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Noise Assessment

Proposed Subdivision, Harrisdale

Reference: 21066443-01A

Prepared for:
Emerge / Yolk Property

Report: 21066443-01A

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Date:	Rev	Description	Prepared By	Verified
30-Jul-21	0	Issued to Client	Terry George	Matt Moyle
16-Aug-23	A	Updated with new subdivision and updated kennel monitoring	Terry George	-

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1 INTRODUCTION

It is proposed to subdivide a number of lots bound by Ranford Road, Balannup Road, Reilly Road and Skeet Road in Harrisdale, as generally located in *Figure 1-1*. Shown on *Figure 1-2* is the proposed subdivision concept whereby commercial would be located towards Ranford Road and the remainder being residential and public open space.

Figure 1-1 Proposed Subdivision Locality

In accordance with *State Planning Policy No. 5.4 Road and Rail Noise* (SPP 5.4), Ranford Road is considered a Strategic Freight/Major Traffic Route and therefore an assessment of road traffic noise is required. SPP 5.4 provides a trigger distance of 300 metres for such a road and this has been shown on *Figure 1-3*.

In addition to road traffic, dog kennels exist to the northwest in Hatch Court, Harrisdale and to the southeast of Matison Street, Southern River. Dog kennels are provided with a 500 metre buffer and this is also shown on *Figure 1-3*.

Being within the trigger/buffer distances does not mean that land cannot be developed for residential purposes, but rather a noise assessment is required and appropriate noise management incorporated, being the purpose of this report.

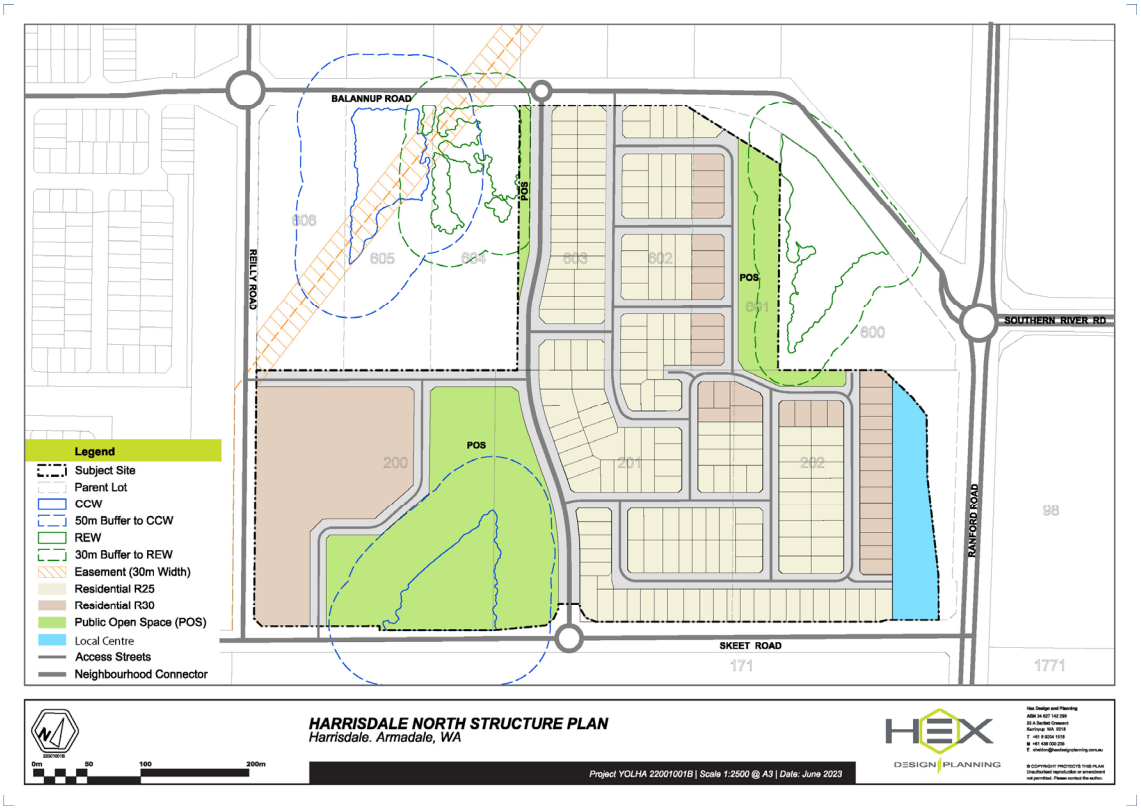

Figure 1-2 Proposed Subdivision Plan

Appendix B contains a description of some of the terminology used throughout this report.

Figure 1-3

Signs and symbols

- Subject Site
- 500m Kennel Buffer
- 300m Road Trigger
- Active Kennel License
- Logger Locations - Short 2021
- Logger Locations - Long 2023

N

Length Scale 1:10000

0 50 100 200 300 400 m

Proposed Subdivision Harrisdale -
Ranford Road Trigger and Kennel Buffers Across Site

SoundPLAN v8.2

14 August 2023

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2 CRITERIA

2.1 Road Traffic Noise

The criteria relevant to this assessment is provided in *State Planning Policy No. 5.4 Road and Rail Noise* (hereafter referred to as SPP 5.4) produced by the Western Australian Planning Commission (WAPC). The objectives of SPP 5.4 are to:

- Protect the community from unreasonable levels of transport noise;
- Protect strategic and other significant freight transport corridors from incompatible urban encroachment;
- Ensure transport infrastructure and land-use can mutually exist within urban corridors;
- Ensure that noise impacts are addressed as early as possible in the planning process; and
- Encourage best practice noise mitigation design and construction standards

Table 2-1 sets out noise targets that are to be achieved by proposals under which SPP 5.4 applies. Where the targets are exceeded, an assessment is required to determine the likely level of transport noise and management/mitigation required.

Table 2-1 Noise Targets for Noise-Sensitive Land-Use

Outdoor Noise Target		Indoor Noise Target	
55 dB $L_{Aeq(Day)}$	50 dB $L_{Aeq(Night)}$	40 dB $L_{Aeq(Day)}$ (Living and Work Areas)	35 dB $L_{Aeq(Night)}$ (Bedrooms)

Notes:

- Day period is from 6am to 10pm and night period from 10pm to 6am.
- The outdoor noise target is to be measured at 1-metre from the most exposed, habitable[1] facade of the noise sensitive building.
- For all noise-sensitive land-use and/or development, indoor noise targets for other room usages may be reasonable drawn from Table 1 of Australian Standard/New Zealand Standard AS/NZS 2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors (as amended) for each relevant time period.
- Outdoor targets are to be met at all outdoor areas as far as is reasonable and practicable to do so using the various noise mitigation measures outlined in the Guidelines.

The application of SPP 5.4 is to consider anticipated traffic volumes for the next 20 years from when the noise assessment is undertaken.

[1] A habitable room is defined in State Planning Policy 3.1 as a room used for normal domestic activities that includes a bedroom, living room, lounge room, music room, sitting room, television room, kitchen, dining room, sewing room, study, playroom, sunroom, gymnasium, fully enclosed swimming pool or patio.

In the application of the noise targets, the objective is to achieve:

- indoor noise levels specified in *Table 2-1* in noise-sensitive areas (e.g. bedrooms and living rooms of houses and school classrooms); and
- a reasonable degree of acoustic amenity for outdoor living areas on each residential lot. For non-residential noise-sensitive developments, for example schools and childcare centres, the design of outdoor areas should take into consideration the noise target.

2.2 Kennel Noise

Noise from kennels is governed by the *Environmental Protection Act 1986*, through the *Environmental Protection (Noise) Regulations 1997* (the Regulations).

Regulation 7 defines the prescribed standard for noise emissions as follows:

"7. (1) Noise emitted from any premises or public place when received at other premises –

(a) *Must not cause or significantly contribute to, a level of noise which exceeds the assigned level in respect of noise received at premises of that kind; and*

(b) *Must be free of –*

i. tonality;

ii. impulsiveness; and

iii. modulation,

when assessed under regulation 9"

A *"…noise emission is taken to significantly contribute to a level of noise if the noise emission … exceeds a value which is 5 dB below the assigned level…"*

Tonality, impulsiveness and modulation are defined in Regulation 9. Noise is to be taken to be free of these characteristics if:

(a) The characteristics cannot be reasonably and practicably removed by techniques other than attenuating the overall level of noise emission; and

(b) The noise emission complies with the standard prescribed under regulation 7 after the adjustments of *Table 2-2* are made to the noise emission as measured at the point of reception.

Table 2-2 Adjustments Where Characteristics Cannot Be Removed

Where Noise Emission is Not Music			Where Noise Emission is Music	
Tonality	Modulation	Impulsiveness	No Impulsiveness	Impulsiveness
+ 5 dB	+ 5 dB	+ 10 dB	+ 10 dB	+ 15 dB

Note: The above are cumulative to a maximum of 15dB.

The baseline assigned levels (prescribed standards) are specified in Regulation 8 and are shown in *Table 2-3*.

Table 2-3 Baseline Assigned Noise Levels

Premises Receiving Noise	Time Of Day	Assigned Level (dB)		
		L_{A10}	L_{A1}	L_{Amax}
Noise sensitive premises: highly sensitive area[1]	0700 to 1900 hours Monday to Saturday (Day)	45 + influencing factor	55 + influencing factor	65 + influencing factor
	0900 to 1900 hours Sunday and public holidays (Sunday)	40 + influencing factor	50 + influencing factor	65 + influencing factor
	1900 to 2200 hours all days (Evening)	40 + influencing factor	50 + influencing factor	55 + influencing factor
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	35 + influencing factor	45 + influencing factor	55 + influencing factor
Noise sensitive premises: any area other than highly sensitive area	All hours	60	75	80
Commercial	All hours	60	75	80
Industrial	All hours	65	80	90

1. ***highly sensitive area*** means that area (if any) of noise sensitive premises comprising —
   (a) a building, or a part of a building, on the premises that is used for a noise sensitive purpose; and
   (b) any other part of the premises within 15 metres of that building or that part of the building.

The influencing factor, applicable at the future noise sensitive premises within the proposed development varies from 0, 2 or 6 dB, depending on a residences proximity to Ranford Road, being considered a major road (29,337 vehicles per day (vpd) 2019/20 MRWA Site #4775).

Table 2-4 shows the assigned noise levels including the influencing factor at the receiving locations.

Table 2-4 Assigned Noise Levels

Noise sensitive premises: highly sensitive area[1]	Time Of Day	Assigned Level (dB)		
		L_{A10}	L_{A1}	L_{Amax}
Greater than 450m from Ranford Road	0700 to 1900 hours Monday to Saturday (Day)	45	55	65
	0900 to 1900 hours Sunday and public holidays (Sunday)	40	50	65
	1900 to 2200 hours all days (Evening)	40	50	55
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	35	45	55
Within 450m But Greater than 100m from Ranford Road	0700 to 1900 hours Monday to Saturday (Day)	47	57	67
	0900 to 1900 hours Sunday and public holidays (Sunday)	42	52	67
	1900 to 2200 hours all days (Evening)	42	52	57
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	37	47	57
Within 100m from Ranford Road	0700 to 1900 hours Monday to Saturday (Day)	51	61	71
	0900 to 1900 hours Sunday and public holidays (Sunday)	46	56	71
	1900 to 2200 hours all days (Evening)	46	56	61
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	41	51	61

1. ***highly sensitive area*** means that area (if any) of noise sensitive premises comprising —
   (a) a building, or a part of a building, on the premises that is used for a noise sensitive purpose; and
   (b) any other part of the premises within 15 metres of that building or that part of the building.

It is noted the assigned noise levels are statistical levels and therefore the period over which they are determined is important. The Regulations define the Representative Assessment Period (RAP) as *a period of time of not less than 15 minutes, and not exceeding 4 hours*, which is determined by an *inspector* or *authorised person* to be appropriate for the assessment of a noise emission, having regard to the type and nature of the noise emission. An *inspector* or *authorised person* is a person appointed under Sections 87 & 88 of the *Environmental Protection Act 1986* and include Local Government Environmental Health Officers and Officers from the Department of Environment Regulation. Acoustic consultants or other environmental consultants are not appointed as an *inspector* or *authorised person*. Therefore, whilst this assessment is based on a 4 hour RAP, which is assumed to be appropriate given the nature of the operations, this is to be used for guidance only.

3 METHODOLOGY

3.1 Road Traffic

Noise measurements and modelling have been undertaken generally in accordance with the requirements of SPP 5.4 and associated Guidelines[2] as described in *Section 3.1.1* and *Section 3.1.2*.

3.1.1 Site Measurements

Noise monitoring was undertaken 11 metres from Ranford Road in 2021 in order to:

- Quantify the existing noise levels;
- Determine the differences between different acoustic parameters ($L_{A10,18hour}$, $L_{Aeq(Day)}$ and $L_{Aeq(Night)}$); and
- Calibrate the noise model for existing conditions.

The instrument used was an ARL Type 316 noise data logger (S/N: 15-301-468), with the microphone 1.4 metres above ground level (refer *Figure 3-1*). The logger was programmed to record hourly L_{A1}, L_{A10}, L_{A90}, and L_{Aeq} levels. This instrument complies with the instrumentation requirements of *Australian Standard 2702-1984 Acoustics – Methods for the Measurement of Road Traffic Noise*. The logger was field calibrated before and after the measurement session and found to be accurate to within +/- 1 dB. Lloyd George Acoustics also holds current laboratory calibration certificate for the loggers.

[2] Road and Rail Noise Guidelines, September 2019

Figure 3-1 Photograph of Noise Logger on Site

3.1.2 Noise Modelling

The computer programme *SoundPLAN 8.2* was utilised incorporating the *Calculation of Road Traffic Noise* (CoRTN) algorithms, modified to reflect Australian conditions. The modifications included the following:

- Vehicles were separated into heavy (Austroads Class 3 upwards) and non-heavy (Austroads Classes 1 & 2) with non-heavy vehicles having a source height of 0.5 metres above road level and heavy vehicles having two sources, at heights of 1.5 metres and 3.6 metres above road level, to represent the engine and exhaust respectively. By splitting the noise source into three, allows for less barrier attenuation for high level sources where barriers are to be considered;
- Note that a -8.0 dB correction is applied to the exhaust and -0.8 dB to the engine (based on Transportation Noise Reference Book, Paul Nelson, 1987), so as to provide consistent results with the CoRTN algorithms for the no barrier scenario.

Predictions are made at heights of 1.4 m above ground floor level for single storey houses and 4.2 m for double storey houses. The noise is predicted at 1.0 metre from an assumed building facade resulting in a + 2.5 dB correction due to reflected noise.

Various input data are included in the modelling such as ground topography, road design, traffic volumes etc. These model inputs are discussed in the following sections.

Ground Topography

Topographical and road design data for this project was a combination of survey data and spot heights taken from publicly available data e.g. *Google*. The concept design levels have also been incorporated into the model, as provided by Porter Consulting Engineers on 14 August 2023.

Buildings have also been included as these can provide barrier attenuation when located between a source and receiver, in much the same way as a hill or wall provides noise shielding. All buildings are modelled as single storey with a height of 3.5 metres. This means where calculations are undertaken for upper floors, the noise is going over the top of the single storey buildings.

Traffic Data

Traffic data includes:

- Road Surface – The noise relationship between different road surface types is shown in *Table 3-1*.

