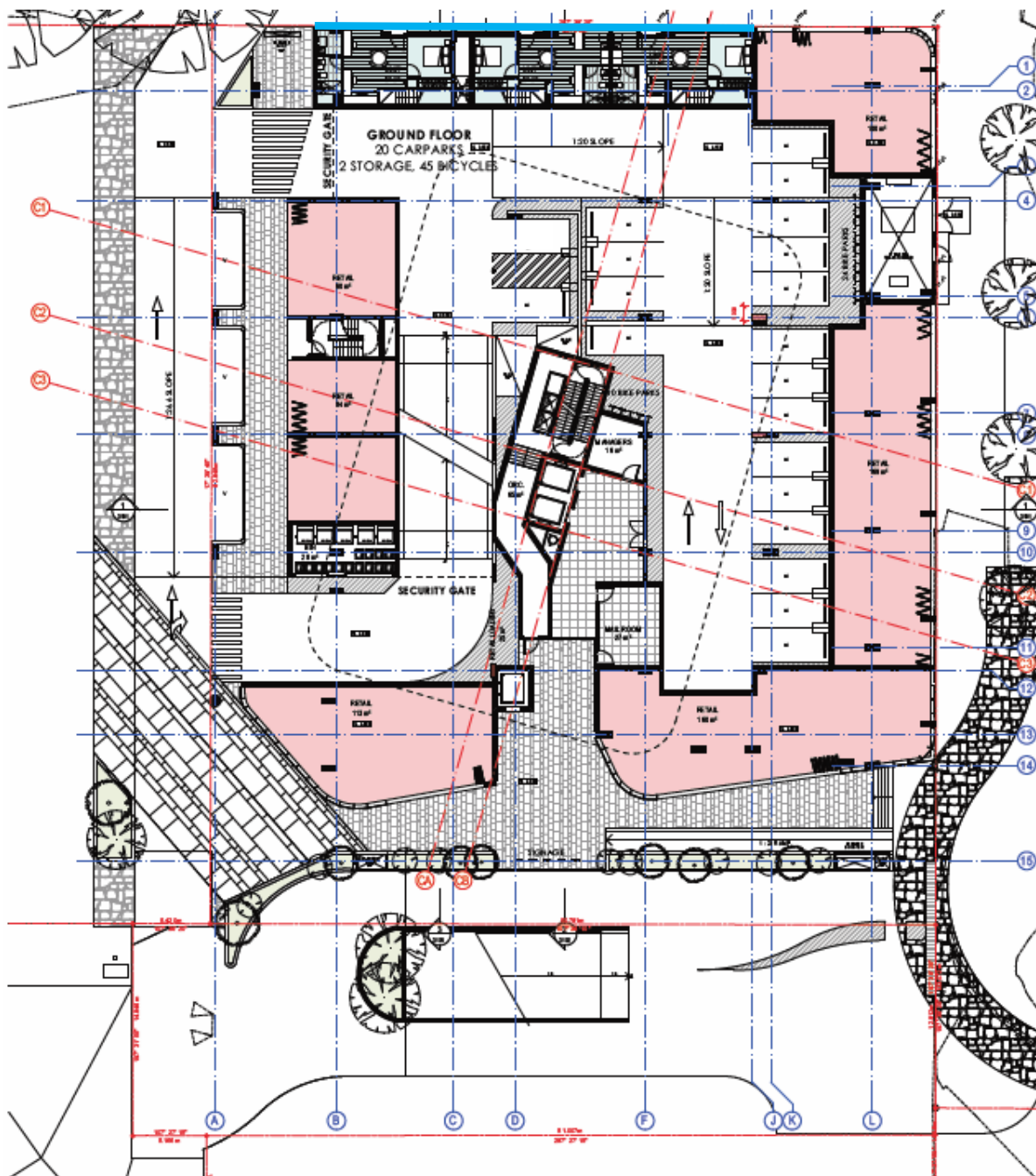
APPENDIX A
FACADE TYPES (TYPICAL LEVEL)

