

Environmental Noise Assessment - Reception & Private Recreation Centre

295 Karoborup Road, Carabooda

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1. INTRODUCTION

Lloyd George Acoustics was engaged by Dynamic Planning to undertake an environmental noise assessment for a proposed reception and private recreational centre to be located at 295 Karoborup Road, Carabooda - refer *Figure 1-1*.



Figure 1-1: Subject Site Location (Source: DPLH PlanWA)

The development (refer *Appendix A*) consists of:

- An easterly event space for yoga or martial arts;
- A mid-point area with up to 60 patrons and westerly area with up to 40 patrons for recreational events;
- Amplified speakers located on the westerly recreational area oriented back towards the east;
- An approved rum family run production businesses and bed and breakfast;
- 26 parking bays to the west of lot;
- Up to 30 caravans to stay short term on the lot which may incorporate rooftop mounted air conditioners and car doors closing have been allowed for each.

With regard to noise emissions, consideration is given to noise from patrons, amplified speakers, mechanical services including air conditioning units atop caravans and closing car doors at neighbouring properties, against the prescribed standards of the *Environmental Protection (Noise) Regulations 1997*.

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

2. CRITERIA

Environmental noise in Western Australia is governed by the *Environmental Protection Act 1986*, through the *Environmental Protection (Noise) Regulations 1997* (the Regulations).

2.1. Regulations 7, 8 & 9

This group of regulations provide the prescribed standard for noise as follows:

“7. Prescribed standard for noise emissions

- (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; and*
 - (ii) *impulsiveness; and*
 - (iii) *modulation,**when assessed under regulation 9.*
- (2) *For the purposes of subregulation (1)(a), 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 at the point of reception.”*

Tonality, impulsiveness and modulation are defined in regulation 9 (refer *Appendix C*). Under regulation 9(3), “Noise is taken to be free of the characteristics of tonality, impulsiveness and modulation 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(1)(a) after the adjustments in the table [Table 2-1] ... are made to the noise emission as measured at the point of reception.”*

Table 2-1 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

* These adjustments are cumulative to a maximum of 15 dB.

The assigned levels (prescribed standards) for all premises are specified in regulation 8(3) and are shown in *Table 2-2*. The L_{A10} assigned level is applicable to noises present for more than 10% of a representative assessment period, generally applicable to “steady-state” noise sources. The L_{A1} is for short-term noise sources present for less than 10% and more than 1% of the time. The L_{Amax} assigned level is applicable for incidental noise sources, present for less than 1% of the time.

Table 2-2 Baseline Assigned 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 Premises	All hours	60	75	80
Industrial and Utility Premises	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 (IF), in relation to noise received at noise sensitive premises, has been calculated as 0 dB, as determined in *Appendix B*. As such *Table 2-3* baseline levels are applicable.

Table 2-3 Assigned Levels

Premises Receiving Noise	Time Of Day	Assigned Level (dB)		
		L _{A10}	L _{A1}	L _{Amax}
+0 dB IF Noise sensitive premises: highly sensitive area ¹	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
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

It must be noted the assigned levels above apply outside the receiving premises and at a point at least 3 metres away from any substantial reflecting surfaces.

The assigned 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, 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 Water Environmental 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.

2.2. Regulation 3

“3. Regulations do not apply to certain noise emissions

- (1) *Nothing in these regulations applies to the following noise emissions –*
- (a) *Noise emissions from the propulsion and braking systems of motor vehicles operating on a road;”*

The car park and caravan parking areas are considered a road and therefore vehicle noise (propulsion and braking) is not assessed. Noise from vehicle car doors however are assessed, since these are not part of the propulsion or braking system.

2.3. Regulation 14A

“14A. Waste Collection and Other Works

- (2) *Regulation 7 does not apply to noise emitted in the course of carrying out class 1 works if –*
- (a) *The works are carried out in the quietest reasonable and practicable manner; and*
 - (b) *The equipment used to carry out the works is the quietest reasonably available;*

class 1 works means specified works carried out between -

- (a) *0700 hours and 1900 hours on any day that is not a Sunday or a public holiday; or*
- (b) *0900 hours and 1900 hours on a Sunday or public holiday.*

specified works means -

- (a) *The collection of waste; or*
- (b) *The cleaning of a road or the drains for a road; or*
- (c) *The cleaning of public places, including footpaths, cycle paths, car parks and beaches;”*

In the case where specified works are to be carried out outside of class 1, a noise management plan is to be prepared and approved by the CEO.

