MARSHALL DAY Acoustics

HAZELMERE DATA CENTRE
DA NOISE ASSESSMENT

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Project: **HAZELMERE DATA CENTRE**

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1.0 INTRODUCTION

GreenSquareDC Pty Ltd has engaged Marshall Day Acoustics (Australia) Pty Ltd (MDA) to provide an acoustic assessment of a proposed data storage facility for Lot 14 & 15 Stirling Crescent, Hazelmere.

The proposed development comprises a data storage warehouse, offices, and associated building services such as HVAC and generators.

This report presents an assessment of noise emissions to review compliance with the Environmental Protection (Noise) Regulations 1997 (the Regulations) for development approval purposes.

Acoustic terminology used throughout this report is described in Appendix A.

2.0 SITE DESCRIPTION

The development site is located at Lot 14 & 15 Stirling Crescent, Hazelmere WA. An aerial photograph showing the site and surrounds is presented in Figure 1. The nearest noise receivers surrounding the site are numbered and described in Table 1.

Figure 1: Aerial photograph of the site and surrounds (Image: MetroMap)

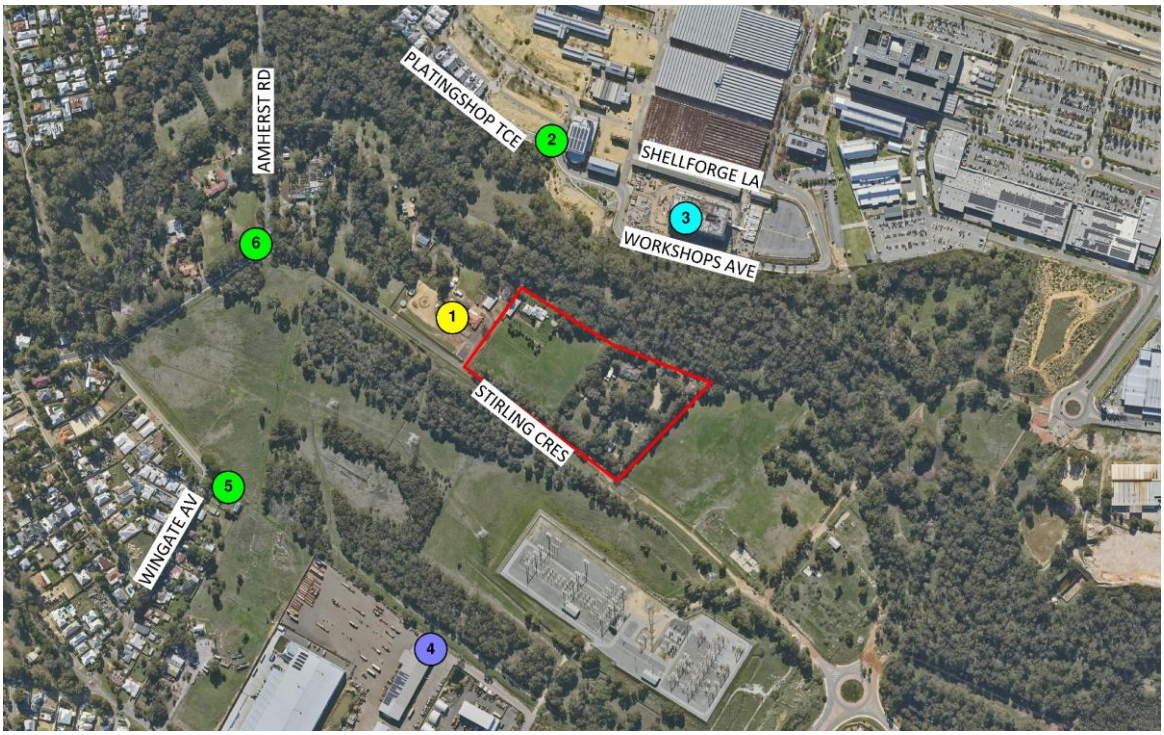


Table 1: Nearest receiver details

Receiver	Address	Type of premises	Comment
1	13 Stirling Crescent	Noise sensitive	Helena River Steiner School
2	51 Platingshop Terrace	Noise sensitive	Potential future residential
3	Lot 787 Shellforge Lane	Noise sensitive	SJOG Midland private hospital (future)
4	5 Central Avenue	Industrial	McMahon Burnett Transport
5	15 Wingate Avenue	Noise sensitive	Existing residential dwelling
6	816 Stirling Crescent	Noise sensitive	Potential future residential

The subject site is located within the Hazelmere Enterprise Area Structure Plan on land zoned Special Use Zone 15 under Local Planning Scheme 17.