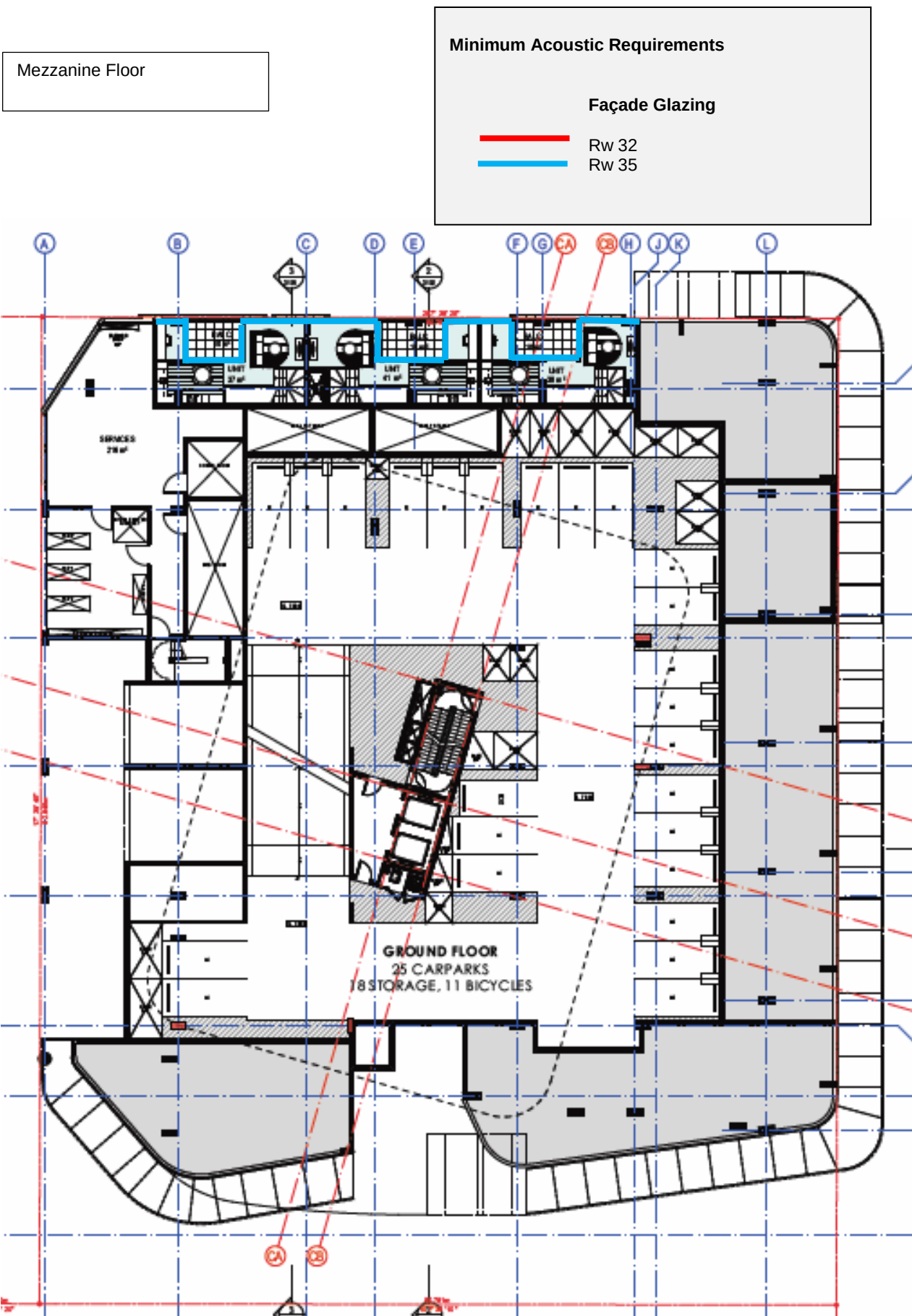
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