3. METHODOLOGY

Computer modelling has been used to predict the noise emissions from the development to all nearby receivers. The software used was *SoundPLAN 9.0* with the CONCAWE algorithms (ISO 17534-3 improved method) selected, as they include the influence of meteorological conditions. Input data required in the model are listed below and discussed in *Section 3.1* to *Section 3.4*:

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

3.1. Meteorological Conditions

Meteorological information utilised is provided in *Table 3-1* 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. As events will run until midnight then the night-time critical conditions are modelled.

Table 3-1: Modelling Meteorological Conditions

Parameter	Night (7.00pm to 7.00am) ²
Temperature (°C)	15
Humidity (%)	50
Wind Speed (m/s)	3
Wind Direction ¹	All
Pasquil Stability Factor	F

Notes:

1. The modelling package allows for all wind directions to be modelled simultaneously.
2. The conditions above are as defined in *Guideline: Assessment of Environmental Noise Emissions*; May 2021

Alternatives to the above default conditions can be used where one year of weather data is available and the analysis considers the worst 2% of the day and night for the month of the year in which the worst-case weather conditions prevail (source: *Draft Guideline on Environmental Noise for Prescribed Premises*, May 2016). In most cases, the default conditions occur for more than 2% of the time and therefore must be satisfied.

3.2. Topographical Data

Topographical data was adapted from publicly available information (e.g. *Google*) in the form of spot heights and combined with the site plan.

Surrounding existing buildings were also incorporated in the noise model, as these can provide noise shielding as well as reflection paths. Single storey buildings are modelled with a height of 3.5 metres and so as to be

conservative all outdoor sheds were also modelled at the same height, with receivers 1.4 metres above ground at 15 metres from houses, being the maximum distance away from the dwelling and still considered highly noise sensitive.

The area is rural with boundary fencing assumed to be acoustically transparent in nature, due to the likelihood of wire or timber slatted construction.

Figure 3-1 shows a 2D overview of the noise model with the location of all relevant receivers identified.