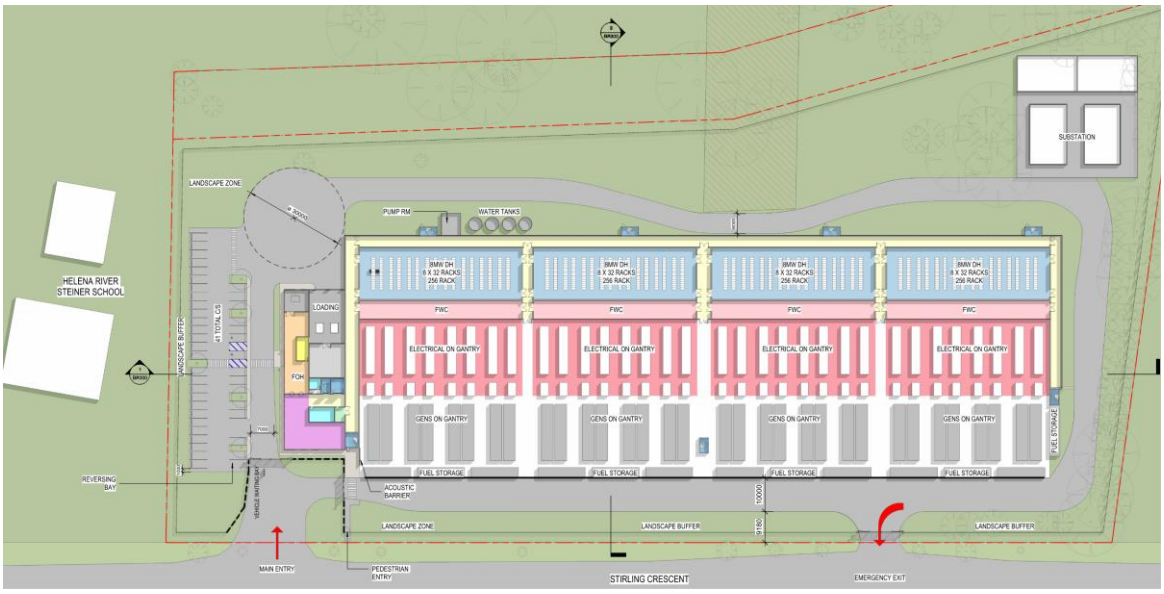
A planning map showing the land use zoning is provided in Appendix B.

2.1 Proposed development

The proposed development comprises a data storage warehouse, offices, and associated building services such as HVAC and generators.

A site plan of the proposed development is provided in Figure 2.

Figure 2: Site plan – ground floor



3.0 LEGISLATION AND GUIDELINES

3.1 Environmental Protection (Noise) Regulations 1997

External noise emission is governed by the *Western Australia Environmental Protection (Noise) Regulations 1997* (the Noise Regulations). The Noise Regulations are a "prescribed standard" under the *Environmental Protection Act 1986*.

The assessment of noise emission under the Noise Regulations is based on external noise level limits that apply at a receiver position. The calculation of the noise level limits takes into account the local road network, the land use in the surrounding area and the time of day. These calculated noise level limits are known as 'assigned noise levels.'

Noise emissions from a proposed development site are assessed over an assessment period which can vary between fifteen minutes and four hours. The assessment period must be appropriate for the assessment of the emission and depends on the type and character of the noise source(s).

The assigned noise levels are defined in terms of statistical A-weighted and Slow-weighted sound pressure levels as follows:

- L_{AS10}, this is the noise level not to be exceeded for more than 10% of the assessment period
- L_{AS1}, this is the noise level not to be exceeded for more than 1% of the assessment period
- L_{ASmax}, this is the noise level not to be exceeded at any time.

In determining the assigned noise levels applicable to the development, reference has been made to the planning maps described and presented in Appendix B.

3.1.1 Assigned noise levels

The assigned noise levels applicable at receivers are presented in Table 2. Full details of the parameters used in the calculation of the assigned noise levels are provided in Appendix B.

Table 2: Summary of assigned noise levels

Type of premises receiving noise	Time of day	Assigned noise level (dB)		
		L_{A10}	L_{A1}	L_{Amax}
Noise sensitive premises: highly sensitive area	0700-1900 – Monday to Saturday	45 + IF	55 + IF	65 + IF
	0900-1900 – Sunday and public holidays	40 + IF	50 + IF	65 + IF
	1900-2200 – All days	40 + IF	50 + IF	55 + IF
	2200-0700 – Monday to Saturday, or 2200-0900 – Sunday and public holidays	35 + IF	45 + IF	55 + IF
Noise sensitive premises: any area other than highly sensitive area	All hours	60	75	80
Commercial premises	All hours	60	75	80
Industrial and utility premises	All hours	65	80	90

For brevity in reporting, the assessment periods are referred to as per Table 5.

Table 3: Simplified references to assessment periods

Referred to as	Time of day
Day	0700-1900 Monday to Saturday
Evening	0900-1900 Sunday and public holidays, or 1900-2200 all days
Night	2200-0700 Monday to Saturday, or 2200-0900 Sunday and public holidays

The calculated influencing factor (IF) at each of the nearest receivers is presented in Table 4.