Table 3-1 Noise Relationship Between Different Road Surfaces

Road Surfaces							
Chip Seal				Asphalt			
14mm	10mm	5mm	Slurry	Dense Graded	Novachip	Stone Mastic	Open Graded
+3.5 dB	+2.5 dB	+1.5 dB	+1.0 dB	0.0 dB	-0.2 dB	-1.5 dB	-2.5 dB

The existing road surface is dense graded asphalt and is expected to remain unchanged into the future.

- Vehicle Speed – The existing and future posted speeds are 80km/hr.

- Traffic Volumes – Existing traffic volumes were obtained from the Main Roads WA Traffic Map (Site #4775). At the time of the report, forecast traffic volumes were not provided by Main Roads WA, such that these were estimated to be around 20,000 vehicles per day in each direction with the percentage heavy assumed unchanged based on general information provided by Porter Consulting Engineers. *Table 3-2* provides the traffic volume input data in the model.

Table 3-2 Traffic Information Used in the Modelling

Parameter	Scenario			
	Existing – 2019/20		Future - 2041	
	Northbound	Southbound	Northbound	Southbound
24 Hour Volume	14,976	14,361	20,000	20,000
% Heavy	8.5	7.5	8.5	7.5

Ground Attenuation

The ground attenuation has been assumed to be 0.0 (0%) for the road and commercial area, 0.6 (60%) throughout the subdivision, except for the public open spaces, which were set to 1.00 (100%). Note 0.0 represents hard reflective surfaces such as water and 1.0 represents absorptive surfaces such as grass.

Parameter Conversion

The CoRTN algorithms used in the *SoundPlan* modelling package were originally developed to calculate the $L_{A10,18hour}$ noise level. SPP 5.4 however uses $L_{Aeq(Day)}$ and $L_{Aeq(Night)}$. The relationship between the parameters varies depending on the composition of traffic on the road (volumes in each period and percentage heavy vehicles).

As noise monitoring was undertaken, the relationship between the parameters is based on the results of the monitoring – refer *Section 4.1*.

3.2 Kennel Noise

3.2.1 Site Measurements

Under the Regulations, there are certain requirements that must be satisfied when undertaking measurements and are defined in Regulations 19, 20, 22 and 23 and Schedule 4. In undertaking the measurements, these have been satisfied, specifically noting the following:

- The sound level meter used was a Bruel & Kjaer Type 2250 (S/N: 3011946). This was used to undertake roving measurements throughout the kennel area around Matison Street, Talbot Road and Cairn Road on Sunday 11 July 2021, between 6.00am and 9.00am. This period was chosen to coincide with the critical night period of the Regulations and the school holiday period, where kennel occupancy is likely to be at its maximum.
- Two noise data loggers were used during the same session as above to provide further analysis at a fixed point. The noise data loggers used were:
    - ARL Type Ngara (S/N: 878210) on Matison Street, approximately 70m east of Ranford Road; and
    - ARL Type Ngara (S/N: 87803E) at the eastern end of the newly constructed road alongside North Harrisdale Primary School (Colville Street).
- At the request of the local government, longer term noise monitoring was undertaken over a 1-week period between 28 July to 4 August 2023 as follows:
    - ARL Type Ngara (S/N: 878210) on Matison Street, approximately 200m northeast of Ranford Road and 35 metres northwest of Matison Street in the bushland; and
    - ARL Type Ngara (S/N: 8781CA) towards the northern end of the private property of #30 Balannup Road, Harrisdale and approximately 200 metres southwest of Ranford Road. Note that the resident has lived on this property for over 10 years and stated she rarely hears any dog barking.

  These logger locations are shown on *Figure 1-3*.

- All equipment holds current laboratory certificates of calibration that are available upon request. The equipment was also field calibrated before and after and found to be within +/- 0.5 dB.
- Each microphone was fitted with a standard wind screen.
- The microphones were at least 1.2 metres above ground level and at least 3.0 metres from reflecting facades (other than the ground plane).

For the 2021 measurements were recorded on 11 July 2021 between 6.00am and 9.00am. Meteorological conditions at the time, recorded at the Bureau of Meteorology's Jandakot site, were:

- Temperature 13°C
- Humidity 77%
- Wind Speed 4.7m/s
- Wind Direction East-North-Easterly
- Rainfall 0

For the 2023 measurements, the focus was on the early morning period prior to 7.00am. Whilst rooster calling and dog barking were audible, by 6.00am there was significant traffic that dog noise could not be quantified. The Sunday morning period from 5.00am (30 July 2023) through to 9.00am became the focus, which is night-time in the Noise Regulations. Again, by 6.00am road traffic noise became dominant. Between 5.00am and 6.00am, the weather conditions were:

- Temperature 13°C
- Humidity 99%
- Wind Speed Calm
- Wind Direction N/A
- Rainfall 0

In both cases, background noise was dominated by road traffic, with intermittent noise from birds as well as some aircraft noise. Also, rooster calling occurred at the Matison Street area, which was not removed from the data set.

3.2.2 Noise Modelling

As described in *Section 3.1.2*, the software used to predict noise levels to the site was *SoundPLAN 8.2* with the CONCAWE (ISO 17534-3 improved method) algorithms selected. These algorithms have been selected as they include the influence of wind and atmospheric stability. Input data required in the model are:

- Meteorological Information;
- Topographical data;
- Ground Absorption; and
- Source sound power levels.

Meteorological Information

Meteorological information utilised is provided in *Table 3-3* and is considered to represent worst-case conditions for noise propagation. At wind speeds greater than those shown, sound propagation may be further enhanced, however background noise from the wind itself and from local vegetation is likely to be elevated and dominate the ambient noise levels.

Table 3-3 Modelling Meteorological Condition

Parameter	Night (1900-0700)
Temperature (°C)	15
Humidity (%)	50
Wind Speed (m/s)	3
Wind Direction*	All
Pasquil Stability Factor	F

* Note that the modelling package used allows for all wind directions to be modelled simultaneously.

It is generally considered that compliance with the assigned noise levels needs to be demonstrated for 98% of the time, during the day and night periods, for the month of the year in which the worst-case weather conditions prevail. In most cases, the above conditions occur for more than 2% of the time and therefore must be satisfied.

Topographical Data and Ground Absorption

As described previously in *Section 3.1.2*.

3.2.3 Source Sound Levels

The critical sound power levels used in the modelling are provided in *Table 3-4*. These were derived from the measurements as described in *Section 4.2*, noting barking in the Hatch Court area was less frequent, albeit louder than that at Matison Street, which was more continuous but at a lower level. Dog barking is modelled as 1-metre above ground level.

Table 3-4 Kennel Source Sound Power Levels, dB(A)

Description	Octave Band Centre Frequency (Hz)								Overall
	63	125	250	500	1k	2k	4k	8k	
Hatch Court Kennels – L_{A1}	81	85	96	113	103	87	71	63	**114**
Matison Street Kennels – L_{A10}	68	72	83	100	90	74	58	50	**101**

4 RESULTS

4.1 Road Traffic

The results of the noise monitoring are summarised in *Table 4-1* and shown graphically in *Figure 4-1*.

Table 4-1 Measured Average Noise Levels

Date	Average Weekday Noise Level, dB			
	$L_{A10,18hour}$	$L_{Aeq,24hour}$	$L_{Aeq\ (Day)}$	$L_{Aeq\ (Night)}$
Thu 24-Jun-21	70.8	66.8	68.1	62.0
Fri-25-Jun-21	71.3	67.1	68.4	62.3
Sat 26-Jun-21	*70.9*	*66.4*	*67.7*	*61.1*
Sun 27-Jun-21	*70.4*	*66.1*	*67.7*	*58.3*
Mon 28-Jun-21	*70.8*	*67.1*	*68.3*	*62.4*
Tue 29-Jun-21	*69.9*	*66.2*	*67.3*	*62.0*
Wed 30-Jun-21	*69.5*	*65.7*	*67.0*	*61.0*
Thu 1-Jul-21	*69.6*	*66.1*	*67.4*	*60.7*
Weekday Average	**71.1**	**67.0**	**68.2**	**62.1**

Italics results not used in average

Note the average shown is for the 24 and 25 June 2021 only as the following week, from Sunday midday, Western Australia went into a Covid-19 related lockdown.

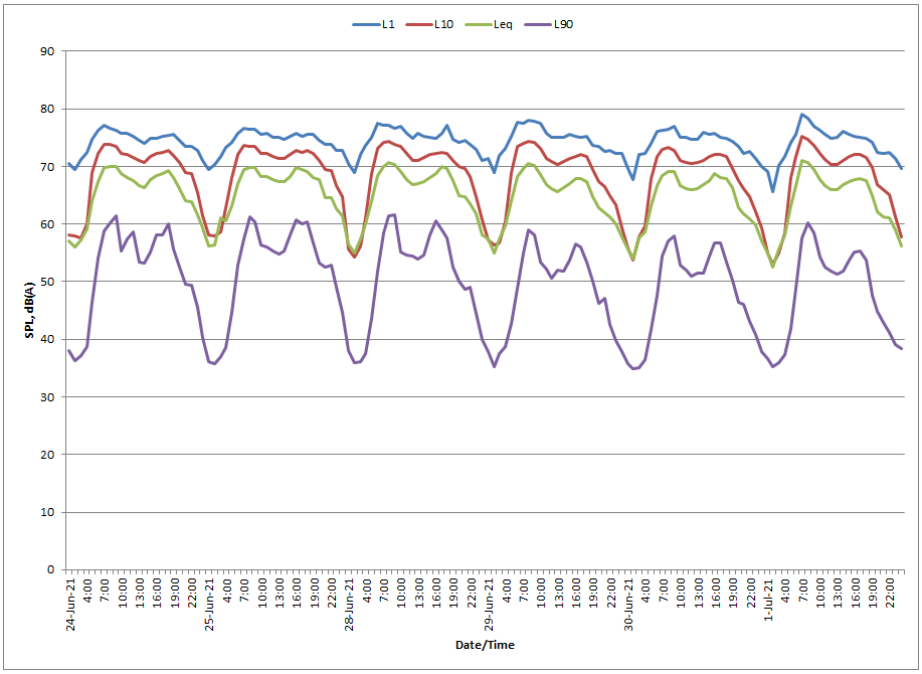


Figure 4-1 Road Traffic Noise Monitoring Results

The average differences between the weekday $L_{Aeq(Day)}$ and $L_{Aeq(Night)}$ is 6.1 dB and this conversion has been used in the modelling. This same difference has been assumed to exist in future years. As such, it is the daytime noise levels that will dictate compliance since these are at least 5 dB more than night-time levels.

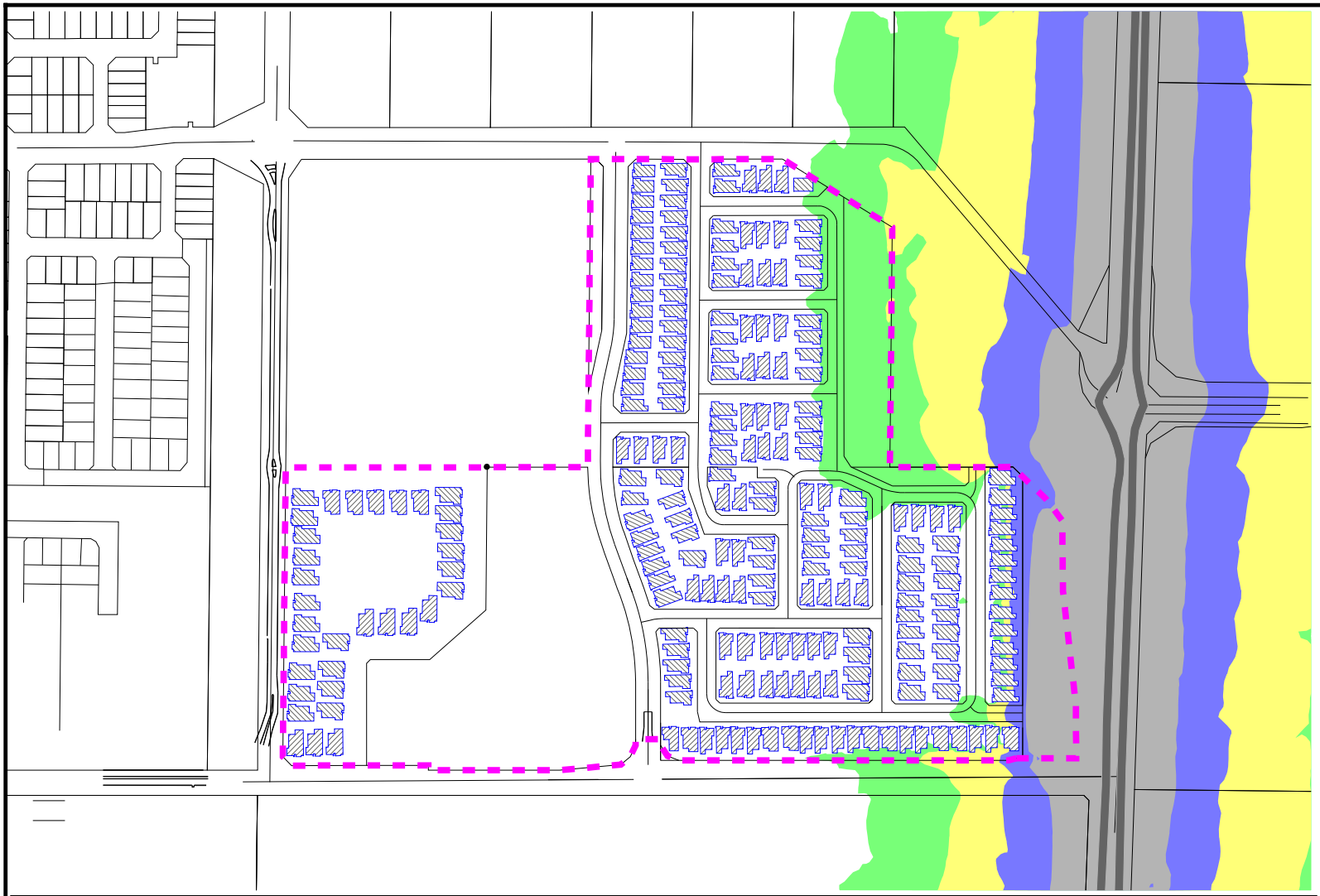
The noise model is initially set-up and calibrated for existing conditions. It is then updated to reflect future conditions incorporating the proposed development and future traffic volumes with the results provided in *Figure 4-2* as an $L_{Aeq(Day)}$ noise level contour plot. It can be seen that noise levels will be above the outdoor noise target at some residences and therefore noise control must be implemented with the following recommended:

- Construct a noise wall as shown in *Figure 4-3* to *Figure 4-6*. The noise wall is to be solid, free of gaps and of minimum surface mass 15 kg/m^2. The noise contours to ground floor and a potential upper floor are provided in *Figure 4-3* and *Figure 4-4* respectively. The wall ranges in height from 2.0m to 2.4m (relative to finished lot level). A portion of standard fencing is also required along Skeet Road.
- Where lots are still above the outdoor noise target, the following Packages (refer *Appendix A*) are required as shown on *Figure 4-5* and *Figure 4-6* for ground and upper floor respectively:
    - Package A where noise levels are between 56 dB and 58 dB $L_{Aeq(Day)}$;
    - Package B where noise levels are between 59 dB and 62 dB $L_{Aeq(Day)}$;
    - Package C where noise levels are between 63 dB and 66 dB $L_{Aeq(Day)}$;

      Alternative constructions from the deemed to satisfy packages may be acceptable if supported by a report undertaken by a suitably qualified acoustical consultant (member firm of the Association of Australasian Acoustical Consultants (AAAC)), once the lots specific building plans are available.
- All affected lots are to have notifications on lot titles as per SPP 5.4 requirements – refer *Appendix A*.