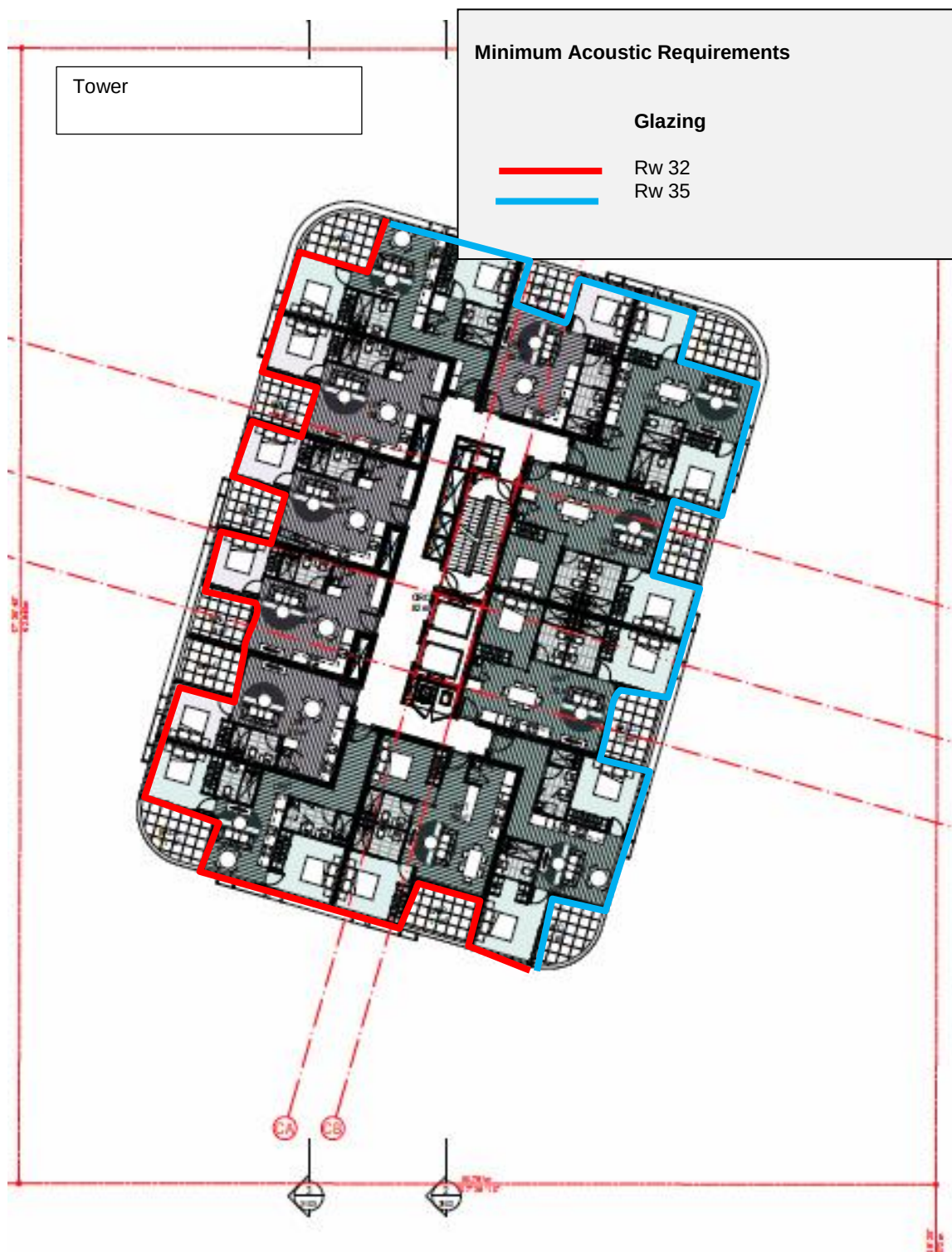
Minimum Acoustic Requirements