Table 4: Influencing factor (IF)

Receiver	Address	Type of premises	Influencing factor (IF)
1	13 Stirling Crescent	Noise sensitive (existing school)	+14
2	51 Platingshop Terrace	Noise sensitive (future residential)	+5
3	Lot 787 Shellforge Lane	Noise sensitive (future hospital)	+7
4	5 Central Avenue	Industrial	n/a
5	15 Wingate Avenue	Noise sensitive (existing residential)	+12
6	816 Stirling Crescent	Noise sensitive (future residential)	+5

In addition, the noise emissions must be free of dominant or intrusive characteristics such as impulsiveness, modulation and tonality. Adjustments are also applicable where the noise emission is music. These adjustments are presented in Table 5.

Table 5: Adjustments for dominant or intrusive characteristics

Adjustment where noise emission is not music. These adjustments are cumulative to a maximum of 15 dB			Adjustment where noise emission is music	
Where tonality is present	Where modulation is present	Where impulsiveness is present	Where impulsiveness is not present	Where impulsiveness is present
+5 dB	+5 dB	+10 dB	+10 dB	+15 dB

4.0 NOISE ASSESSMENT

To estimate potential noise emissions from the development, a 3-dimensional model of the site and surrounding environment was created using SoundPLAN$_{noise}$ 9.1 proprietary noise modelling software. Details of the noise modelling are provided in Appendix C.

4.1 Noise sources

Building services specification data was provided by GreensquareDC for significant plant equipment proposed for the project. The design includes noise-generating equipment that will be located outside.

The following outdoor equipment has been identified and considered in this assessment:

- 64 evaporatively-cooled chillers
- 88 diesel generators.

The source noise levels used in the assessment are outlined in Table 12 (see Appendix C3).

4.1.1 Building services

Noise from regular operation building services, comprising the 64 evaporatively-cooled chillers, has been modelled based on all units operating simultaneously at 100% capacity. This operating scenario is not expected to occur in practice and is a conservative assumption that has been made in the absence of more specific operational information.

It is recognised that there are likely to be additional outdoor building services required for the development, including condenser units and exhaust fans for administrative office areas. Information for these systems is not available at this stage, however, noise levels from these systems are expected to be low compared to the roof mounted data centre chillers. It is recommended that the final building services design be reviewed for noise breakout once the final equipment selections and design are confirmed.

Assessment of regular operation building services has been made against the L_{A10} assigned levels.

4.1.2 Emergency and backup services

Noise from emergency services equipment such as backup generators must also comply with the Noise Regulations. Since these types of equipment operate infrequently, the commonly accepted approach within WA is for noise emissions to be assessed based on the routine maintenance test operating scenario.

It is understood that periodic testing of emergency and backup services requires:

- A start test every quarter for 15 mins (4 times a year)
- An annual load test for 30 mins (1 per year).

Testing will be scheduled for within daytime hours (i.e. 0700-1900 – Monday to Saturday).

The testing is undertaken sequentially, one unit at a time, therefore, the scenario considered in this assessment is for testing of each generator in isolation. The calculated levels for assessment are based on noise from the worst-case generator relative to each receiver.

Assessment of this scenario has been made against the L_{A10} assigned levels.

4.2 Noise controls

Initial noise modelling showed that noise controls are needed to demonstrate compliance with the Noise Regulations. Suitable noise control options for the major plant equipment have been determined and are outlined in the sections below.

4.2.1 Chillers

The sound data for the rooftop chillers is understood to represent the total sound power level for each chiller under maximum operating conditions. Preliminary noise modelling, based on all 64 chillers operating at maximum capacity at night showed that attenuation is required. The minimum attenuation required for each octave band is outlined in Table 6.

Table 6: Required minimum attenuation (dB) – chillers

	Octave band centre frequency, Hz						
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**
Attenuation	-4	-6	-8	-8	-10	-10	-10

The following options would be suitable to control noise from the chillers:

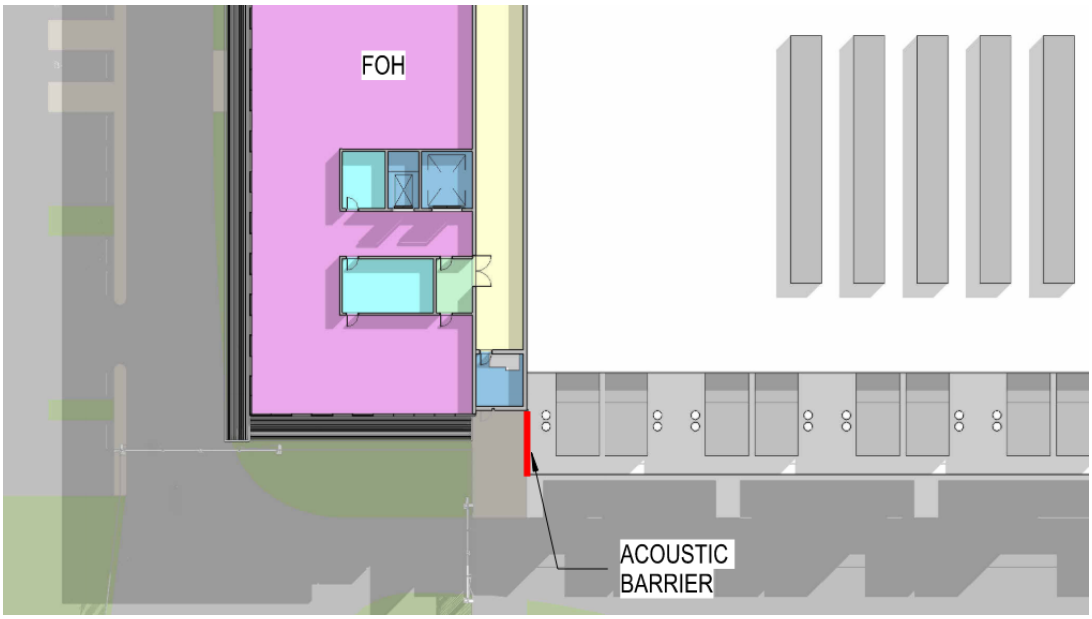
- Operation of units at lower duties – the assessment is based on 100% duty, however it is understood that this operating duty would not normally occur during night-time hours and lower noise levels would be likely in practice.
- Selection of alternative, quieter units.
- Incorporation of manufacturer attenuation packages such as fan silencers and condenser lagging.
- Localised screening around rooftop plant – it is noted that this option would have limited benefit to northern receivers, which are elevated relative to the rooftop plant.

One or more of the above options would be needed to demonstrate compliance with the assigned noise levels, however the extent of attenuation required is not considered onerous and is achievable. Specific details should be reviewed and assessed during the detail design phase of the project.

4.2.2 Generators

To control noise from the generators during routine maintenance testing, a noise barrier has been included as highlighted in Figure 3. This noise control is required to demonstrate compliance with assigned noise level at the nearest noise sensitive receiver (Helena River Steiner School - receiver #1). Compliance with the assigned noise levels at all other noise sensitive receivers is demonstrated without the need for any additional noise controls.

Figure 3: Noise barrier location



For effective noise control, the noise barrier should:

- Be constructed using material with surface density of at least 15 kg/m²
- Extend at least 1 m beyond the generator at both the end (near the road) and top.
- Be free of gaps and penetrations, including at the base.

Suitable materials include 12 mm thick compressed fibre-cement sheet, 75 mm thick Hebel Powerpanel, concrete, brick or other approved material that meets the minimum surface density specification. Final layout and constructions should be reviewed and assessed during the detail design phase of the project.

4.3 Assessment results

Results are presented below for the regular operation building services and emergency services testing scenarios.

The results for the regular operation building services scenario are based on implementation of the noise controls described in Section 4.2.1, or equivalent performing alternative means of attenuation.

The results for the emergency services testing scenario are based on implementation of the noise barrier described in Section 4.2.2.

4.3.1 Building services

The results for this scenario are presented in Table 7 and as a noise contour map in Appendix D1. It should be noted that the most stringent assigned noise level for assessment at each receiver varies depending on the relevant time period, as indicted in brackets. For example, the night period is not applicable at the school receiver since this facility would not normally be in use at this time.

Table 7: Calculated noise levels – building services (dB)

Receiver	Address	Receiver level (L_{A10})	Assigned level (L_{A10})	Compliance
1	13 Stirling Crescent	36	54 (evening)	✓
2	51 Platingshop Terrace	33	40 (night)	✓
3	Lot 787 Shellforge Lane	37	42 (night)	✓
4	5 Central Avenue	33	65 (any time)	✓
5	15 Wingate Avenue	31	47 (night)	✓
6	816 Stirling Crescent	31	40 (night)	✓

The following is noted:

- The calculated levels show that the assigned levels can be achieved by margins of at least 5 dB at the nearest receivers.
- Noise from chillers can often be tonal. If tonality is present at receivers, an adjustment of +5 dB would apply. Hence, the recommended noise controls are based on achieving compliance by at least 5 dB at all receivers so that this adjustment can be accommodated for if necessary.

Based on the above, compliance is considered to be demonstrated to all receivers.

4.3.2 Emergency services

The results for this scenario are presented in Table 8 and as a noise contour map in Appendix D2.

Table 8: Calculated noise levels – emergency services (dB)

Receiver	Address	Receiver level (L_{A10})	Assigned level (L_{A10})	Compliance
1	13 Stirling Crescent	56	59 (day)	✓
2	51 Platingshop Terrace	29	50 (day)	✓
3	Lot 787 Shellforge Lane	34	52 (day)	✓
4	5 Central Avenue	51	65 (day)	✓
5	15 Wingate Avenue	48	57 (day)	✓
6	816 Stirling Crescent	48	50 (day)	✓

The calculated levels show that the assigned levels can be achieved by margins of at least 2 dB at the nearest receivers when the noise barrier is included. Generator noise is not typically categorised as having tonal characteristics. Additionally, the duration of the noise would be a relevant consideration in terms of the potential annoyance. Since the calculated levels are based on noise from the worst-case generator relative to each receiver, noise levels from all other generators being tested are expected to be lower than the levels presented.