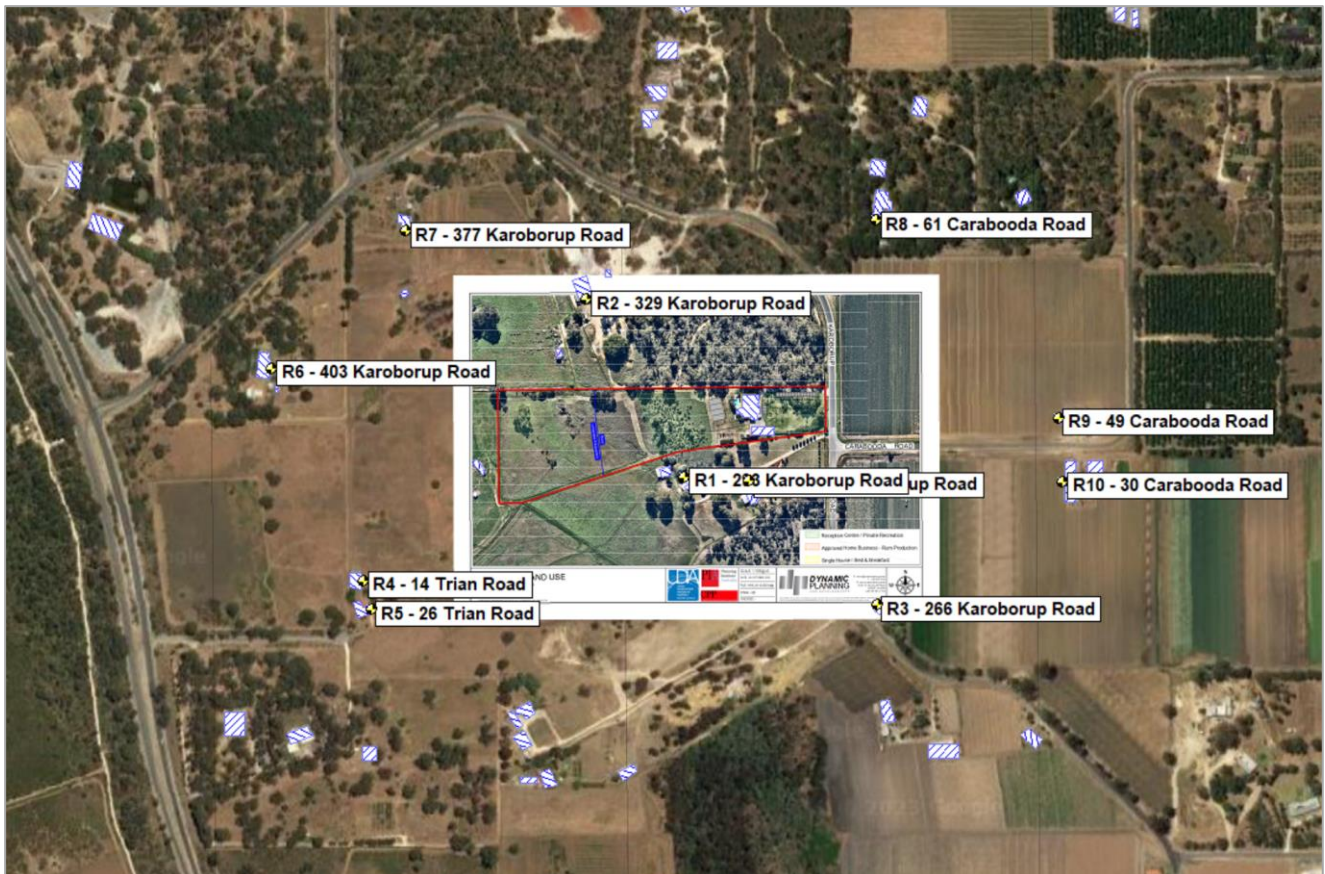


Figure 3-1: Overview of Noise Model

3.3. Ground Absorption

The ground absorption has been assumed to be 0.0 (0%) for the roads and 0.4 (40%) elsewhere, noting that 0.0 represents hard reflective surfaces such as water and 1.0 represents absorptive surfaces such as grass.

3.4. Source Sound Levels

The source sound power levels used in the modelling are provided in *Table 3-2*.

Table 3-2: Source Sound Power Levels, dB

Description	Octave Band Centre Frequency (Hz)								Overall dB(A)
	63	125	250	500	1k	2k	4k	8k	
Amplified Speakers x 2	89	94	87	86	88	78	73	64	90
Car Doors Closing x 55 (L _{max})	71	74	77	81	80	78	72	61	84
Caravan Rooftop Mounted A/C Compressors x 30	66	62	62	59	56	51	45	38	61
B&B & Rum Shed A/C Unit x 2	75	71	71	68	65	60	54	47	70
Refrigerated Unit For Rum Shed	81	75	75	71	61	52	44	44	71
Western Area – 40 Patrons with 50 % talking at any one time (18 normal level voices and 2 raised voices)	69	73	75	79	75	70	65	60	80
Middle Area - 60 Patrons with 50 % talking at any one time (27 normal level voices and 3 raised voices)	71	75	76	80	77	71	67	62	81
Eastern Area – Although yoga is generally quiet, to allow for martial arts where there may be more noise it is assumed 40 Patrons with 50 % talking at any one time (18 normal level voices and 2 raised voices)	69	73	75	79	75	70	65	60	80

The following is noted in relation to *Table 3-2*:

- Air conditioning condenser plant sound levels are estimated from previous projects and are located at 1.0m above roof level for the B&B and Rum Shed. The A/C units on the caravan roofs are located at a height of 3.2 metres above ground height. These will need to be reviewed at detailed design;
- All noise sources are assumed to be L_{A10} unless noted otherwise.
- All mechanical and refrigerant plant were modelled as omni-directional point sources;
- All three event areas are modelled with patronage noise as area sources 1.5 metre above ground height;
- All plant is assumed to be running simultaneously at 100 percent operation speed;
- 2 x amplified speakers are at 1 metre above ground height and orientated to the east with a resultant SPL of 70 dB(A) @ 5 metres in front at a height of 1.5m above ground, representing background type sound levels;
- Sources are grouped as indicated.