Note that the proposed noise walls and architectural packages will also provide acoustic mitigation of the dog kennel noise, as well as providing a visual and acoustic barrier to separate the commercial land and residential land.

Figure 4-2



Noise levels
$L_{Aeq(Day)}$ dB

<= 55	
<= 56	Exposure A
<= 57	
<= 58	
<= 59	Exposure B
<= 60	
<= 61	
<= 62	
<= 63	Exposure C
<= 64	
<= 65	
<= 66	
> 66	Exposure D

SPP 5.4 (Sep 2019)

Signs and symbols
- Ranford Road
- Indicative Building
- Subject Site

Length Scale 1:5000

0 25 50 100 150 200 m

Proposed Subdivision Harrisdale -
Future $L_{Aeq(Day)}$ Noise Level Contours - Ground Floor

Assumed 40,000 vpd on Ranford Road for 2041

SoundPLAN v8.2
CoRTN Algorithms

15 August 2023

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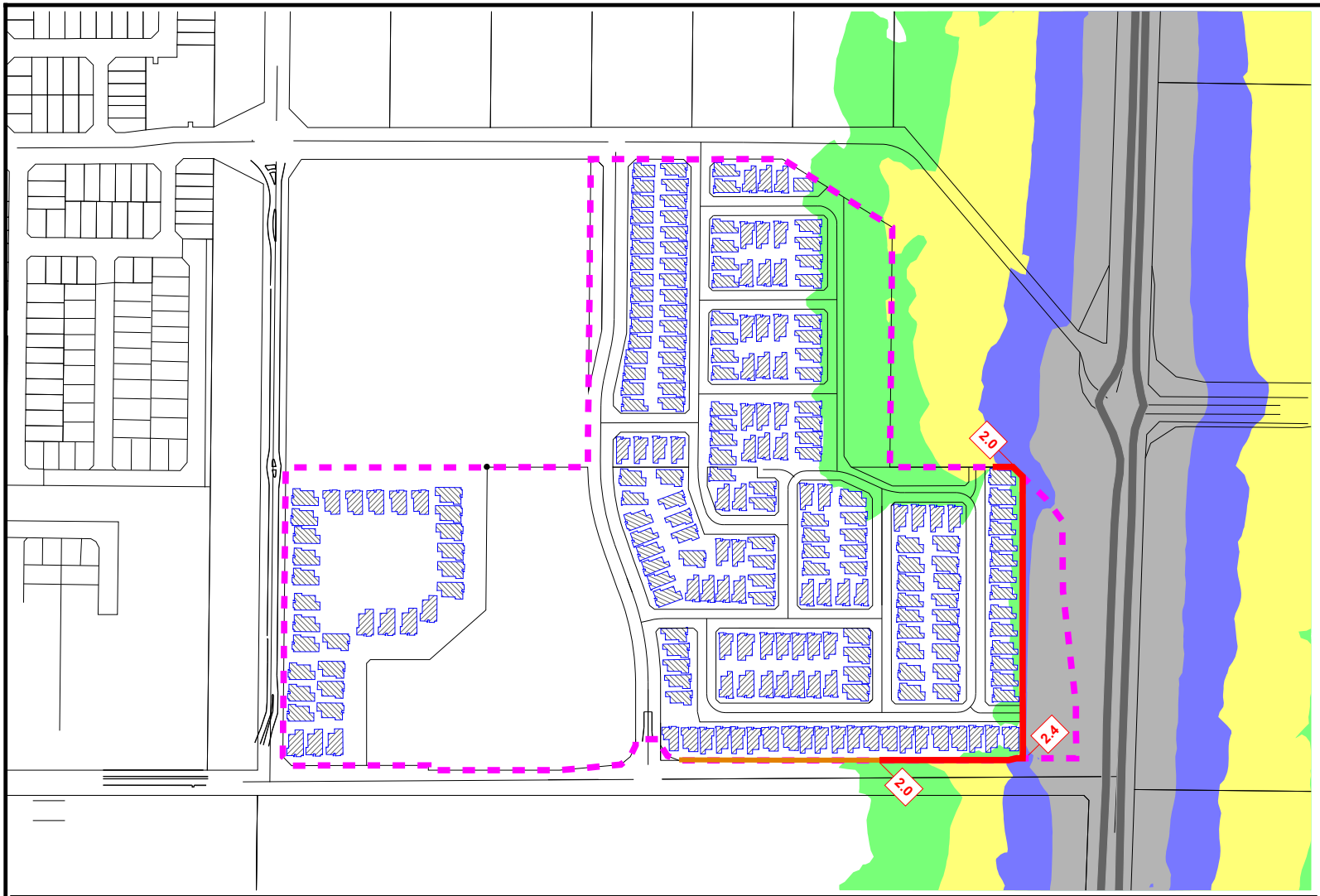
Figure 4-3



Noise levels
$L_{Aeq(Day)}$ dB

<= 55	
<= 56	Exposure A
<= 57	
<= 58	
<= 59	Exposure B
<= 60	
<= 61	
<= 62	
<= 63	Exposure C
<= 64	
<= 65	
<= 66	
> 66	Exposure D

SPP 5.4 (Sep 2019)

Signs and symbols
- Ranford Road
- Indicative Building
- Std Fence
- Noise Wall
- Subject Site

N

Length Scale 1:5000

0 25 50 100 150 200 m

Proposed Subdivision Harrisdale -
Future $L_{Aeq(Day)}$ Noise Level Contours - Ground Floor (With Wall)

Includes Fence and Wall for Road Traffic Mitigation (Read Left to Right Down to Up)
Assumed 40,000 vpd on Ranford Road for 2041

SoundPLAN v8.2
CoRTN Algorithms

15 August 2023

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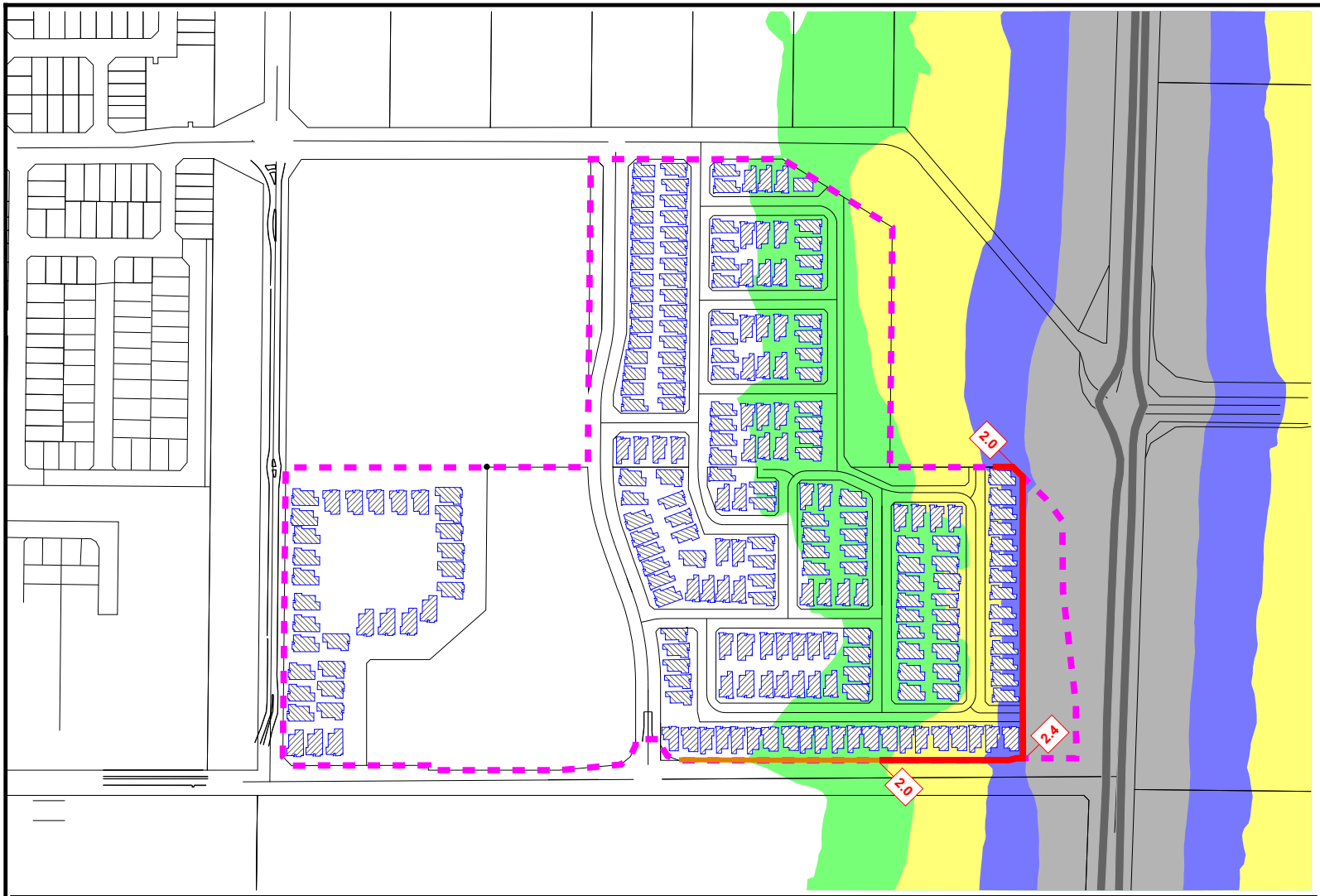
Figure 4-4



Noise levels
$L_{Aeq(Day)}$ dB

<= 55	
<= 56	Exposure A
<= 57	
<= 58	
<= 59	Exposure B
<= 60	
<= 61	
<= 62	
<= 63	Exposure C
<= 64	
<= 65	
<= 66	
> 66	Exposure D

SPP 5.4 (Sep 2019)

Signs and symbols
- Ranford Road
- Indicative Building
- Std Fence
- Noise Wall
- Subject Site

N

Proposed Subdivision Harrisdale -
Future $L_{Aeq(Day)}$ Noise Level Contours - Upper Floor (With Wall)

Includes Fence and Wall for Road Traffic Mitigation (Read Left to Right Down to Up)
Assumed 40,000 vpd on Ranford Road for 2041

SoundPLAN v8.2
CoRTN Algorithms

15 August 2023

Length Scale 1:5000

0 25 50 100 150 200 m

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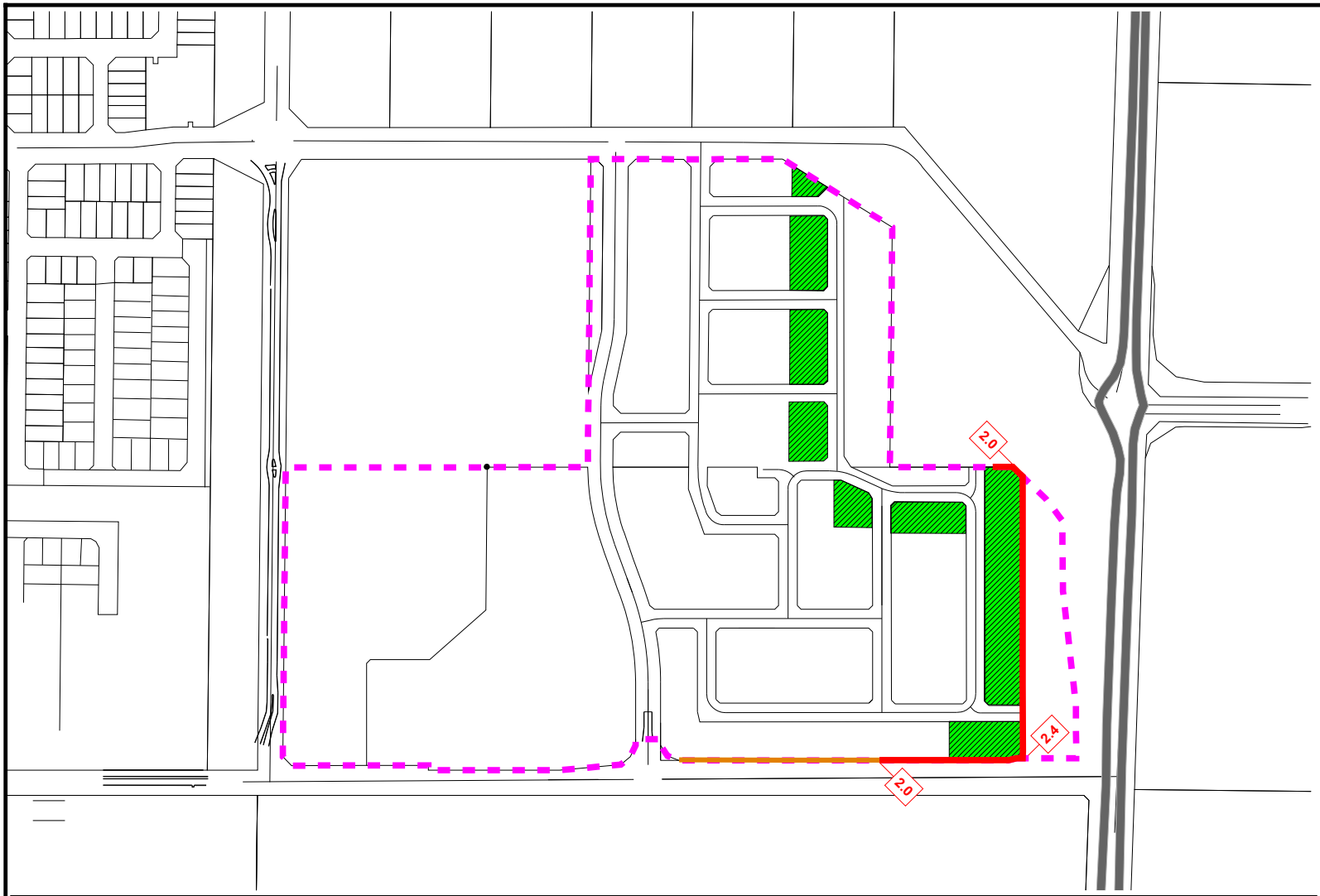
Figure 4-5



Signs and symbols
- Ranford Road
- Std Fence
- Noise Wall
- Subject Site
- Package A
- Package B
- Package C

Length Scale 1:5000

0 25 50 100 150 200 m

Proposed Subdivision Harrisdale - Mitigation Requirements - Ground Floor (With Wall)

Includes Fence and Wall for Road Traffic Mitigation (Read Left to Right Down to Up)
Assumed 40,000 vpd on Ranford Road for 2041