Based on the above, compliance is considered to be demonstrated to all receivers.

5.0 SUMMARY

GreenSquareDC Pty Ltd has engaged Marshall Day Acoustics (Australia) Pty Ltd (MDA) to provide an acoustic assessment of a proposed data storage facility for Lot 14 & 15 Stirling Crescent, Hazelmere.

A noise modelling assessment was undertaken to review compliance with the Environmental Protection (Noise) Regulations 1997. The assessment found that compliance with the assigned levels can be demonstrated at all receivers, however some noise controls will need to be implemented.

Acoustic review of the final design, including implemented noise controls, is recommended to confirm the compliance status and expected outcomes.

The assessment is based on the equipment types and layouts provided by GreenSquareDC. Should there be any significant changes to the equipment type or layouts, updated noise modelling should be carried out to reconfirm compliance.

APPENDIX A GLOSSARY OF TERMINOLOGY

dB	Decibel The unit of sound level. Expressed as a logarithmic ratio of sound pressure P relative to a reference pressure of Pr=20 μPa i.e. dB = 20 x log(P/Pr)
dB(A)	The unit of sound level which has its frequency characteristics modified by a filter (A-weighted) so as to more closely approximate the frequency bias of the human ear.
A-weighting	A set of frequency-dependent sound level adjustments that are used to better represent how humans hear sounds. Humans are less sensitive to low and very high frequency sounds. Sound levels using an "A" frequency weighting are expressed as dB L_A. Alternative ways of expressing A-weighted decibels are dBA or dB(A).
$L_{A1\,(t)}$	The A-weighted noise level which is equalled or exceeded for 1% of the measurement period. This is sometimes referred to as the typical maximum noise level. The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.
$L_{A10\,(t)}$	The A-weighted noise level equalled or exceeded for 10% of the measurement period. This is commonly referred to as the average maximum noise level. The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.
L_{Amax}	The A-weighted maximum noise level. The highest noise level which occurs during the measurement period.
L_P	Sound pressure level. The sound level measured at distance from a source. Distinctly different from sound power level (L_W)
L_w	Sound Power Level. The calculated level of total sound power radiated by a sound source. Usually A-weighted i.e. L_{WA}.

APPENDIX B ASSIGNED NOISE LEVEL CALCULATIONS

The determination of the Influencing Factor (IF) which affects the assigned levels applicable at the nearest residential receivers is based on the following:

- The number of major and secondary roads in proximity to the receiver
- The area of commercial and industrial zoned land surrounding the receiver.

The procedure defined in the Noise Regulations considers the land use and road types with two circles centred on the receiver location, one of 450 m radius, and one of 100 m radius.

The land use has been determined from:

- City of Swan Intramaps online mapping service (accessed September 2025)
- City of Swan Midland Activity Centre Master Plan v3.0 (dated December 2017)

An extract from Intramaps showing the 100 m and 450 m radius circles centred at the nearest noise sensitive receivers is presented in Figure 4. An extract from the Midland Activity Centre Master Plan is provided in Figure 5.

Figure 4: Extract of planning maps with 100 m and 450 m radius areas used to determine the IFs shown