4. RESULTS

The noise levels were predicted for various scenarios:

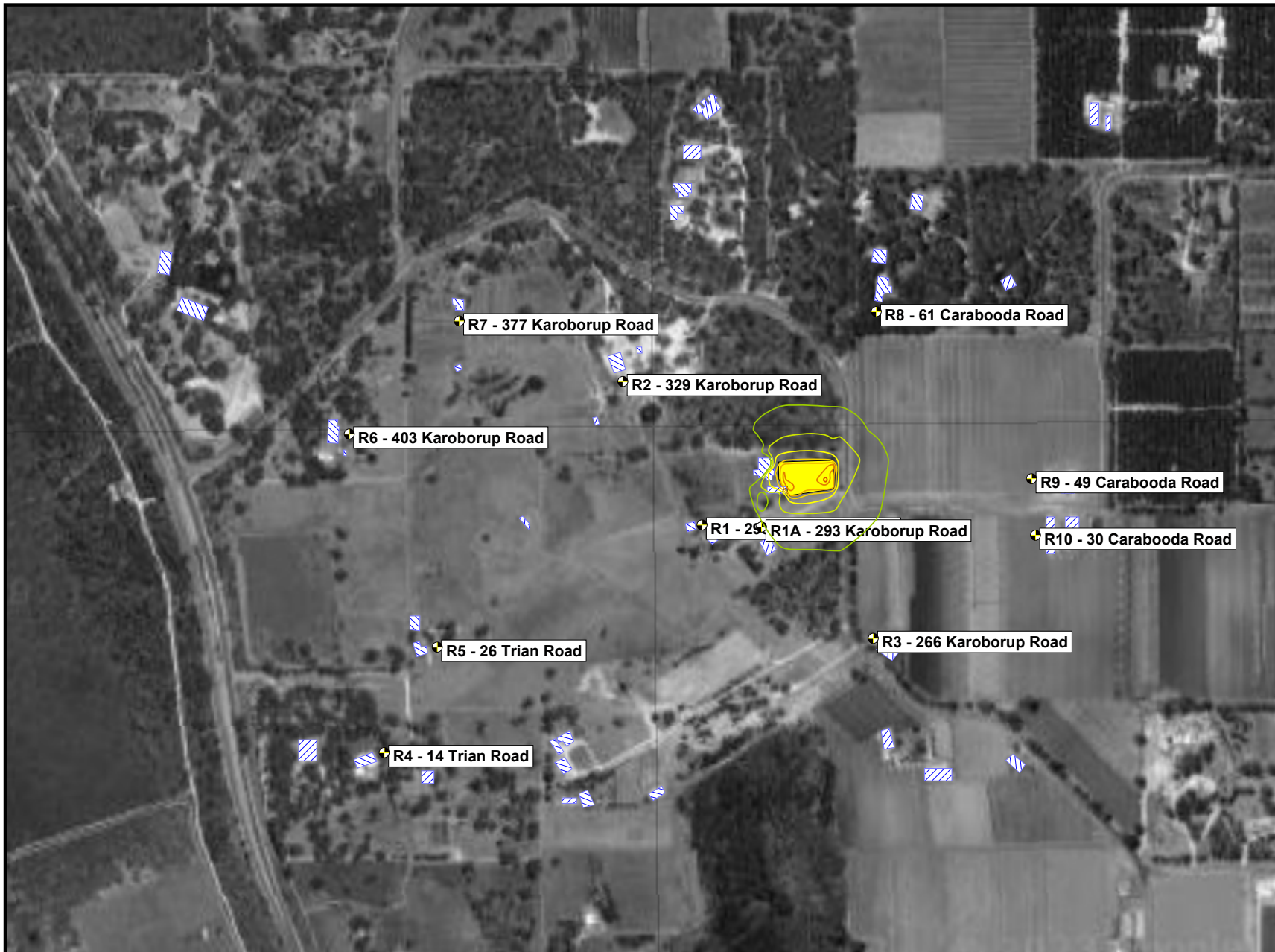
- Scenario 1 - Yoga/Karate Event in Eastern Entertainment Area (L_{10}) : Patronage Noise (40 patrons);
- Scenario 2 - Western & Mid Area Events in Entertainment Areas (L_{10}) : Patronage Noise (100 patrons) and 2 x amplified speakers orientated east;
- Scenario 3 - All Mechanical Plant - 30 caravan rooftop mounted condensers, 1 B&B condenser, 1 rum shed condenser and 1 rum shed refrigerant unit running simultaneously – all rooftop mounted (L_{10});
- Scenario 4 - 30 caravan located car doors and 25 car park bay car doors all closing simultaneously (L_{max}).