SoundPLAN v8.2
CoRTN Algorithms

15 Aug 2023

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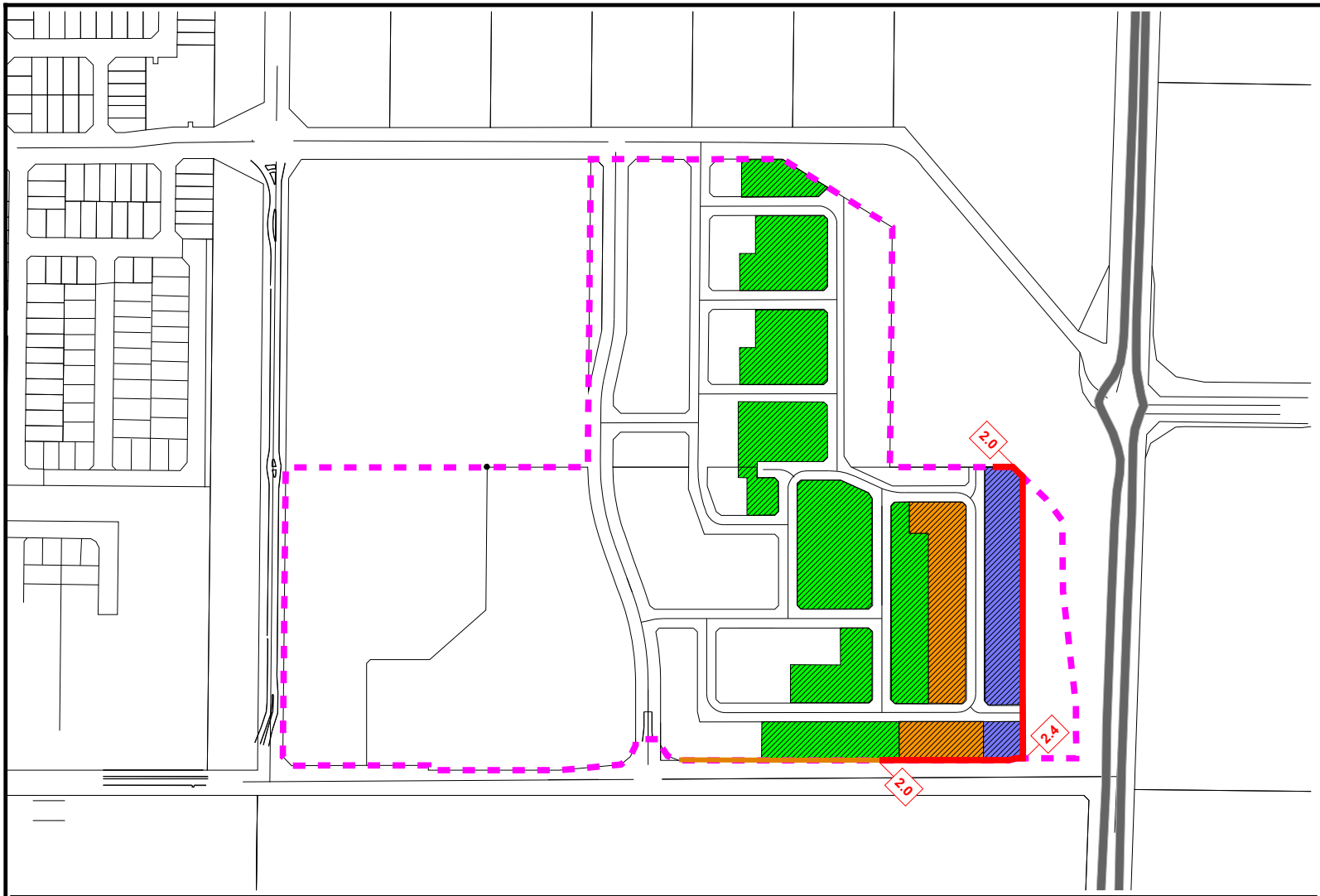
Figure 4-6



Signs and symbols
- Ranford Road
- Std Fence
- Noise Wall
- Subject Site
- Package A
- Package B
- Package C

Proposed Subdivision Harrisdale -
Mitigation Requirements - Upper Floor (With Wall)

Includes Fence and Wall for Road Traffic Mitigation (Read Left to Right Down to Up)
Assumed 40,000 vpd on Ranford Road for 2041

SoundPLAN v8.2
CoRTN Algorithms

15 August 2023

Length Scale 1:5000

0 25 50 100 150 200 m

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4.2 Kennel Noise

4.2.1 Hatch Court Analysis – Short Term (2021)

The audio files recorded in 2021 near the Hatch Court kennels were reviewed in order to quantify dog barking noise and assess how often barking occurred. The most consistent noise source is from road traffic, resulting in the background noise level generally being around 40 dB L_{A90}. Other intermittent noises were associated with birds mostly, as well as rooster calling. For much of the time, noise from dog barking would blend into background noise, however it began to increase at around 6.25am. From 6.30am to 6.45am, the noise levels were assessed as 49 dB L_{Amax} and 47 dB L_{A1}. No L_{A10} value was recorded for dog barking as the significant barking was present for less than 10% of the time (less than 1-½ minutes in 15-minutes). Between 6.45am and 7.00am the results were similar, albeit slightly quieter. Between 7.00am and 7.15am there was negligible dog barking. From 7.15am to 7.30am, the amount of dog barking was similar to earlier, although at a higher level with results of 56 dB L_{Amax} and 52 dB L_{A1}. The time history for this period is provided in *Figure 4-7* with the red dots indicating times of dog barking events. From 7.30am dog barking was still occurring, however bird noise became significant and traffic noise increased such that quantifying dog barking alone became more difficult, with the exception of 8.30am to 8.45am where there were periods where dog barking noise was above background noise, resulting in calculated levels of 58 dB L_{Amax} and 55 dB L_{A1}.

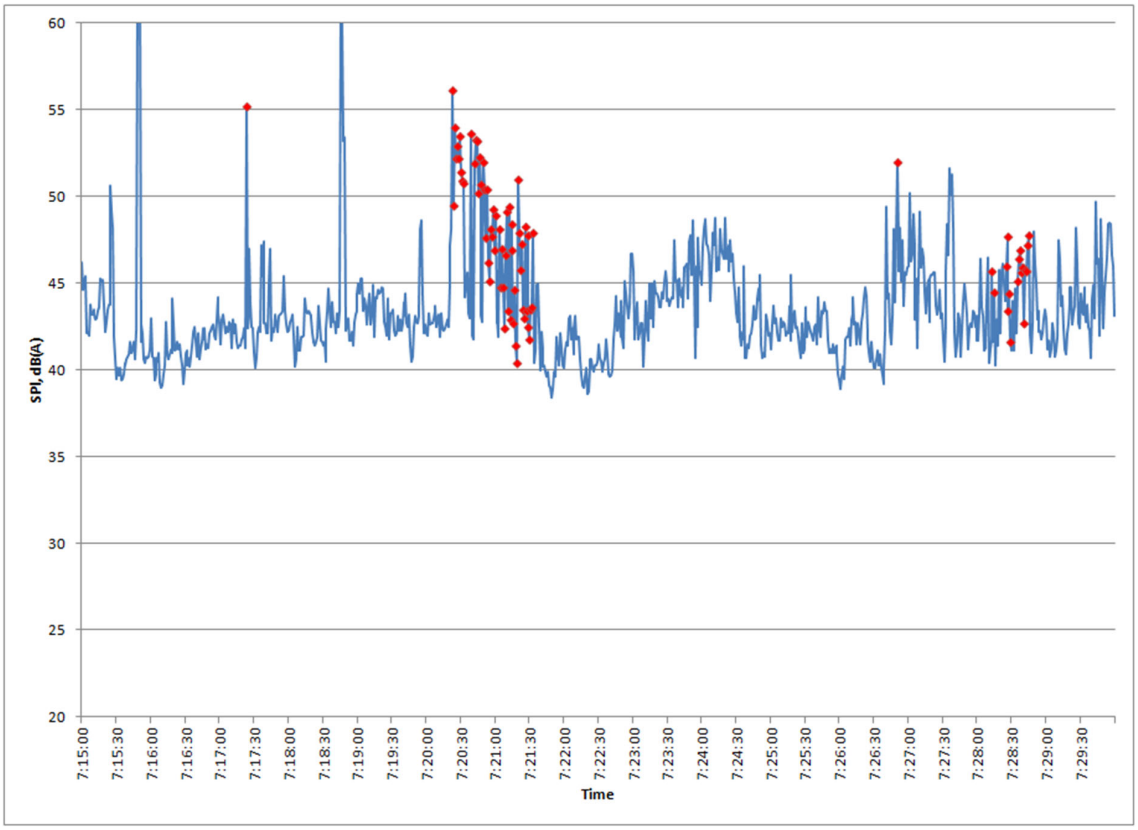


Figure 4-7 Typical Hatch Court Noise Level Measurements

Whilst the L_{A10} level was not quantified, it may be that dog barking at times does occur for more than 10% of the time. However, the level of the dog barking noise becomes difficult to separate from background noise and therefore it is considered the L_{A1} becomes a more representative parameter for intrusiveness.

Using the worst-case 15-minute period, the L_{Amax} and L_{A1} sound power levels are calculated to be 112 dB L_{Amax} and 109 dB L_{A1} respectively. Given the L_{A1} sound power level is within 3 dB of the L_{Amax}, it is the L_{A1} that will determine compliance. The octave band sound power level is provided in *Table 4-2* with the one-third octave band sound pressure level provided in *Figure 4-8*. As the noise is present for less than 10% of the time, it is the 8 dB tonality rule that is applicable rather than the 3 dB rule and as such, the noise is not considered tonal. Impulsiveness is also not considered to be present at the proposed subdivision and barking is not considered to be modulating such that no adjustments for intrusiveness are applicable.

Table 4-2 Hatch Court 2021 Determined Sound Power Level, dB(A)

Description	Octave Band Centre Frequency (Hz)								Overall
	63	125	250	500	1k	2k	4k	8k	
2021 Hatch Court Dog Barking – L_{A1}	76	80	91	108	98	82	66	58	**109**

The above sound power level was positioned in the noise model on each of the Hatch Court Kennels with an active kennel license.

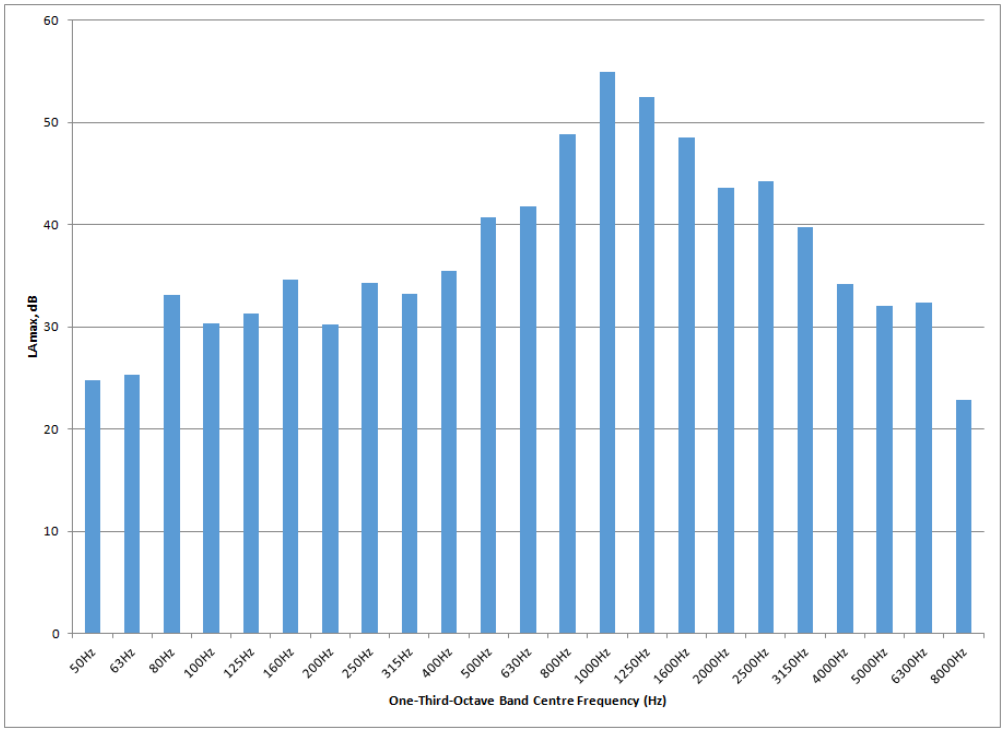


Figure 4-8 Typical Hatch Court Noise Level Measurements

4.2.2 Hatch Court Analysis – Long Term (2023)

Noise monitoring was set-up at the rear of #30 Balannup Road with permission from the resident with the 15-minute data of all recorded noise plotted in *Figure 4-9*. It was noted by the resident that has been there for over 10 years that the dog barking noise is not an issue and is rarely heard. This location was chosen as it is in the direction of the proposed subdivision and the previous monitoring location has now been subdivided so a secure location could not be found.

Upon review of the audio files, the residents statement is generally supported. Even on a Sunday where road traffic noise is less than other days, whilst dog barking noise could occasionally be heard, it could not be quantified. Bird noise and frog noise were also influencing the noise levels. The best data to quantify dog barking noise occurred between 5.00am and 6.00am, where bird calling and road traffic were less and particularly between 5.45am and 6.00am as the worst-case 15-minute period, recording 54 dB L_{Amax} and 51 dB L_{A1}. Outside of this time, dog barking was infrequent.

Again, with limited difference between the L_{Amax} and L_{A1}, it is the L_{A1} that will determine compliance. It is also noted that no L_{A10} value was recorded for dog barking since barking occurred for less than 10% of the time. These recorded levels are approximately 5 dB higher than those from the 2021 short-term measurements and as such, the sound power level has been adjusted accordingly as per *Table 4-3*. Note outside of this 15-minute period, the next worst-case was 48 dB L_{Amax} and 45 dB L_{A1}, which more closely aligns with the 2021 measurements, meaning the use of the *Table 4-3* sound power level is considered conservative.