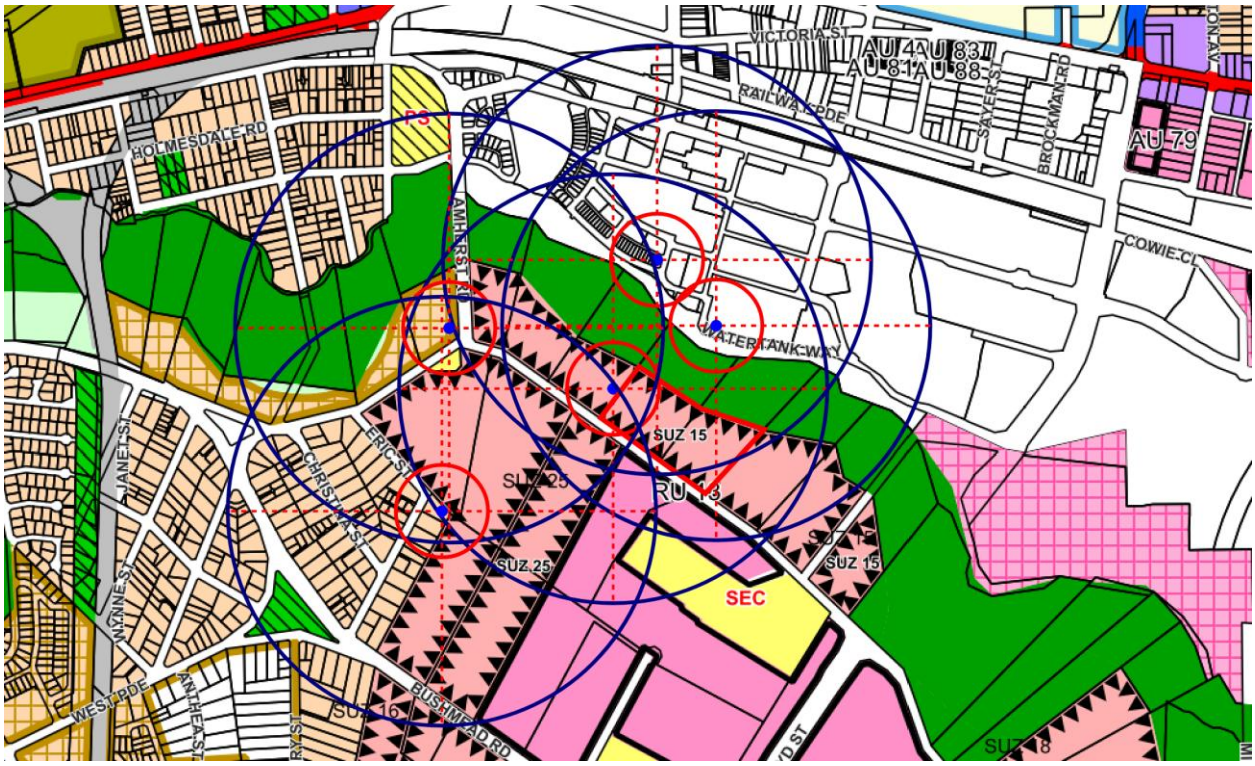


Figure 5: Land use within Midland Activity Centre

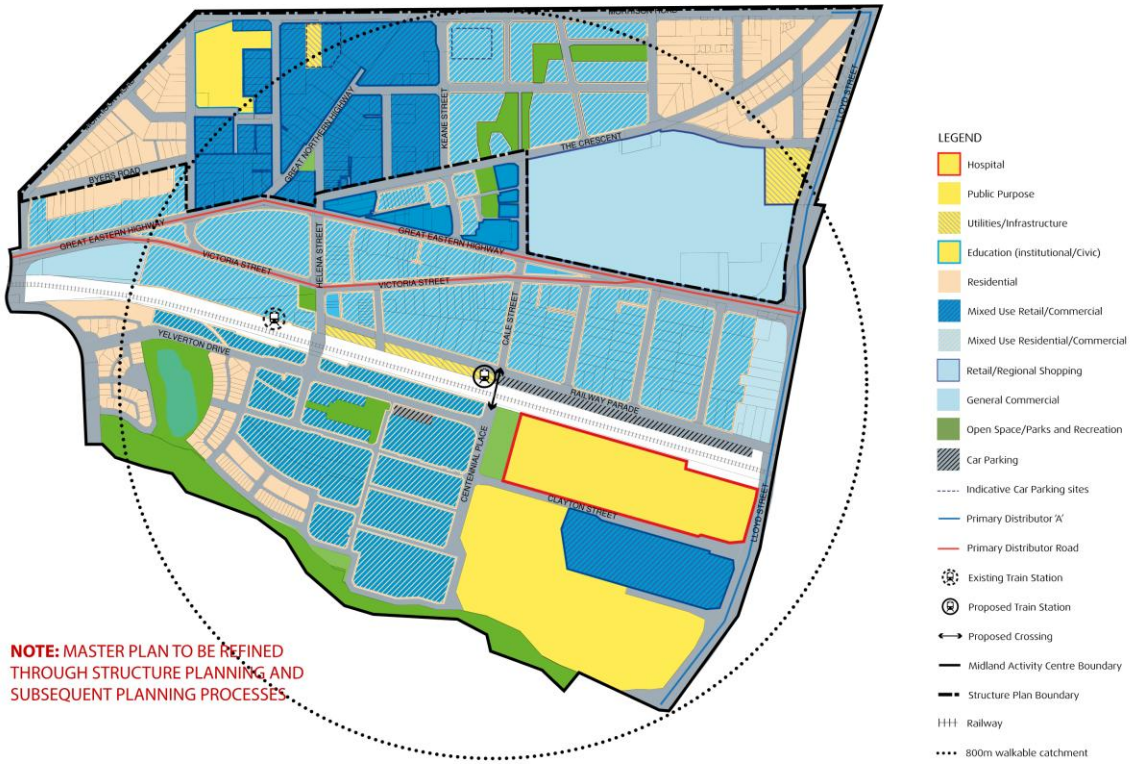


Figure 33. Midland Activity Centre Master Plan (as adopted)

Transport factors of 6 dB and 2 dB apply if there are any Major Roads (a road carrying in excess of 15,000 AADT) within the 100 m and 450 m circles respectively. For each Secondary Road (a road carrying in between 6,000 - 15,000 AADT) within the 100 m circle, a 2 dB transport factor applies. The total transport factor that is included in the IF is limited to 6 dB.

Traffic data for the nearby roads obtained from Main Roads is presented in Table 9.

Table 9: Traffic data and classifications for nearby roads (source: Main Roads)

Road	Average annual daily traffic (AADT)	Classification
Bushmead Road	6,604 (2021-2022)	-

B1 Influencing Factor

A summary of the input parameters used to determine the IF is presented in Table 10.