The results for Scenarios 1 to 4 are provided in *Table 4-1*. A noise contour plot is also provided in *Figure 4-1* to *Figure 4-4* showing noise levels at ground floor.

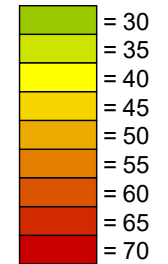
Table 4-1: Scenario 1 to 4 Predicted Levels, dB(A)

Receiver	Scenario 1 (L_{10})	Scenario 2 (L_{10})	Scenario 3 (L_{10})	Scenario 4 (L_{max})
R1/1A – 293 Karoborup Rd	23/29	38/35	28/30	40/38
R2 – 329 Karoborup Rd	20	33	24	34
R3 – 266 Karoborup Rd	24	27	20	28
R4 – 14 Trian Rd	13	22	15	24
R5 – 26 Trian Rd	14	25	19	30
R6 – 403 Karoborup Rd	13	25	17	26
R7 – 377 Karoborup Rd	15	26	18	26
R8 – 61 Carabooda Rd	23	23	20	30
R9 – 49 Carabooda Rd	22	22	16	27
R10 – 30 Carabooda Rd	21	26	17	28





Figure 4-1



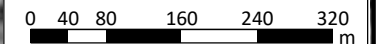
Predicted Noise level L_{A10} dB



Signs and symbols

-  Area Sources
-  Point source
-  Point receiver
-  Buildings

Scale 1:8000



Yoga/Martial Arts Events In Eastern Events Area - Predicted Noise Levels

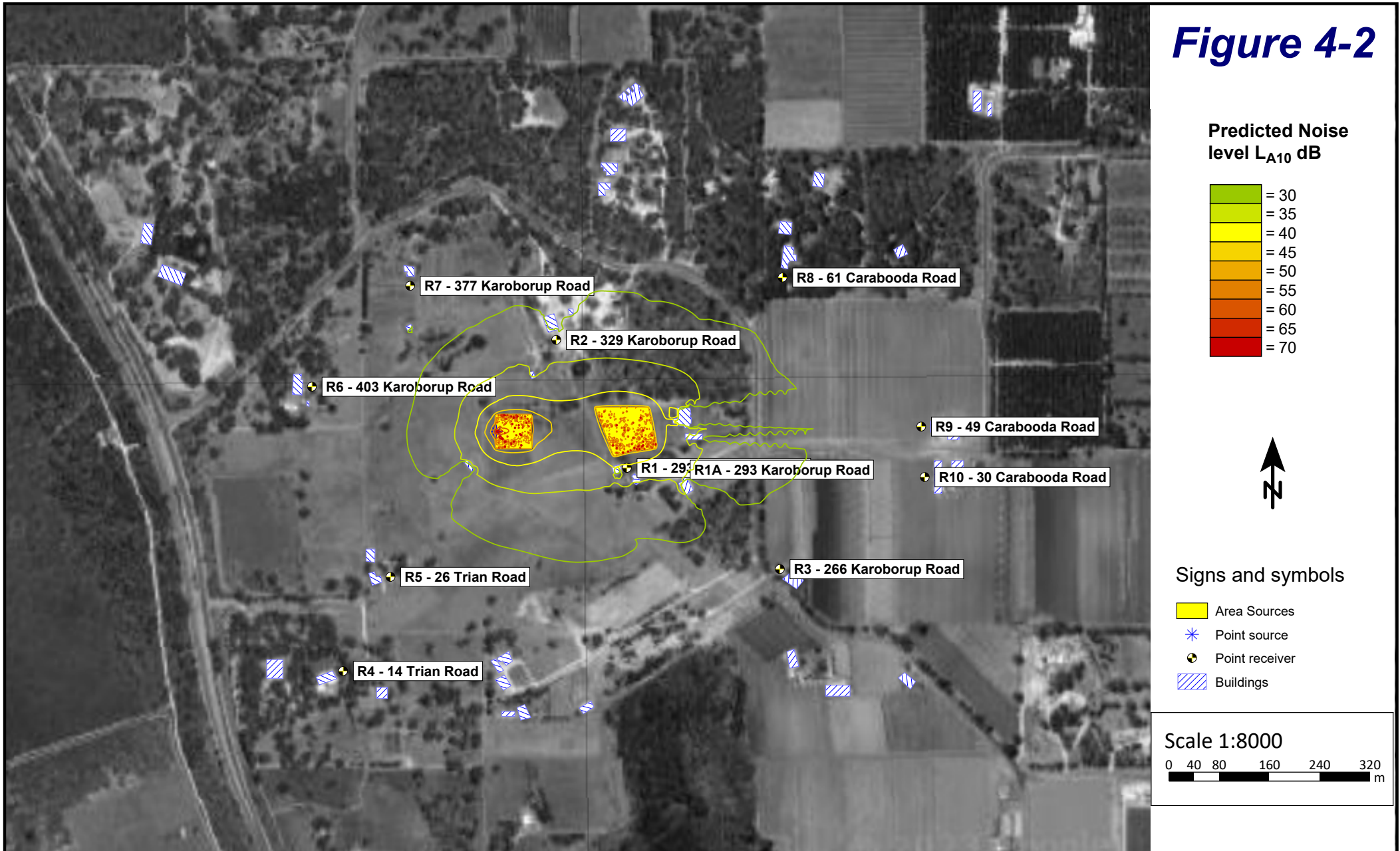
L_{A10} Noise Level Contours - Yoga/Martial Arts Events Only