Table 4-3 Hatch Court 2023 Determined Sound Power Level, dB(A)

Description	Octave Band Centre Frequency (Hz)								Overall
	63	125	250	500	1k	2k	4k	8k	
2021 Hatch Court Dog Barking – L_{A1}	81	85	96	113	103	87	71	63	**114**

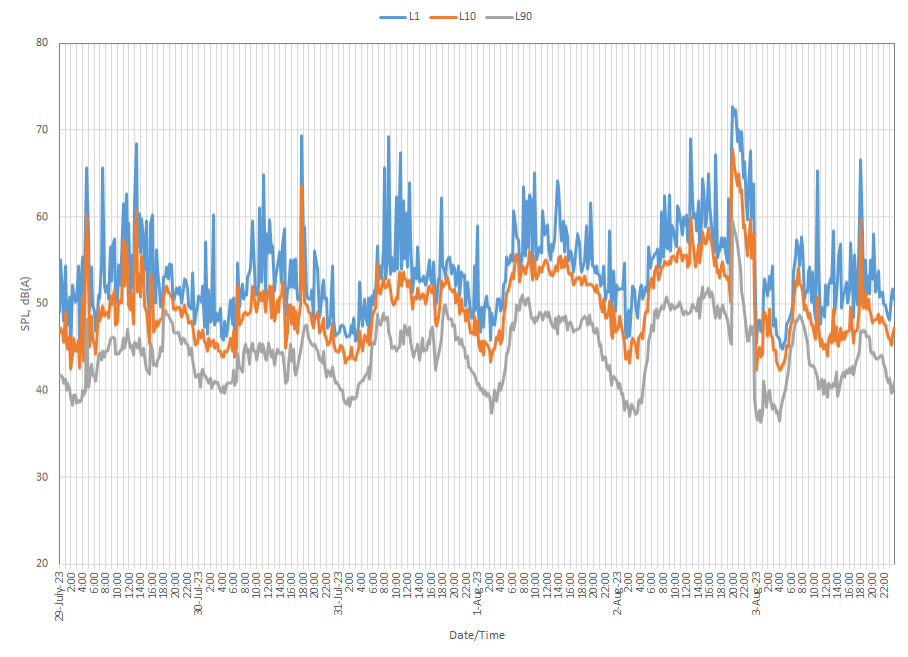


Figure 4-9 Long Term Monitoring at 30 Balinnup Road (2023)

4.2.3 Matison Street Analysis – Short Term (2021)

The audio files at this location were also reviewed. The position of the logger is around 70 metres from Ranford Road and is significantly influenced by road traffic noise. Bird noise is also significant at this location. From the audio files, it is apparent that dog barking noise is more continuous in this area. Whilst the dog barking noise is audible, it is generally not at a level that allows it to be accurately quantified. For instance, the background noise is generally around 45-47 dB(A) and does not change when barking occurs, despite the noise being audible. This indicates that barking noise is below the overall background noise level. Unlike Hatch Court, there were no distinct maximum noise events but rather just distant and much more persistent barking, most likely because of the number of kennels and that they are shielded by buildings to the logger location (and subject site).

As a clean signal could not be obtained from the measurements, the same spectra determined in *Section 4.2.1* has been used. It has then been reduced to an overall level of 101 dB(A) (refer *Table 3-4*), representing an L_{A10} level in this case since dog barking occurs more frequently. This results in a noise level of 45 dB L_{A10} at the Matison Street logger.

4.2.4 Matison Street Analysis – Long Term (2023)

The noise logger on this occasion was set-up further from Ranford Road, in an attempt to minimise road traffic noise, whilst still recording noise in the general direction of the proposed subdivision, with the 15-minute data of all recorded noise provided in *Figure 4-10*.

Reviewing the audio files, road traffic noise still dominates the noise levels in the area and by 6.00am, even on a Sunday, there was too much traffic noise to be able to quantify dog barking noise. The influence of road traffic noise is evident by the day/night trend shown on the logger results. For the Hatch Court logger, with dog barking being infrequent, the barking was extracted from the data set. For this area, the barking is far more consistent, such that data that is influenced by vehicles passing was extracted, with the focus being between 5.00am and 6.00am, as the only period where dog barking was persistent and road traffic was relatively intermittent.

Finding the worst-case 15-minute period, results in noise levels of 53 dB L_{Amax}, 50 dB L_{A1} and 45 dB L_{A10}. Again with relatively small differences between the three parameters, it will be the L_{A10} that determines compliance. The result of 45 dB L_{A10} aligns with that previously used from the 2021 analysis and is therefore unchanged.

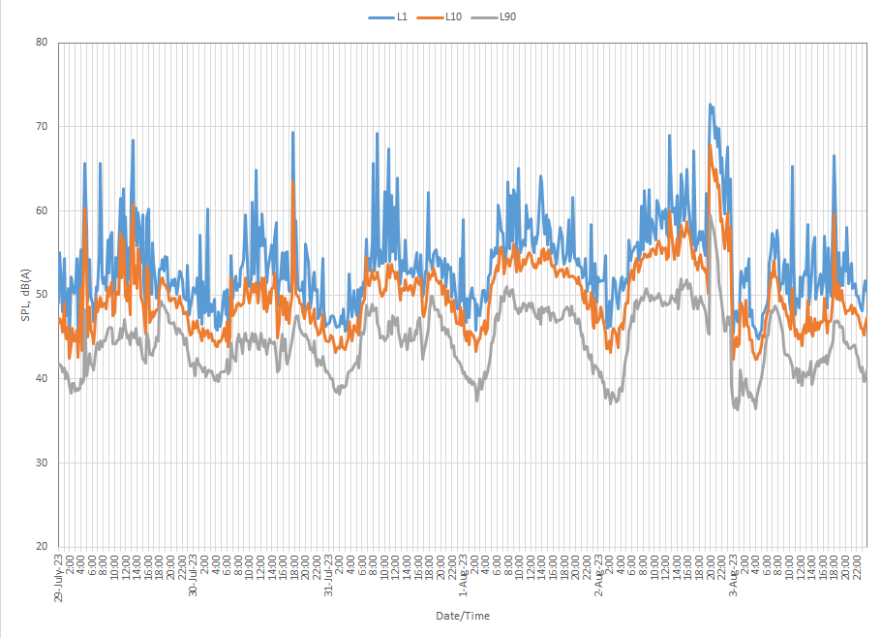


Figure 4-10 Long Term Monitoring at Matison Street (2023)

4.2.5 Hatch Court Noise Modelling

The results from the Hatch Court kennel area are presented as noise contours in *Figure 4-11* and *Figure 4-12*, being for the ground and upper floor levels respectively. Also shown on the contour plots are the lines defining the different areas of assigned noise level, depending on a residences proximity to Ranford Road (refer *Table 2-4*).

As discussed in *Section 4.2.1*, intrusive characteristics are not considered present at the proposed subdivision in accordance with the Regulations and as such, no penalties are considered applicable. This is based on the measurements, the background noise levels and the separation distance. However, the local government commented tonality and impulsiveness should be applied. In past projects (Heron Park and Piara Waters), tonality has been applied to L_{A10} and L_{A1} levels. Impulsiveness has been applied to L_{Amax} levels, however in this project L_{Amax} is less critical for compliance. As such, to be consistent with other approved subdivisions, predicted L_{A1} and L_{A10} noise levels are to be adjusted by 5 dB for tonality.

For those residences within 100 metres of Ranford Road, the most stringent assigned noise level is 51 dB L_{A1}. This reduces to 47 dB L_{A1} for those residences within 450 metres of Ranford Road (and greater than 100 metres). Where a residence is more than 450 metres from Ranford Road, the assigned noise level is 45 dB L_{A1}.

Noise control is to be in the form of notifications on title and architectural packages. For consistency, those used for road traffic have been adopted, although it is noted these are more effective for barking noise than road traffic as there is less low frequency noise as follows:

- Within 5 dB of the assigned level (thereby allowing for tonal penalty) – Package A;
- Up to 5 dB above the assigned level – Package B;
- More than 10 dB above the assigned level – Package C.

The above are noted in *Figure 4-15* and *Figure 4-16* after being combined with the City of Gosnells kennel zone impacts and were defined as:

- Southwest of the blue line the assigned level is 45 dB L_{A1}. Allowing for tonality, lots where noise contours are between 40 dB L_{A1} and 45 dB L_{A1} are to incorporate Package A, which would be all houses in this area.
- Between the blue line and the brown line, the assigned level is 47 dB L_{A1}. Allowing for tonality, lots where noise contours are between 42 dB L_{A1} and 47 dB L_{A1} are to incorporate Package A.
- Northeast of the brown line, the assigned level is 51 dB L_{A1}. Allowing for tonality, lots where noise contours are between 46 dB L_{A1} and 51 dB L_{A1} would need to incorporate Package A. From *Figure 4-11* and *Figure 4-12*, this does not occur in this area, although it is noted that such a package is applied in any case for road traffic.

4.2.6 Matison Street Noise Modelling

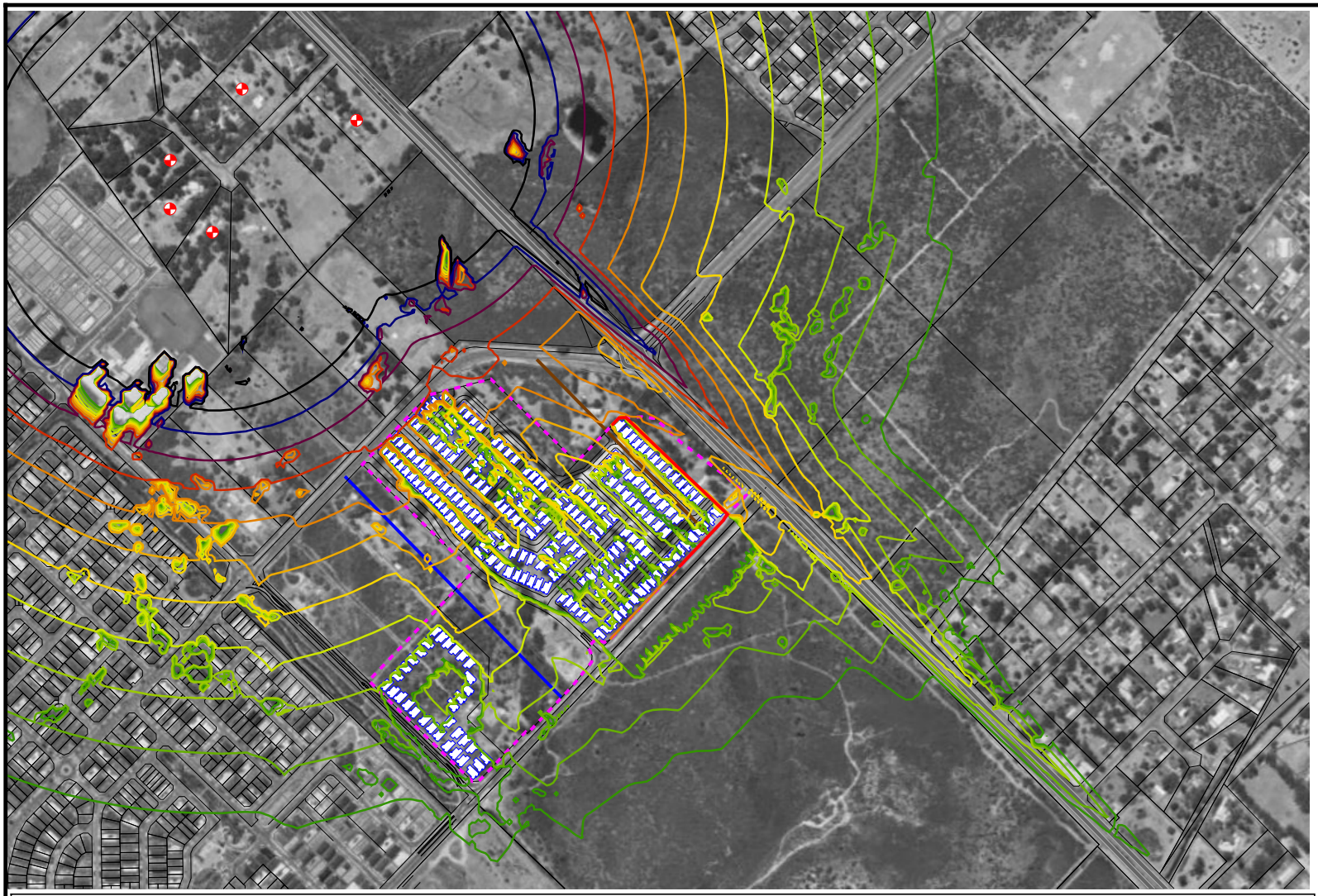
The noise modelling results from the kennel area in City of Gosnells, east of Matison Street are presented as noise contours in *Figure 4-13* and *Figure 4-14*, being for the ground and upper floor levels respectively. Again the contour plots include the lines defining the different areas of assigned noise level, depending on a residences proximity to Ranford Road (refer *Table 2-4*).

For those residences within 100 metres of Ranford Road, the most stringent assigned noise level is 41 dB L_{A10}. This reduces to 37 dB L_{A10} for those residences within 450 metres of Ranford Road (and greater than 100 metres). Where a residence is more than 450 metres from Ranford Road, the assigned noise level is 35 dB L_{A10}. As discussed in *Section 4.2.5*, the + 5 dB tonality adjustment is to be considered.

The above are noted in *Figure 4-15* and *Figure 4-16* after being combined with the Hatch Court kennel impacts and were defined as:

- Southwest of the blue line the assigned level is 35 dB L_{A10}. Allowing for tonality, lots where noise contours are between 30 dB L_{A10} and 35 dB L_{A10} are to incorporate Package A, which would not apply to any of these houses, although it is noted Package A would be implemented due to Hatch Court.
- Between the blue line and the brown line, the assigned level is 37 dB L_{A10}. Allowing for tonality, lots where noise contours are between 32 dB L_{A10} and 37 dB L_{A10} are to incorporate Package A.
- Northeast of the brown line, the assigned level is 41 dB L_{A10}. Allowing for tonality, lots where noise contours are between 36 dB L_{A10} and 41 dB L_{A10} would need to incorporate Package A, noting this is required for road traffic noise in any case.

Figure 4-11



Noise levels
L_{A1}, dB

= 40.0
= 41.0
= 42.0
= 43.0
= 44.0
= 45.0
= 46.0
= 47.0
= 48.0
= 49.0
= 50.0

Signs and symbols

- Ranford Road
- Indicative Building
- Std Fence
- Noise Wall
- Subject Site
- 100m to Ranford
- 450m to Ranford
- Active Kennel License

N

Length Scale 1:10000

0 50 100 200 300 400 m

Proposed Subdivision Harrisdale -
Hatch Court Dog Kennel Noise - L_{A1} to Ground Floor