Table 10: Influencing Factor (IF) calculation parameters

Receiver:	#1 – 13 Stirling Cr			#2 – 51 Platingshop Tce			#3 – Lot 787 Shellforge Ln			#5 – 15 Wingate Av			816 Stirling Cr		
	100 m	450 m	IF	100 m	450 m	IF	100 m	450 m	IF	100 m	450 m	IF	100 m	450 m	IF
Land use:															
Industrial %	78%	59%	13.7	0%	21%	2.1	0%	30%	3.0	57%	60%	11.7	20%	32%	5.2
Commercial %	0%	12%	0.6	30%	27%	2.9	37%	33%	3.5	0%	0%	-	0%	0%	-
Transport Factor:															
Major road	0	0	-	0	0	-	0	0	-	0	0	-	0	0	-
Secondary roads	0	n/a	-	0	n/a	-	0	n/a	-	0	n/a	-	0	n/a	-
Influencing Factor:			**14 dB**			**5 dB**			**7 dB**			**12 dB**			**5 dB**

Note: the IF for receiver #4 has not been calculated since the receiver is an industrial premises.

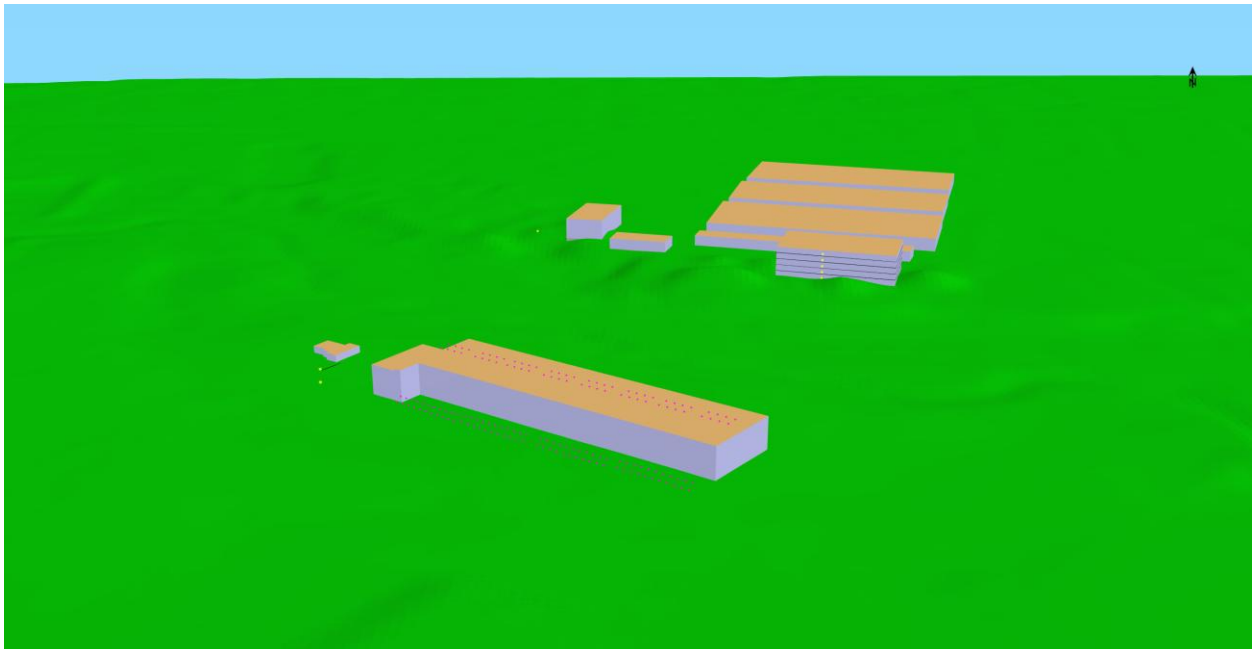
APPENDIX C NOISE MODELLING DETAILS

C1 Modelling method

A 3-dimensional model of the proposed buildings, plant equipment and surrounding environment has been created using SoundPLANnoise 9.1 proprietary noise modelling software.

The geometries in the model are simplified representations of the built environment that have been configured to a level of detail that is appropriate for noise calculation purposes. A screenshot from the noise model is shown in Figure 6.

Figure 6: Screenshot from SoundPLAN noise model



The SoundPLAN model has been used to calculate noise levels in accordance with the International Standard *ISO 9613-2:2024 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation* (ISO 9613-2). ISO 9613-2 is a general environmental noise calculation standard that has been used extensively throughout Australia, New Zealand, and Europe since its publication in 1996.

The implementation of ISO 9613-2 within proprietary noise modelling software enables multiple sound transmission paths, including reflected and screened paths, to be accounted for in the calculated noise levels.

The ISO 9613-2 predicts noise levels for conditions which favour the propagation of noise. The meteorological conditions assumed in the noise modelling are 10°C with 70% humidity.

C2 Noise modelling inputs

Selected key inputs for the noise model are presented in Table 11.