Façade Glazing

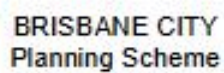
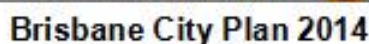
- Rw 32
- Rw 35







APPENDIX B
NOISE CORRDOR MAP



Date: 6/06/2018

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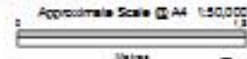
This map is notationally suitable for use for integrating City Plan provisions relating to specific sites. To properly interpret the map, the planning scheme must be referred to. The Digital Cadastre Database (supplied by State of Queensland - Department of Natural Resources and Mines) will be updated from time to time.

Mapping adapted by Council, effective 18 September 2014.

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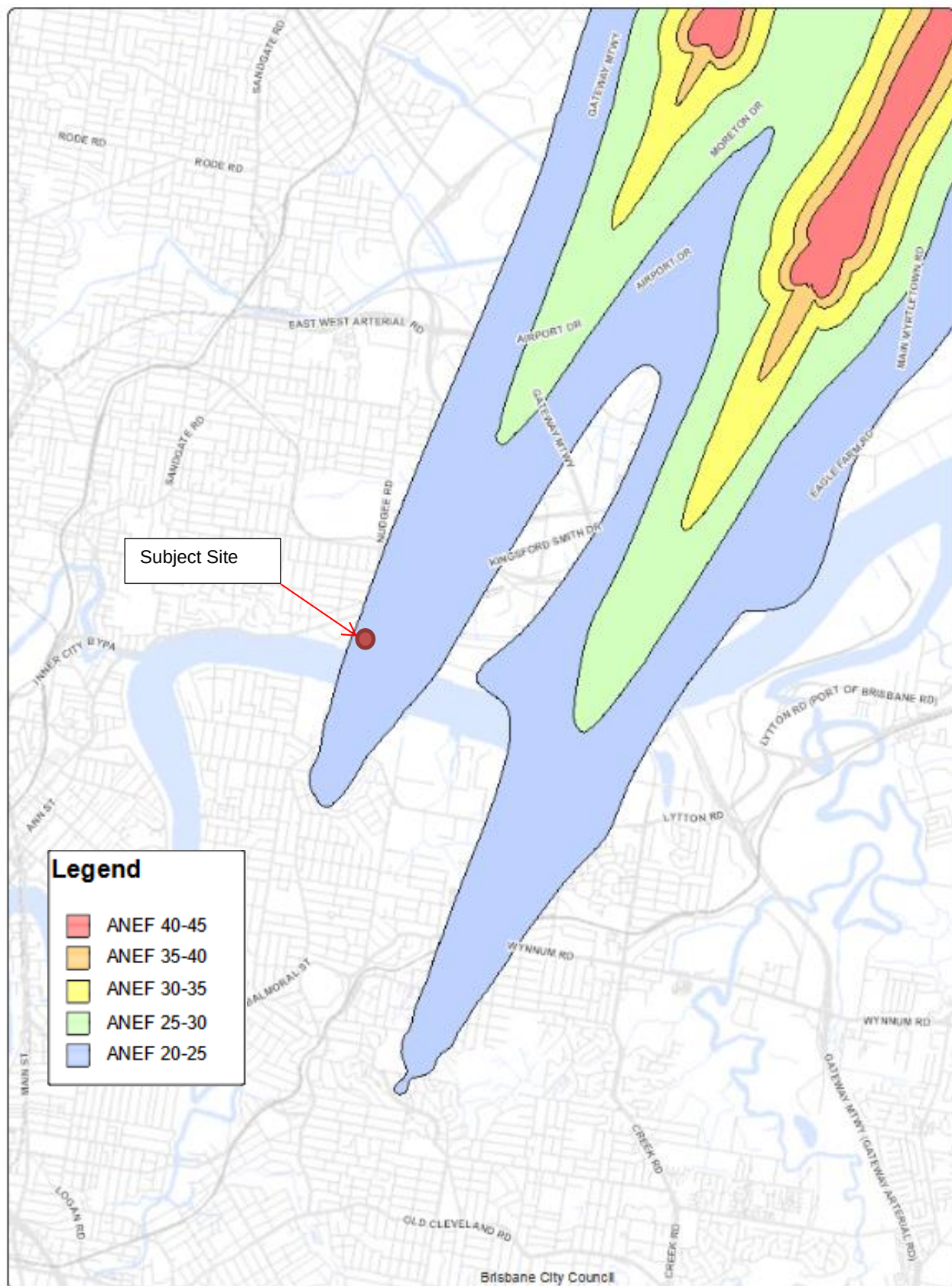
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Projection: Map Grid of Australia, Zone 55
Horizontal Datum: Geocentric Datum of Australia 1984
Approximate Scale @ A4: 1:50,000