Includes Fence and Wall for Road Traffic Mitigation

SoundPLAN v8.2
CONCAWE Algorithms - 3m/s Winds and Temperature Inversion

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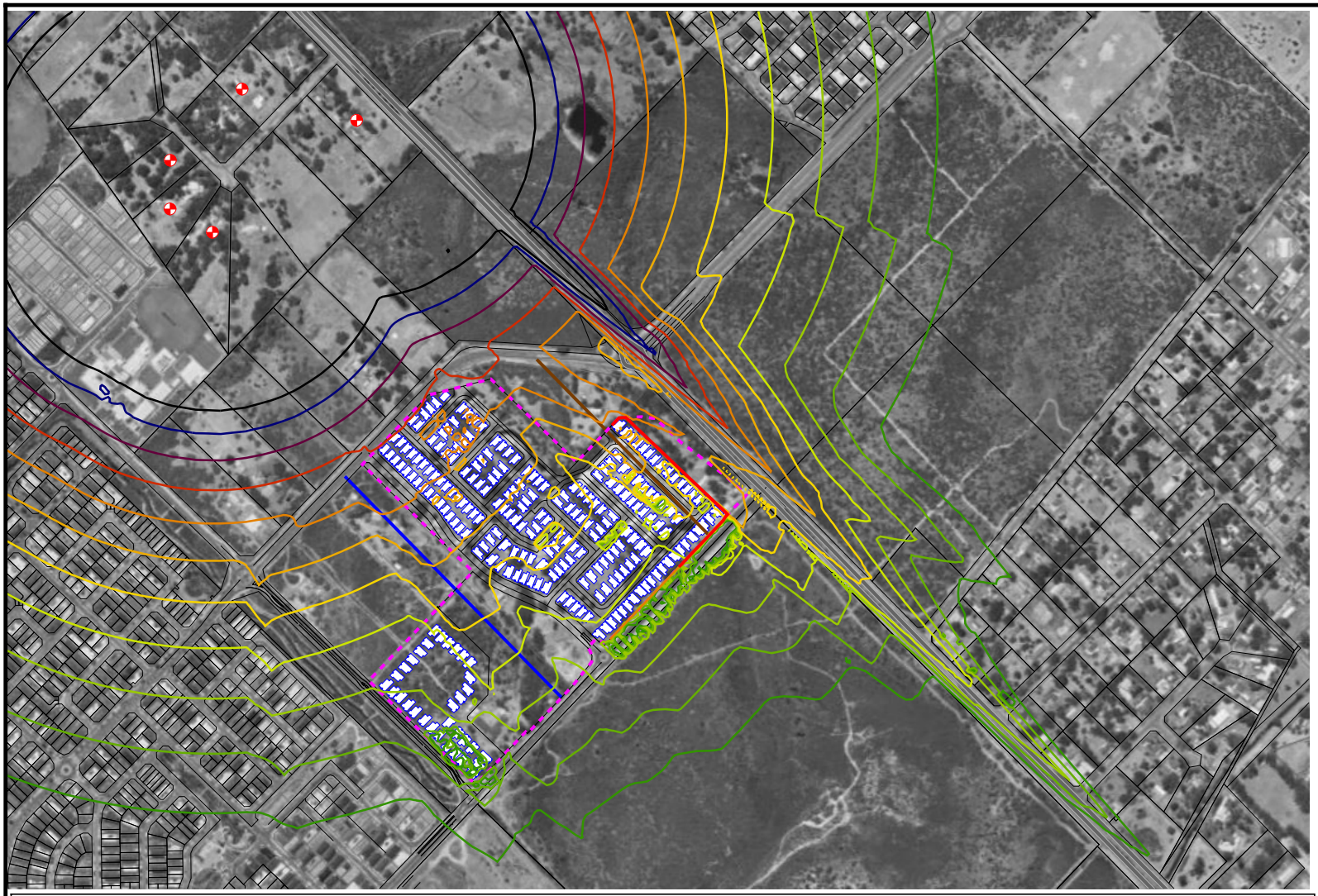
Figure 4-12



Noise levels
L_{A1}, dB

= 40.0
= 41.0
= 42.0
= 43.0
= 44.0
= 45.0
= 46.0
= 47.0
= 48.0
= 49.0
= 50.0

Signs and symbols

- Ranford Road
- Indicative Building
- Std Fence
- Noise Wall
- Subject Site
- 100m to Ranford
- 450m to Ranford
- Active Kennel License

N

Length Scale 1:10000

0 50 100 200 300 400 m

Proposed Subdivision Harrisdale -
Hatch Court Dog Kennel Noise - L_{A1} to Upper Floor

Includes Fence and Wall for Road Traffic Mitigation

SoundPLAN v8.2
CONCAWE Algorithms - 3m/s Winds and Temperature Inversion

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Figure 4-13

Noise levels
L_{A10}, dB

= 30.0
= 31.0
= 32.0
= 33.0
= 34.0
= 35.0
= 36.0
= 37.0
= 38.0
= 39.0
= 40.0

Signs and symbols

- Ranford Road
- Indicative Building
- Std Fence
- Noise Wall
- Subject Site
- 100m to Ranford
- 450m to Ranford
- Active Kennel License

N

Length Scale 1:10000

0 50 100 200 300 400 m

Proposed Subdivision Harrisdale -
Gosnells Dog Kennel Noise - L_{A10} to Ground Floor

Includes Fence and Wall for Road Traffic Mitigation

SoundPLAN v8.2
CONCAWE Algorithms - 3m/s Winds and Temperature Inversion

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Figure 4-14

Noise levels
L_{A10}, dB

= 30.0
= 31.0
= 32.0
= 33.0
= 34.0
= 35.0
= 36.0
= 37.0
= 38.0
= 39.0
= 40.0

Signs and symbols

- Ranford Road
- Indicative Building
- Std Fence
- Noise Wall
- Subject Site
- 100m to Ranford
- 450m to Ranford
- Active Kennel License

N

Length Scale 1:10000

0 50 100 200 300 400 m

Proposed Subdivision Harrisdale -
Gosnells Dog Kennel Noise - L_{A10} to Upper Floor

Includes Fence and Wall for Road Traffic Mitigation

SoundPLAN v8.2
CONCAWE Algorithms - 3m/s Winds and Temperature Inversion

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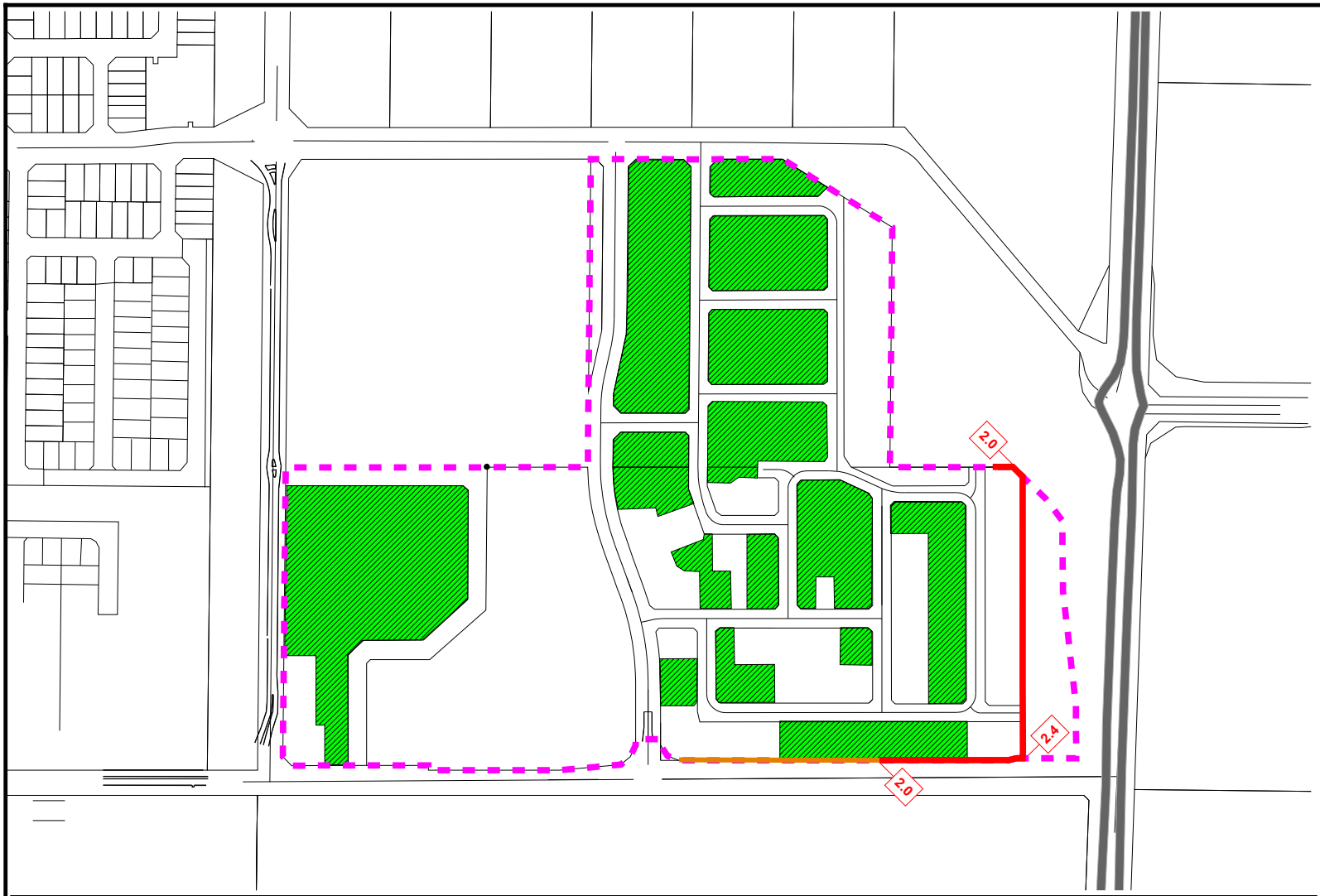
Figure 4-15



Signs and symbols
- Ranford Road
- Std Fence
- Noise Wall
- Subject Site
- Package A
- Package B
- Package C

Proposed Subdivision Harrisdale -
Kennel Mitigation Requirements - Ground Floor (With Wall)

Includes Fence and Wall for Road Traffic Mitigation (Read Left to Right Down to Up)

SoundPLAN v8.2
CONCAWE Algorithms

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Length Scale 1:5000

0 25 50 100 150 200 m

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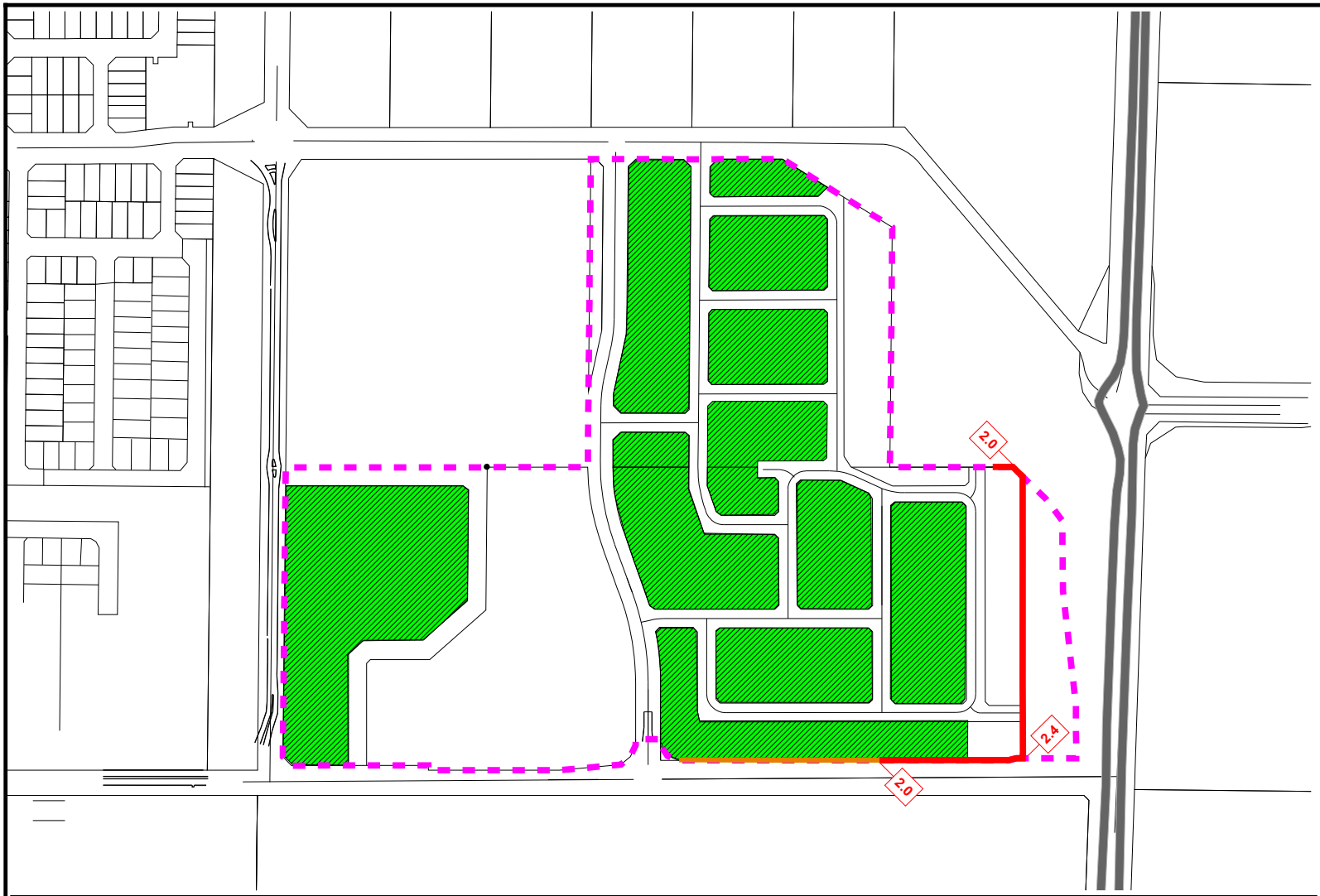
Figure 4-16



Signs and symbols

- Ranford Road
- Std Fence
- Noise Wall
- Subject Site
- Package A
- Package B
- Package C

Proposed Subdivision Harrisdale -
Kennel Mitigation Requirements - Upper Floor (With Wall)

Includes Fence and Wall for Road Traffic Mitigation (Read Left to Right Down to Up)

SoundPLAN v8.2
CONCAWE Algorithms

16 Aug 2023

Length Scale 1:5000

0 25 50 100 150 200 m

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5 CONCLUSION

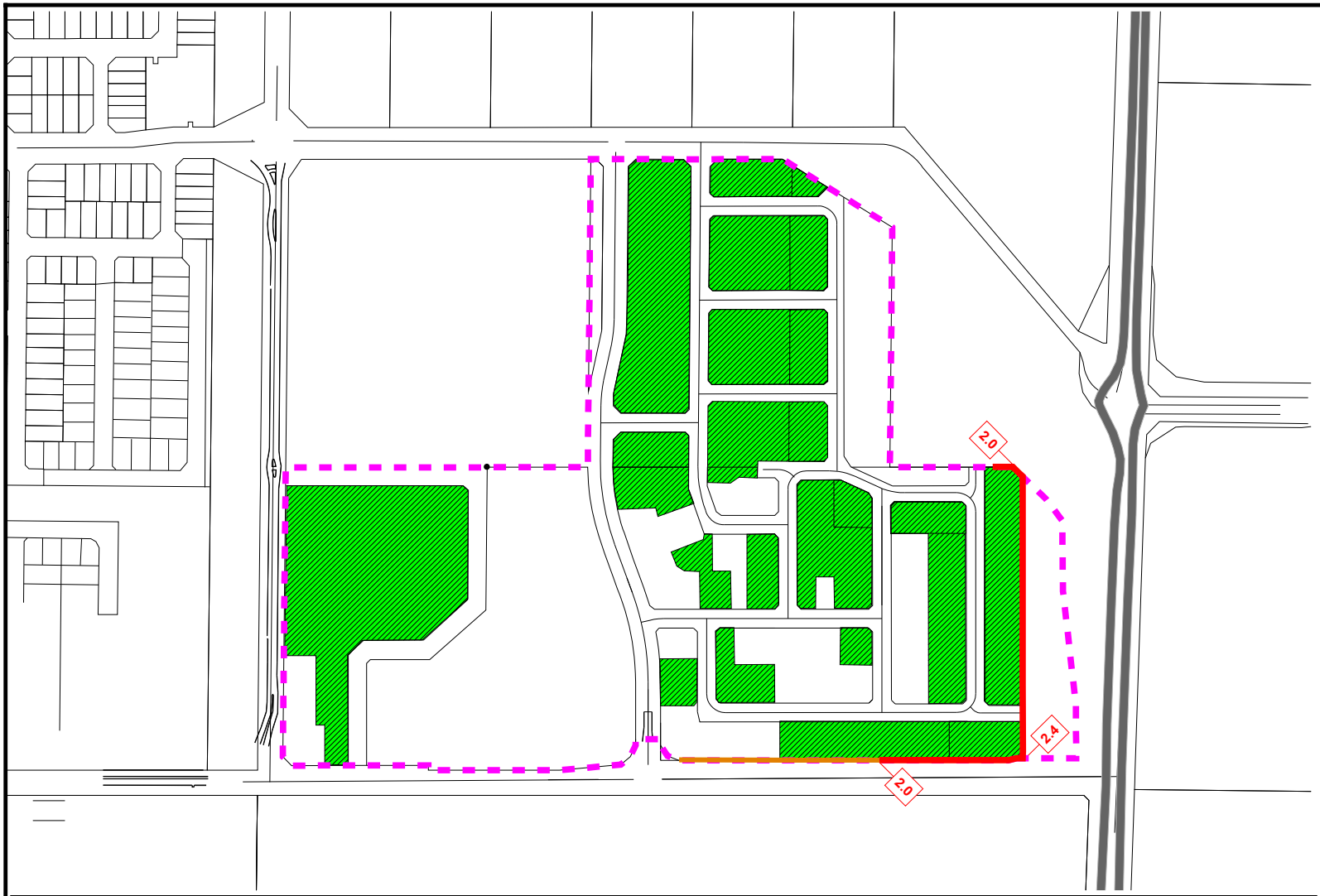
This report has been prepared to consider noise impacts from road traffic and dog kennels to the proposed subdivision, bound by Ranford Road, Balannup Road, Reilly Road and Skeet Road in Harrisdale. The outcomes of the study are:

- Construct a noise wall as shown in *Figure 5-1*. The noise wall is to be solid, free of gaps and of minimum surface mass 15 kg/m^2. The wall ranges in height from 2.0m to 2.4m (relative to finished lot level). A portion of standard fencing is also required along Skeet Road.
- Dwellings are to incorporate architectural packages (refer *Appendix A*) as shown on *Figure 5-1* and *Figure 5-2* for ground and upper floors respectively, noting these combine the requirements for both noise sources.