No Penalty Applied For Intrusive Characteristics - 1.5m Above Ground

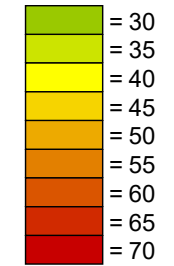


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Figure 4-2



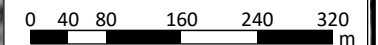
Predicted Noise level L_{A10} dB



Signs and symbols

- Area Sources
- Point source
- Point receiver
- Buildings

Scale 1:8000



Events In Western & Middle Events Areas - Predicted Noise Levels

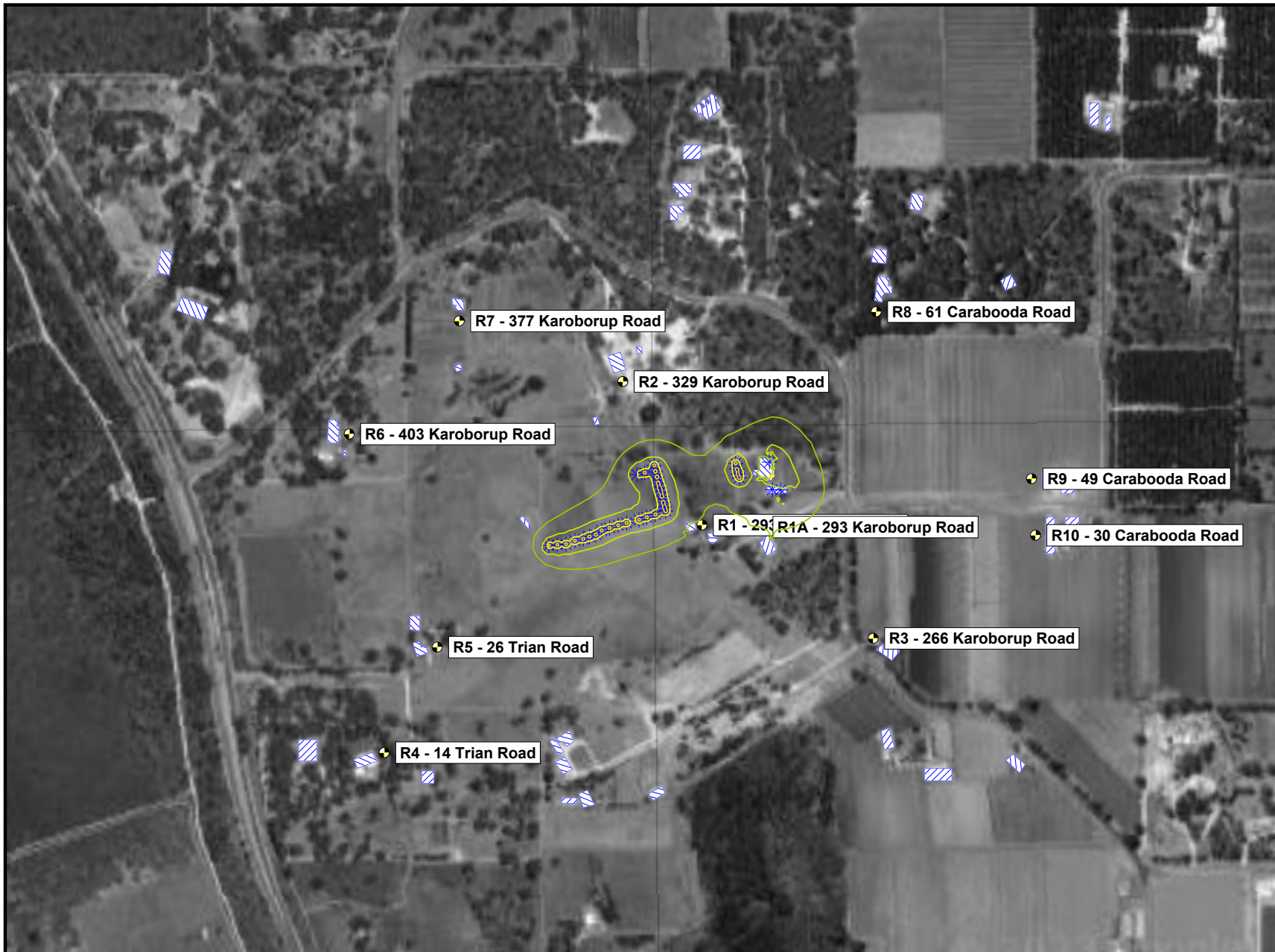
L_{A10} Noise Level Contours - Patronage & Amplified Music Only