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APPENDIX C
ANEF OVERLAY



Brisbane City Plan 2014

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BRISBANE CITY
Planning Scheme

Date: 6/06/2018

NOTES

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Mapping adopted by Council, effective 18 September 2015.

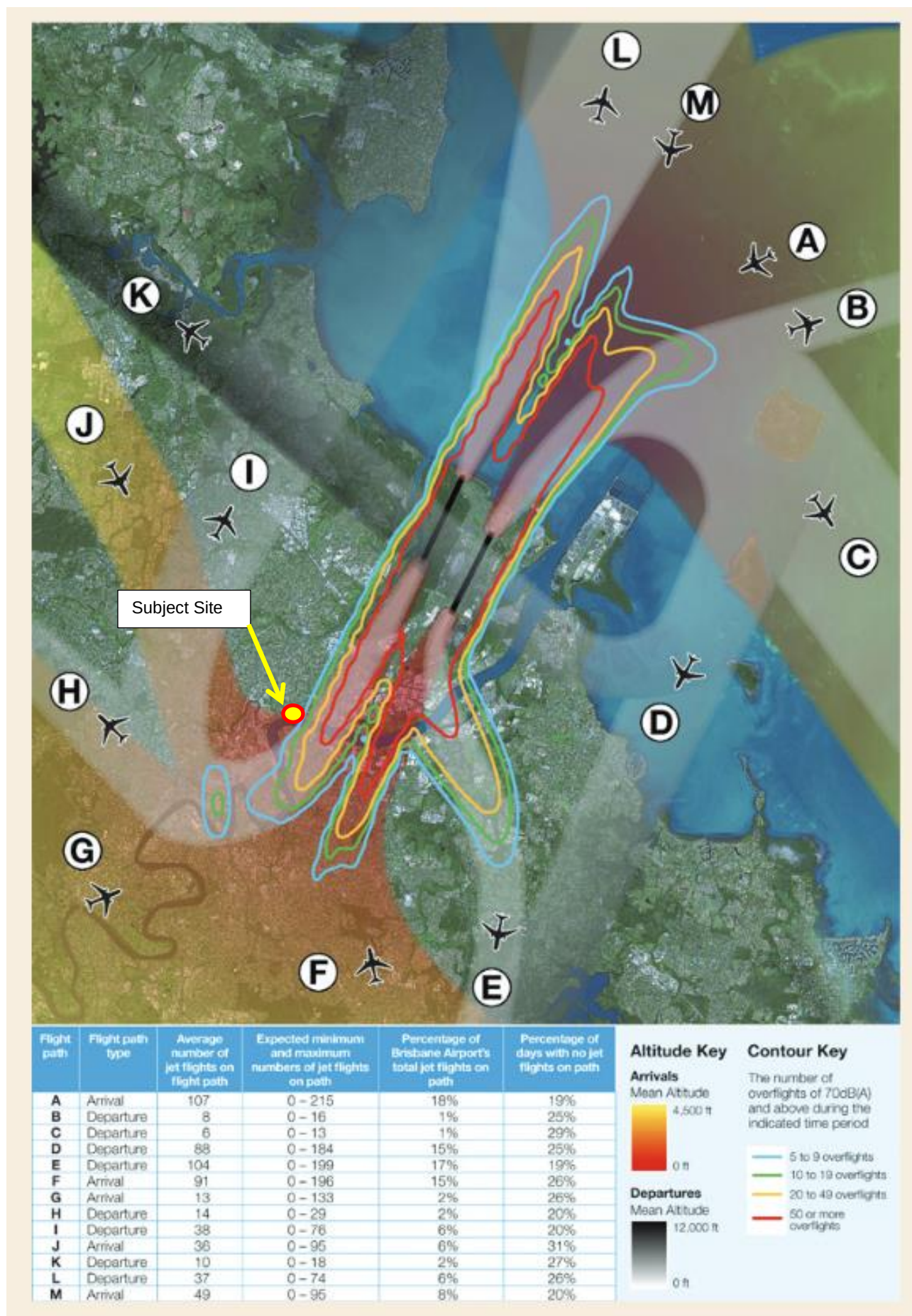
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Projection: Map Grid of Australia, Zone 56
Horizontal Datum: Geocentric Datum of Australia 1984
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1:500
Metres