  Alternative constructions from the deemed to satisfy packages may be acceptable if supported by a report undertaken by a suitably qualified acoustical consultant (member firm of the Association of Australasian Acoustical Consultants (AAAC)), once the lots specific building plans are available.

- All lots affected by road traffic are to have notifications on lot titles as per SPP 5.4 requirements – refer *Appendix A*.
- All lots within the development are to have notifications on lot titles advising of the potential for dog barking noise.

Figure 5-1



Signs and symbols
- Ranford Road
- Std Fence
- Noise Wall
- Subject Site
- Package A
- Package B
- Package C

Proposed Subdivision Harrisdale -
Combined Mitigation Requirements - Ground Floor (With Wall)

Includes Fence and Wall for Road Traffic Mitigation (Read Left to Right Down to Up)

SoundPLAN v8.2

16 Aug 2023

Length Scale 1:5000

0 25 50 100 150 200 m

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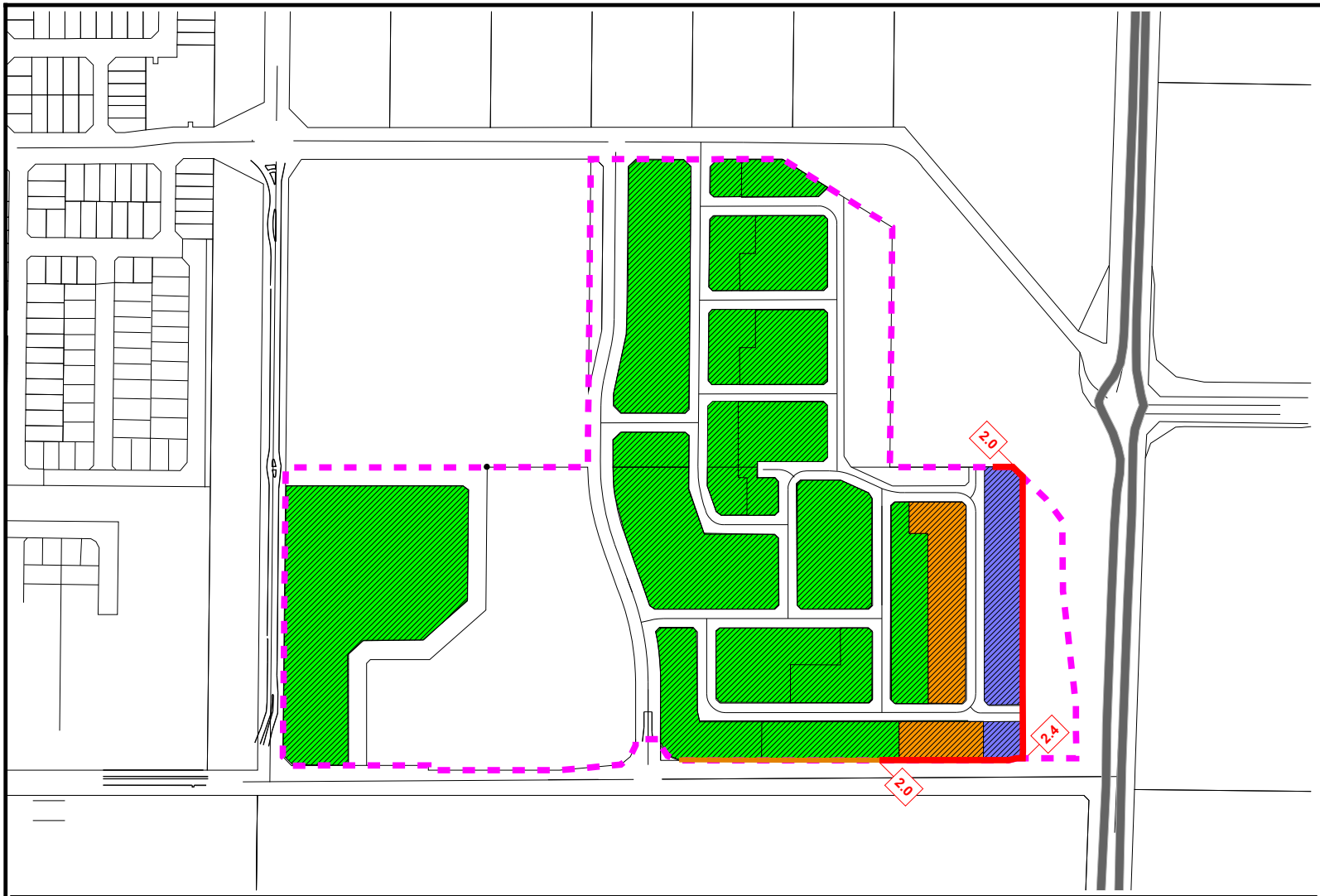
Figure 5-2



Signs and symbols

- Ranford Road
- Std Fence
- Noise Wall
- Subject Site
- Package A
- Package B
- Package C

Proposed Subdivision Harrisdale -
Combined Mitigation Requirements - Upper Floor (With Wall)

Includes Fence and Wall for Road Traffic Mitigation (Read Left to Right Down to Up)

SoundPLAN v8.2

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Length Scale 1:5000

0 25 50 100 150 200 m

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Appendix A

Quiet House Packages

The packages and information provided on the following pages are taken from *Road and Rail Noise Guidelines* (September 2019).

Where outdoor and indoor noise levels received by a noise-sensitive land-use and/or development exceed the policy's noise target, implementation of quiet house requirements is an acceptable solution.

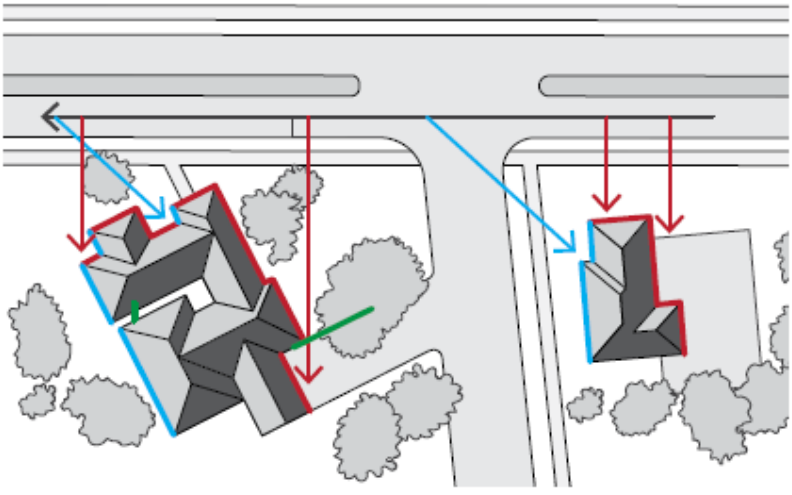
The quiet house packages are not the only solution to achieving acceptable internal transport noise levels. A suitably qualified acoustical engineer or consultant may also determine more tailored acoustic design requirements for buildings in a transport noise corridor by carrying out acoustic design in accordance with relevant industry standards. This includes the need to meet the relevant design targets specified in AS/NZS 2107:2016 for road traffic noise.

With regards to the packages, the following definitions are provided:

- **Facing** the transport corridor (red): Any part of a building façade is 'facing' the transport corridor if any straight line drawn perpendicular (at a 90 degree angle) to its nearest road lane or railway line intersects that part of the façade without obstruction (ignoring any fence).

- **Side-on** to transport corridor (blue): Any part of a building façade that is not 'facing' is 'side-on' to the transport corridor if any straight line, at any angle, can be drawn from it to intersect the nearest road lane or railway line without obstruction (ignoring any fence).

- **Opposite** to transport corridor (green): Neither 'side on' nor 'facing', as defined above.



Quiet House Package A

Element	Orientation	Room	
		Bedroom	**Indoor Living and Work Areas**
External Windows	Facing	• Up to 40% floor area ($R_w + C_{tr} \geq 28$): ○ Sliding or double hung with minimum 10mm single or 6mm-12mm-10mm double insulated glazing; ○ Sealed awning or casement windows with minimum 6mm glass. • Up to 60% floor area ($R_w + C_{tr} \geq 31$): ○ Sealed awning or casement windows with minimum 6mm glass.	• Up to 40% floor area ($R_w + C_{tr} \geq 25$): ○ Sliding or double hung with minimum 6mm single or 6mm-12mm-6mm double insulated glazing; • Up to 60% floor area ($R_w + C_{tr} \geq 28$); • Up to 80% floor area ($R_w + C_{tr} \geq 31$).
	Side On	As above, except $R_w + C_{tr}$ values may be 3 dB less or max % area increased by 20%.	
	Opposite	No specific requirements	
External Doors	Facing	• Fully glazed hinged door with certified $R_w + C_{tr} \geq 28$ rated door and frame including seals and 6mm glass.	• Doors to achieve $R_w + C_{tr} \geq 25$: ○ 35mm Solid timber core hinged door and frame system certified to R_w 28 including seals; ○ Glazed sliding door with 10mm glass and weather seals.
	Side On	As above, except $R_w + C_{tr}$ values may be 3 dB less.	
	Opposite	No specific requirements	
External Walls	All	• $R_w + C_{tr} \geq 45$: ○ Two leaves of 90mm thick clay brick masonry with minimum 20mm cavity; or ○ Single leaf of 150mm brick masonry with 13mm cement render on each face; or ○ One row of 92mm studs at 600mm centres with: ▪ Resilient steel channels fixed to the outside of the studs; and ▪ 9.5mm hardboard or fibre cement sheeting or 11mm fibre cement weatherboards fixed to the outside; ▪ 75mm thick mineral wool insulation with a density of at least 11kgkg/m^3; and ▪ 2 x 16mm fire-rated plasterboard to inside.	
Roofs and Ceilings	All	• $R_w + C_{tr} \geq 35$: ○ Concrete or terracotta tile or metal sheet roof with sarking and at least 10mm plasterboard.	

Quiet House Package B

Element	Orientation	Room	
		Bedroom	**Indoor Living and Work Areas**
External Windows	Facing	• Up to 40% floor area ($R_w + C_{tr} \geq 31$): ○ Fixed sash, awning or casement with minimum 6mm glass or 6mm-12mm-6mm double insulated glazing. • Up to 60% floor area ($R_w + C_{tr} \geq 34$): ○ Fixed sash, awning or casement with minimum 10mm glass or 6mm-12mm-10mm double insulated glazing.	• Up to 40% floor area ($R_w + C_{tr} \geq 28$): ○ Sliding or double hung with 6mm-12mm-10mm double insulated glazing; ○ Sealed awning or casement windows with minimum 6mm glass. • Up to 60% floor area ($R_w + C_{tr} \geq 31$); • Up to 80% floor area ($R_w + C_{tr} \geq 34$).
	Side On	As above, except $R_w + C_{tr}$ values may be 3 dB less or max % area increased by 20%.	
	Opposite	As above, except $R_w + C_{tr}$ values may be 6 dB less or max % area increased by 20%.	
External Doors	Facing	• Fully glazed hinged door with certified $R_w + C_{tr} \geq 31$ rated door and frame including seals and 10mm glass.	• Doors to achieve $R_w + C_{tr} \geq 28$: ○ 40mm Solid timber core hinged door and frame system certified to R_w 32 including seals; ○ Fully glazed hinged door with certified $R_w + C_{tr} \geq 28$ rated door and frame including seals and 6mm glass.
	Side On	As above, except $R_w + C_{tr}$ values may be 3 dB less or max % area increased by 20%.	
	Opposite	As above, except $R_w + C_{tr}$ values may be 6 dB less or max % area increased by 20%.	
External Walls	All	• $R_w + C_{tr} \geq 50$: ○ Two leaves of 90mm thick clay brick masonry with minimum 50mm cavity between leaves and 25mm glasswool or polyester (24kg/m³). Resilient ties used where required to connect leaves. ○ Two leaves of 110mm clay brick masonry with minimum 50mm cavity between leaves and 25mm glasswool or polyester insulation (24kg/m³). ○ Single leaf of 220mm brick masonry with 13mm cement render on each face. ○ 150mm thick unlined concrete panel or 200mm thick concrete panel with one layer of 13mm plasterboard or 13mm cement render on each face. ○ Single leaf of 90mm clay brick masonry with: ▪ A row of 70mm x 35mm timber studs or 64mm steel studs at 600mm centres; ▪ A cavity of 25mm between leaves; ▪ 50mm glasswool or polyester insulation (11kg/m³) between studs; and ▪ One layer of 10mm plasterboard fixed to the inside face.	
Roofs and Ceilings	All	• $R_w + C_{tr} \geq 35$: ○ Concrete or terracotta tile or metal sheet roof with sarking and at least 10mm plasterboard ceiling with R3.0+ fibrous insulation.	