No Penalty Applied For Intrusive Characteristics - 1.5m Above Ground

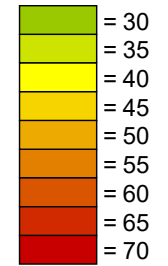


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Figure 4-3



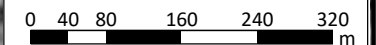
Predicted Noise level L_{A10} dB



Signs and symbols

- Area Sources
- Point source
- Point receiver
- Buildings

Scale 1:8000



All Mechanical Plant - Predicted Noise Levels

L_{A10} Noise Level Contours - Caravan A/C's, B&B A/C, Rum Shed A/C & Refrigerant Only

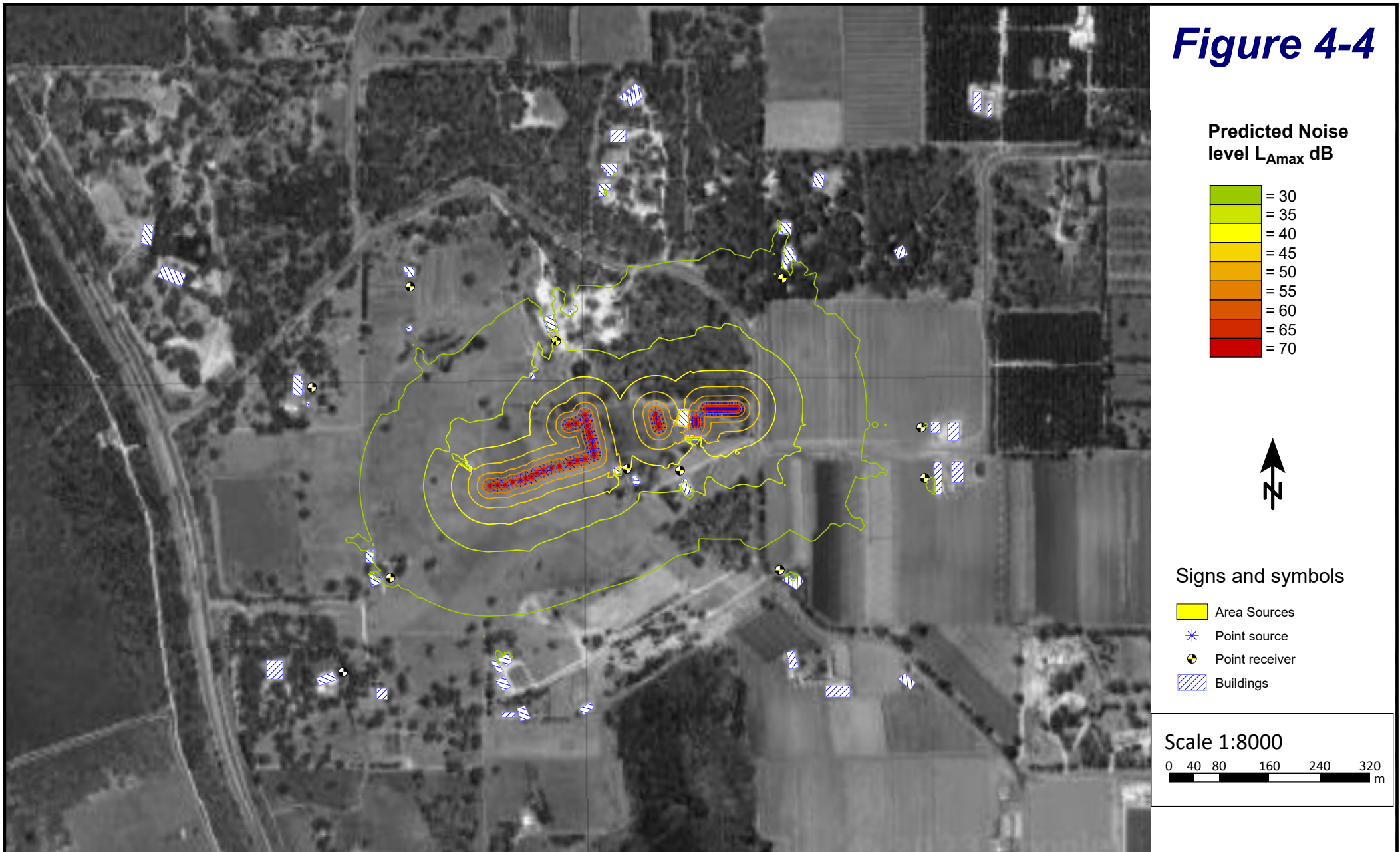
No Penalty Applied For Intrusive Characteristics - 1.5m Above Ground



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Figure 4-4



All Car Door Closing Events - Predicted Noise Levels

L_{Amax} Noise Level Contours - 30 Caravan Related Car Doors & 25 Carpark Closing Door Events Only
No Penalty Applied For Intrusive Characteristics - 1.5m Above Ground



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5. ASSESSMENT

5.1. Scenario 1 - Yoga/Karate Event in Eastern Entertainment Area (L₁₀)