Page 1

APPENDIX D

N70 MAP

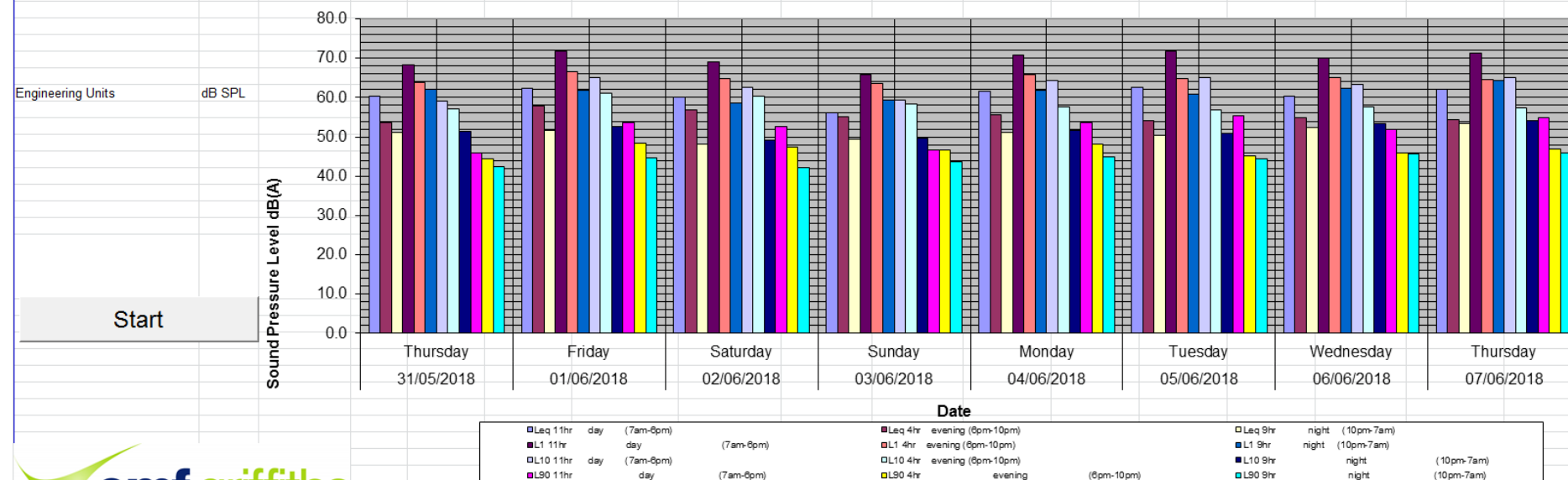


APPENDIX E
NOISE LOGGING DATA

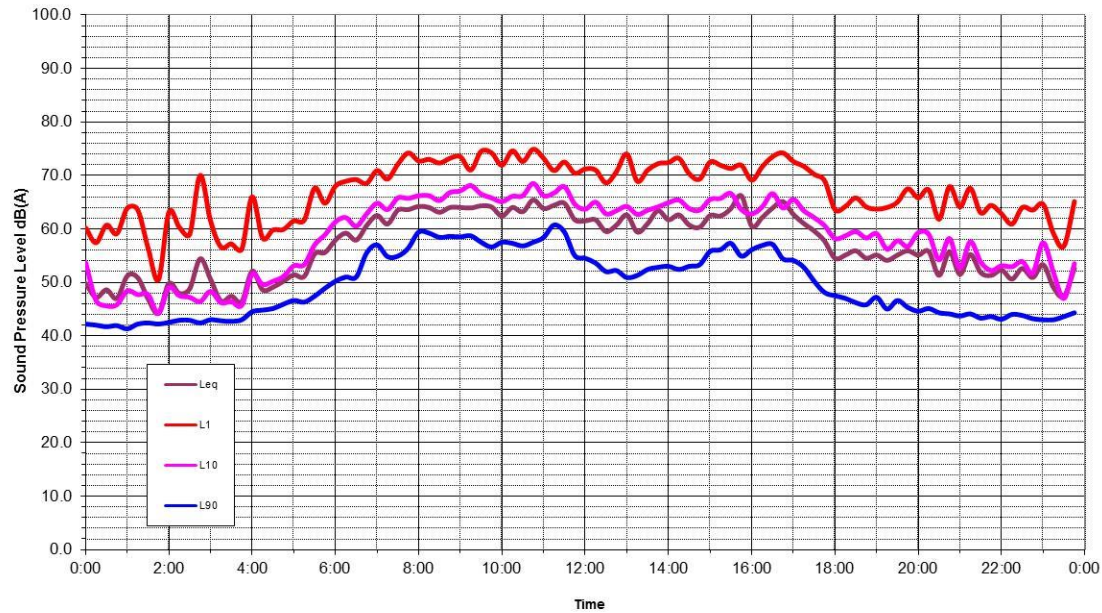
Site Background Noise Levels

			Use for average	Date	Day	Leq 11hr day (7am-6pm)	Leq 4hr evening (6pm-10pm)	Leq 9hr night (10pm-7am)	L1 11hr day (7am-6pm)	L1 4hr evening (6pm-10pm)	L1 9hr night (10pm-7am)	L10 11hr day (7am-6pm)	L10 4hr evening (6pm-10pm)	L10 9hr night (10pm-7am)	L90 11hr day (7am-6pm)	L90 4hr evening (6pm-10pm)	L90 9hr night (10pm-7am)
#s2180106		Averaging															
Portside Building 18 Commercial		Linear	✓	31/05/2018	Thursday	60.4	53.6	51.1	68	64	62	59	57	51	46	44	42
			✓	01/06/2018	Friday	62.4	57.9	51.7	72	67	62	65	61	53	54	48	45
			✓	02/06/2018	Saturday	60.0	57.0	48.3	69	65	59	62	60	49	53	47	42
			✓	03/06/2018	Sunday	56.2	55.0	49.3	66	64	59	59	58	50	47	47	44
Acoustic Research Laboratories Pty Ltd - Type 1 Environm			✓	04/06/2018	Monday	61.5	55.5	51.2	71	66	62	64	58	52	54	48	45
Logger Serial Number	87813D		✓	05/06/2018	Tuesday	62.6	54.1	50.5	72	65	61	65	57	51	55	45	44
Measurement Title	Portside		✓	06/06/2018	Wednesday	60.5	54.8	52.3	70	65	62	63	58	53	52	46	46
Measurement started at	31/05/2018 9:14		✓	07/06/2018	Thursday	62.1	54.4	53.3	71	64	64	65	57	54	55	47	46
Measurement stopped at	13/06/2018 16:25			AVERAGE		61	55	51	70	65	61	63	58	52	52	47	44
Frequency Weighting	A																
Time Averaging	Fast																
Statistical Interval	15min																