Table 11: Noise modelling inputs

Parameter	Input
Noise source data	Refer to Appendix C3 below
Topography data	1 sec DEM obtained from Geoscience Australia
Receiver height	1.5 m above ground
Ground attenuation	Mixed

C3 Noise source levels

Building services equipment sound levels used in the assessment are presented in Table 12. The levels were obtained from manufacturer datasheets for the nominated plant equipment provided by GreenSquareDC.

Table 12: Equipment sound power levels (dB)

Unit	Octave band centre frequency, Hz (dB)								
	63	125	250	500	1000	2000	4000	dBA	Model / info
Chiller	94	86	84	86	85	82	78	89	EB145 – 1265kW

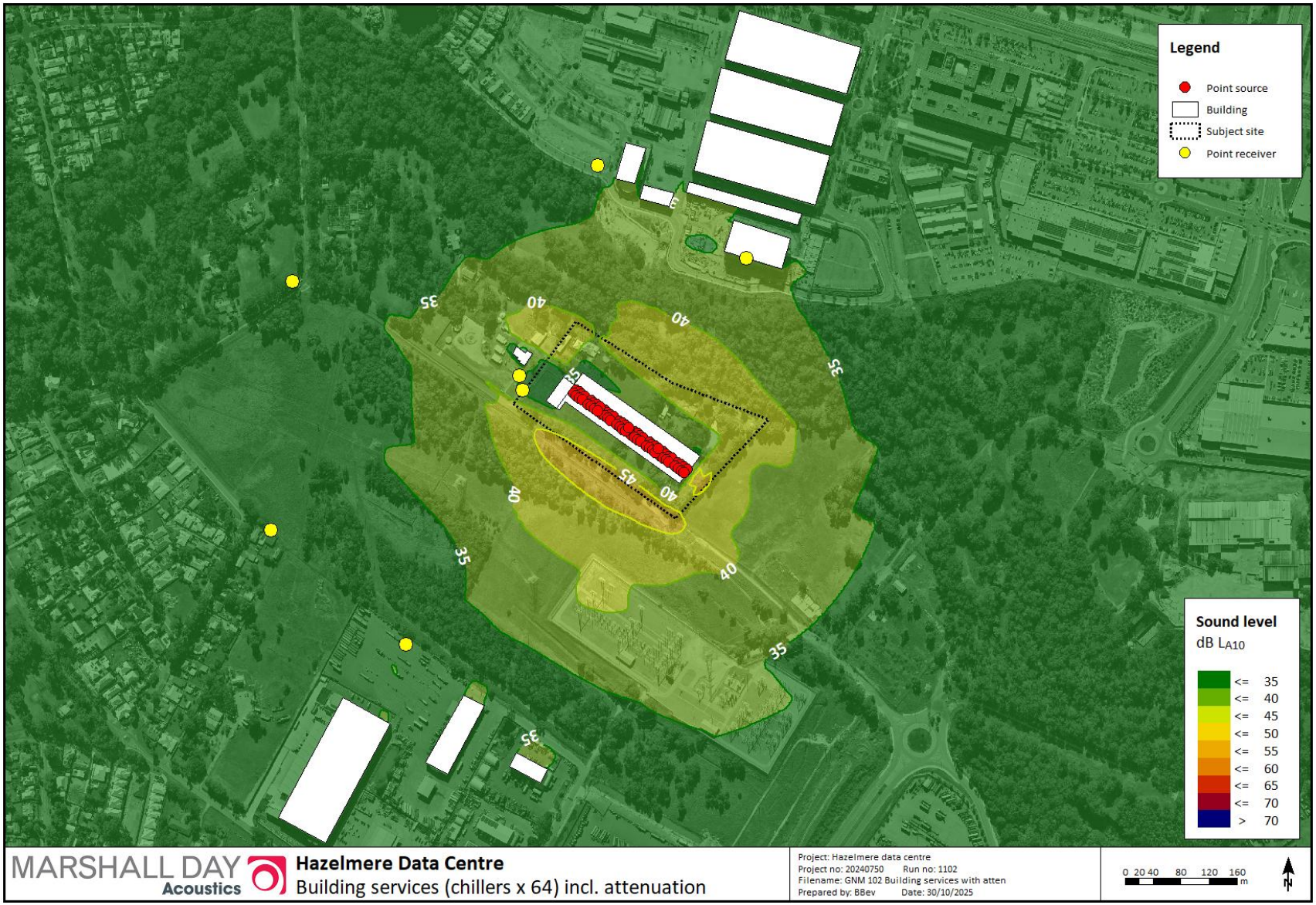
The emergency services equipment noise levels used in the assessment are presented in Table 13.

Table 13: Emergency services sound power levels (dB)

Unit	Octave band centre frequency, Hz (dB)								
	63	125	250	500	1000	2000	4000	dBA	Model / info
Generator	94	102	102	104	106	105	97	111	C2750D5BE-PB

APPENDIX D NOISE CONTOUR MAPS

D1 Building services noise



D2 Emergency services noise