Quiet House Package C

Element	Orientation	Room	
		Bedroom	**Indoor Living and Work Areas**
External Windows	Facing	• Up to 20% floor area ($R_w + C_{tr} \geq 31$): ○ Fixed sash, awning or casement with minimum 6mm glass or 6mm-12mm-6mm double insulated glazing. • Up to 40% floor area ($R_w + C_{tr} \geq 34$): ○ Fixed sash, awning or casement with minimum 10mm glass or 6mm-12mm-10mm double insulated glazing.	• Up to 40% floor area ($R_w + C_{tr} \geq 31$): ○ Fixed sash, awning or casement with minimum 6mm glass or 6mm-12mm-6mm double insulated glazing. • Up to 60% floor area ($R_w + C_{tr} \geq 34$): ○ Fixed sash, awning or casement with minimum 10mm glass or 6mm-12mm-10mm double insulated glazing.
	Side On	As above, except $R_w + C_{tr}$ values may be 3 dB less or max % area increased by 20%.	
	Opposite	As above, except $R_w + C_{tr}$ values may be 6 dB less or max % area increased by 20%.	
External Doors	Facing	• Not recommended.	• Doors to achieve $R_w + C_{tr} \geq 30$: ○ Fully glazed hinged door with certified $R_w + C_{tr} \geq 31$ rated door and frame including seals and 10mm glass; ○ 40mm Solid timber core side hinged door, frame and seal system certified to R_w 32 including seals. Any glass inserts to be minimum 6mm.
	Side On	As above, except $R_w + C_{tr}$ values may be 3 dB less or max % area increased by 20%.	
	Opposite	As above, except $R_w + C_{tr}$ values may be 6 dB less or max % area increased by 20%.	
External Walls	All	• $R_w + C_{tr} \geq 50$: ○ Two leaves of 90mm thick clay brick masonry with minimum 50mm cavity between leaves and 25mm glasswool or polyester insulation (24kg/m³). Resilient ties used where required to connect leaves. ○ Two leaves of 110mm clay brick masonry with minimum 50mm cavity between leaves and 25mm glasswool or polyester insulation (24kg/m³). ○ Single leaf of 220mm brick masonry with 13mm cement render on each face. ○ 150mm thick unlined concrete panel or 200mm thick concrete panel with one layer of 13mm plasterboard or 13mm cement render on each face. ○ Single leaf of 90mm clay brick masonry with: ▪ A row of 70mm x 35mm timber studs or 64mm steel studs at 600mm centres; ▪ A cavity of 25mm between leaves; ▪ 50mm glasswool or polyester insulation (11kg/m³) between studs; and ▪ One layer of 10mm plasterboard fixed to the inside face.	
Roofs and Ceilings	All	• $R_w + C_{tr} \geq 40$: ○ Concrete or terracotta tile roof with sarking, or metal sheet roof with foil backed R2.0+ fibrous insulation between steel sheeting and roof battens; ○ R3.0+ insulation batts above ceiling; ○ 2 x 10mm plasterboard ceiling or 1 x 13mm sound-rated plasterboard affixed using steel furring channel to ceiling rafters.	

Mechanical Ventilation requirements

In implementing the acceptable treatment packages, the following mechanical ventilation / air-conditioning considerations are required:

- Acoustically rated openings and ductwork to provide a minimum sound reduction performance of R_w 40 dB into sensitive spaces;
- Evaporative systems require attenuated ceiling air vents to allow closed windows;
- Refrigerant based systems need to be designed to achieve National Construction Code fresh air ventilation requirements;
- Openings such as eaves, vents and air inlets must be acoustically treated, closed or relocated to building sides facing away from the corridor where practicable.

Notification

Notifications on title advise prospective purchasers of the potential for noise impacts from major transport corridors and help with managing expectations.

The Notification is to state as follows:

This lot is in the vicinity of a transport corridor and is affected, or may in the future be affected, by road and rail transport noise. Road and rail transport noise levels may rise or fall over time depending on the type and volume of traffic.

Appendix B

Terminology

The following is an explanation of the terminology used throughout this report.

Decibel (dB)

The decibel is the unit that describes the sound pressure and sound power levels of a noise source. It is a logarithmic scale referenced to the threshold of hearing.

A-Weighting

An A-weighted noise level has been filtered in such a way as to represent the way in which the human ear perceives sound. This weighting reflects the fact that the human ear is not as sensitive to lower frequencies as it is to higher frequencies. An A-weighted sound level is described as L_A dB.

Sound Power Level (L_w)

Under normal conditions, a given sound source will radiate the same amount of energy, irrespective of its surroundings, being the sound power level. This is similar to a 1kW electric heater always radiating 1kW of heat. The sound power level of a noise source cannot be directly measured using a sound level meter but is calculated based on measured sound pressure levels at known distances. Noise modelling incorporates source sound power levels as part of the input data.

Sound Pressure Level (L_p)

The sound pressure level of a noise source is dependent upon its surroundings, being influenced by distance, ground absorption, topography, meteorological conditions etc and is what the human ear actually hears. Using the electric heater analogy above, the heat will vary depending upon where the heater is located, just as the sound pressure level will vary depending on the surroundings. Noise modelling predicts the sound pressure level from the sound power levels taking into account ground absorption, barrier effects, distance etc.

L_{ASlow}

This is the noise level in decibels, obtained using the A frequency weighting and the S (Slow) time weighting as specified in IEC 61672-1:2002. Unless assessing modulation, all measurements use the slow time weighting characteristic.

L_{AFast}

This is the noise level in decibels, obtained using the A frequency weighting and the F (Fast) time weighting as specified in IEC 61672-1:2002. This is used when assessing the presence of modulation only.

L_{APeak}

This is the greatest absolute instantaneous sound pressure in decibels using the A frequency weighting as specified in IEC 61672-1:2002.

L_{Amax}

An L_{Amax} level is the maximum A-weighted noise level during a particular measurement.

L_{A1}

An L_{A1} level is the A-weighted noise level which is exceeded for one percent of the measurement period and is considered to represent the average of the maximum noise levels measured.

L_{A10}

An L_{A10} level is the A-weighted noise level which is exceeded for 10 percent of the measurement period and is considered to represent the "*intrusive*" noise level.

L_{Aeq}
The equivalent steady state A-weighted sound level ("equal energy") in decibels which, in a specified time period, contains the same acoustic energy as the time-varying level during the same period. It is considered to represent the "average" noise level.

L_{A90}
An L_{A90} level is the A-weighted noise level which is exceeded for 90 percent of the measurement period and is considered to represent the "*background*" noise level.

One-Third-Octave Band
Means a band of frequencies spanning one-third of an octave and having a centre frequency between 25 Hz and 20 000 Hz inclusive.

L_{Amax} assigned level
Means an assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded at any time.

L_{A1} assigned level
Means an assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded for more than 1% of the representative assessment period.

L_{A10} assigned level
Means an assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded for more than 10% of the representative assessment period.

Tonal Noise
A tonal noise source can be described as a source that has a distinctive noise emission in one or more frequencies. An example would be whining or droning. The quantitative definition of tonality is:

the presence in the noise emission of tonal characteristics where the difference between -

(a) the A-weighted sound pressure level in any one-third octave band; and

(b) the arithmetic average of the A-weighted sound pressure levels in the 2 adjacent one-third octave bands,

is greater than 3 dB when the sound pressure levels are determined as $L_{Aeq,T}$ levels where the time period T is greater than 10% of the representative assessment period, or greater than 8 dB at any time when the sound pressure levels are determined as $L_{A\ Slow}$ levels.

This is relatively common in most noise sources.

Modulating Noise
A modulating source is regular, cyclic and audible and is present for at least 10% of the measurement period. The quantitative definition of modulation is:

a variation in the emission of noise that —

(a) is more than 3 dB $L_{A\ Fast}$ or is more than 3 dB $L_{A\ Fast}$ in any one-third octave band;

(b) is present for at least 10% of the representative.

Impulsive Noise
An impulsive noise source has a short-term banging, clunking or explosive sound. The quantitative definition of impulsiveness is:

a variation in the emission of a noise where the difference between $L_{A\ peak}$ and $L_{A\ Max\ slow}$ is more than 15 dB when determined for a single representative event;

Major Road
Is a road with an estimated average daily traffic count of more than 15,000 vehicles.

Secondary / Minor Road
Is a road with an estimated average daily traffic count of between 6,000 and 15,000 vehicles.

Influencing Factor (IF)

$$= \frac{1}{10}(\%\ \text{Type A}_{100} + \%\ \text{Type A}_{450}) + \frac{1}{20}(\%\ \text{Type B}_{100} + \%\ \text{Type B}_{450})$$

where:

$\%\ \text{Type A}_{100}$ = the percentage of industrial land within a100m radius of the premises receiving the noise

$\%\text{TypeA}_{450}$ = the percentage of industrial land within a 450m radius of the premises receiving the noise

$\%\ \text{Type B}_{100}$ = the percentage of commercial land within a100m radius of the premises receiving the noise

$\%\text{TypeB}_{450}$ = the percentage of commercial land within a 450m radius of the premises receiving the noise

+ Traffic Factor (maximum of 6 dB)
= 2 for each secondary road within 100m
= 2 for each major road within 450m
= 6 for each major road within 100m

Representative Assessment Period
Means a period of time not less than 15 minutes, and not exceeding four hours, determined by an inspector or authorised person to be appropriate for the assessment of a noise emission, having regard to the type and nature of the noise emission.

Background Noise
Background noise or residual noise is the noise level from sources other than the source of concern. When measuring environmental noise, residual sound is often a problem. One reason is that regulations often require that the noise from different types of sources be dealt with separately. This separation, e.g. of traffic noise from industrial noise, is often difficult to accomplish in practice. Another reason is that the measurements are normally carried out outdoors. Wind-induced noise, directly on the microphone and indirectly on trees, buildings, etc., may also affect the result. The character of these noise sources can make it difficult or even impossible to carry out any corrections.

Ambient Noise
Means the level of noise from all sources, including background noise from near and far and the source of interest.

Specific Noise
Relates to the component of the ambient noise that is of interest. This can be referred to as the noise of concern or the noise of interest.

$L_{A10,18hour}$
The $L_{A10,18\ hour}$ level is the arithmetic average of the hourly L_{A10} levels between 6.00 am and midnight. The *CoRTN* algorithms were developed to calculate this parameter.

$L_{Aeq,24hour}$
The $L_{Aeq,24\ hour}$ level is the logarithmic average of the hourly L_{Aeq} levels for a full day (from midnight to midnight).

$L_{Aeq,8hour}$ / $L_{Aeq\ (Night)}$
The $L_{Aeq\ (Night)}$ level is the logarithmic average of the hourly L_{Aeq} levels from 10.00 pm to 6.00 am on the same day.

$L_{Aeq,16hour}$ / $L_{Aeq\ (Day)}$
The $L_{Aeq\ (Day)}$ level is the logarithmic average of the hourly L_{Aeq} levels from 6.00 am to 10.00 pm on the same day. This value is typically 1-3 dB less than the $L_{A10,18hour}$.

Noise-sensitive land use and/or development
Land-uses or development occupied or designed for occupation or use for residential purposes (including dwellings, residential buildings or short-stay accommodation), caravan park, camping ground, educational establishment, child care premises, hospital, nursing home, corrective institution or place of worship.

About the Term 'Reasonable'
An assessment of reasonableness should demonstrate that efforts have been made to resolve conflicts without comprising on the need to protect noise-sensitive land-use activities. For example, have reasonable efforts been made to design, relocate or vegetate a proposed noise barrier to address community concerns about the noise barrier height? Whether a noise mitigation measure is reasonable might include consideration of:

- The noise reduction benefit provided;
- The number of people protected;
- The relative cost vs benefit of mitigation;
- Road conditions (speed and road surface) significantly differ from noise forecast table assumptions;
- Existing and future noise levels, including changes in noise levels;
- Aesthetic amenity and visual impacts;
- Compatibility with other planning policies;
- Differences between metropolitan and regional situations and whether noise modelling requirements reflect the true nature of transport movements;
- Ability and cost for mobilisation and retrieval of noise monitoring equipment in regional areas;
- Differences between Greenfield and infill development;
- Differences between freight routes and public transport routes and urban corridors;
- The impact on the operational capacity of freight routes;
- The benefits arising from the proposed development;
- Existing or planned strategies to mitigate the noise at source.

About the Term 'Practicable'

'Practicable' considerations for the purposes of the policy normally relate to the engineering aspects of the noise mitigation measures under evaluation. It is defined as "reasonably practicable having regard to, among other things, local conditions and circumstances (including costs) and to the current state of technical knowledge" (*Environmental Protection Act 1986*). These may include:

- Limitations of the different mitigation measures to reduce transport noise;
- Competing planning policies and strategies;
- Safety issues (such as impact on crash zones or restrictions on road vision);
- Topography and site constraints (such as space limitations);
- Engineering and drainage requirements;
- Access requirements (for driveways, pedestrian access and the like);
- Maintenance requirements;
- Bushfire resistance or BAL ratings;
- Suitability of the building for acoustic treatments.

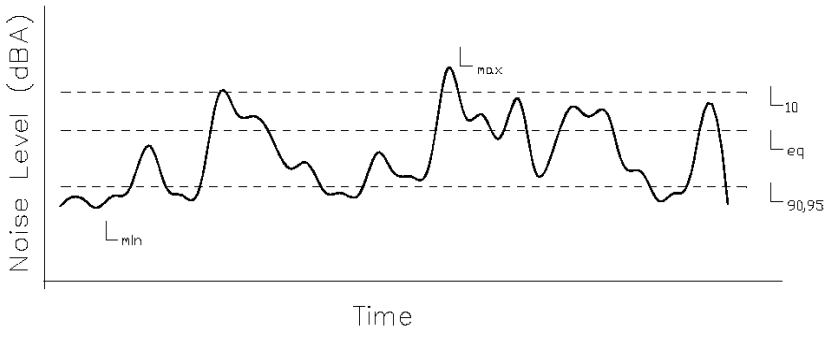
R_w

This is the weighted sound reduction index and is similar to the previously used STC (Sound Transmission Class) value. It is a single number rating determined by moving a grading curve in integral steps against the laboratory measured transmission loss until the sum of the deficiencies at each one-third-octave band, between 100 Hz and 3.15 kHz, does not exceed 32 dB. The higher the R_w value, the better the acoustic performance.

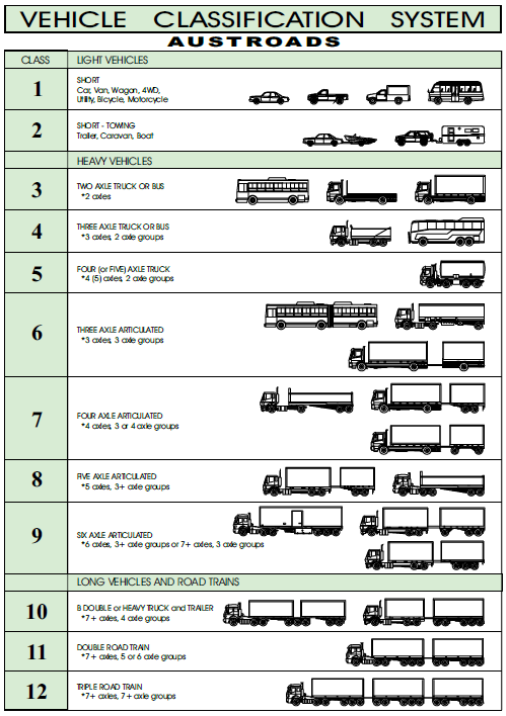
C_{tr}

This is a spectrum adaptation term for airborne noise and provides a correction to the R_w value to suit source sounds with significant low frequency content such as road traffic or home theatre systems. A wall that provides a relatively high level of low frequency attenuation (i.e. masonry) may have a value in the order of –4 dB, whilst a wall with relatively poor attenuation at low frequencies (i.e. stud wall) may have a value in the order of -14 dB.

Chart of Noise Level Descriptors



Austroads Vehicle Class



Typical Noise Levels