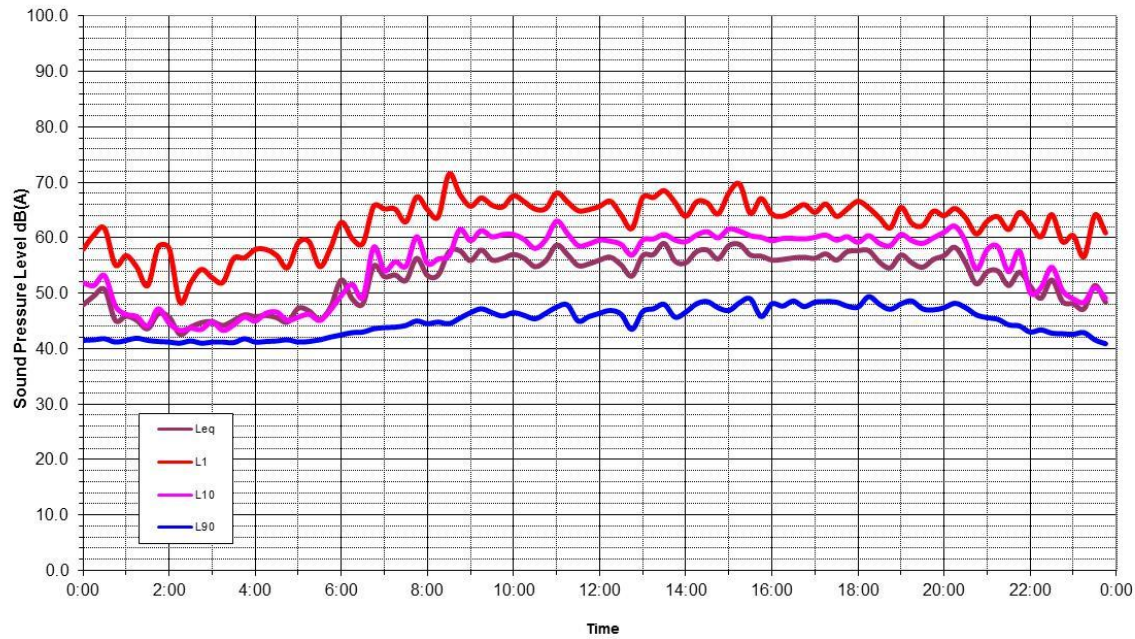
Summary Chart



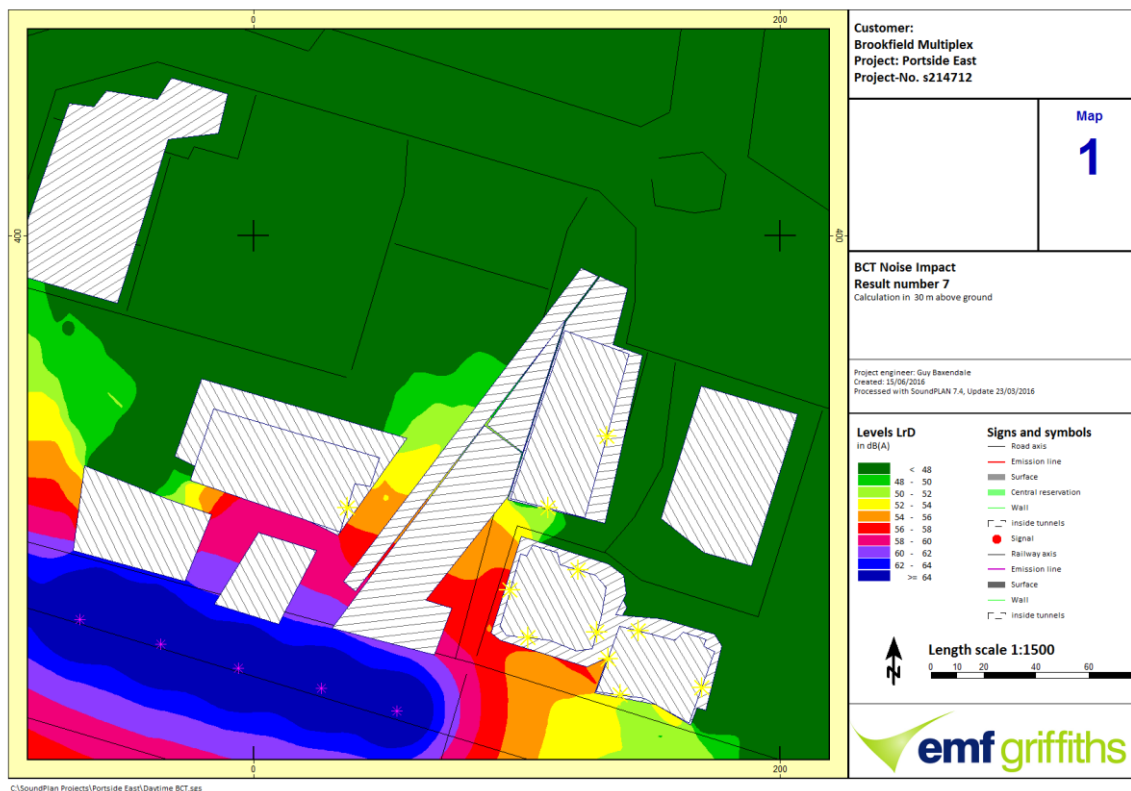
Weekday



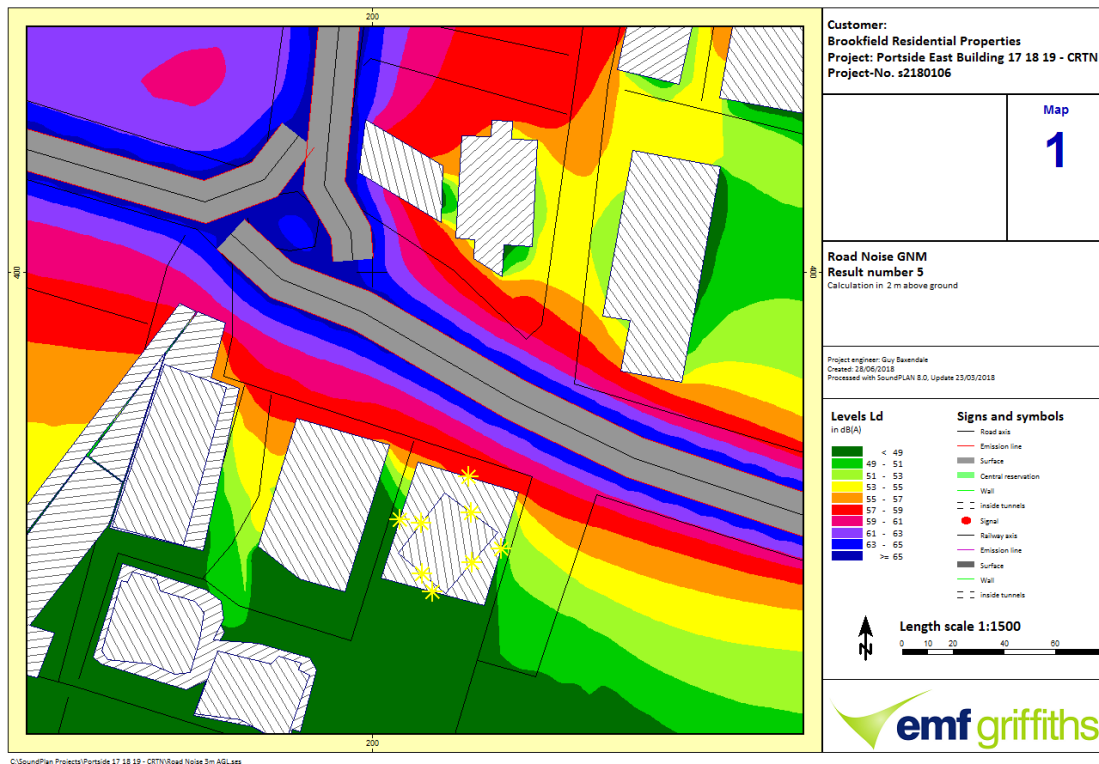
Weekend



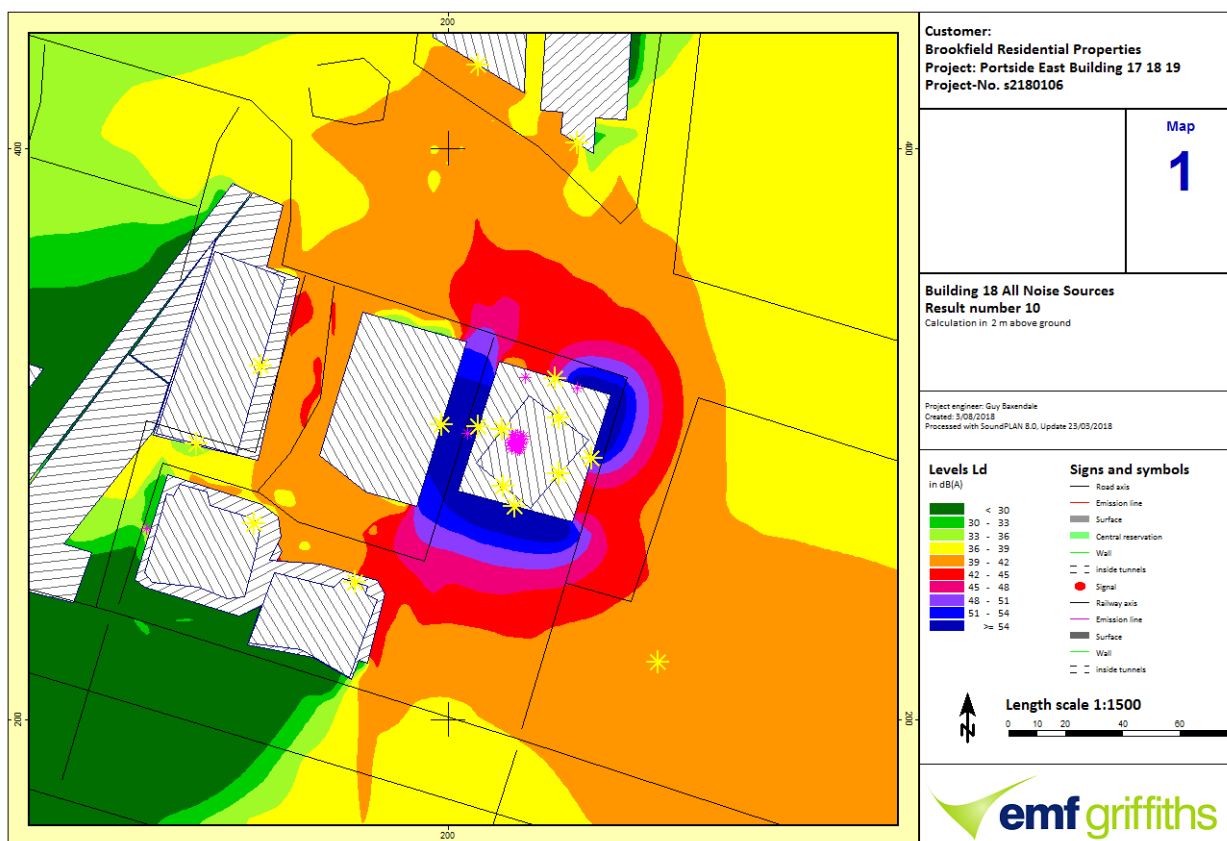
APPENDIX F
NOISE PROPAGATION RESULTS



Noise From Cruise Ships



Noise From Local Roads



Noise From All Site Noise Sources (Daytime)



Noise From All Site Noise Sources (Night time)