Table 5-1 assesses the noise levels for Scenario 1. As Yoga/Karate events may start before 7.00am, the critical night-time criteria is applicable. No intrusive characteristics such as tonality are expected, as there will only be speech from instructor direction with no amplified music.

Table 5-1: Scenario 1 Assessment, dB(A)

Receiver	Predicted	Adjusted	Assigned Level	Assessment
R1/1A – 293 Karoborup Rd	23/29	N/A	35	<i>Complies</i>
R2 – 329 Karoborup Rd	20	N/A	35	<i>Complies</i>
R3 – 266 Karoborup Rd	24	N/A	35	<i>Complies</i>
R4 – 14 Trian Rd	13	N/A	35	<i>Complies</i>
R5 – 26 Trian Rd	14	N/A	35	<i>Complies</i>
R6 – 403 Karoborup Rd	13	N/A	35	<i>Complies</i>
R7 – 377 Karoborup Rd	15	N/A	35	<i>Complies</i>
R8 – 61 Carabooda Rd	23	N/A	35	<i>Complies</i>
R9 – 49 Carabooda Rd	22	N/A	35	<i>Complies</i>
R10 – 30 Carabooda Rd	21	N/A	35	<i>Complies</i>

From the above it is evident compliance is achieved.

5.2. Scenario 2 - Western & Mid Area Events in Entertainment Areas (L₁₀)

Table 5-2 assesses the noise levels for Scenario 2. As events may run past 10.00pm then the critical night time criteria is applicable. The emissions contain music and have therefore been adjusted by + 10 dB.

Table 5-2: Scenario 2 Assessment, dB(A)

Receiver	Predicted	Adjusted*	Assigned Level	Assessment
R1/1A – 293 Karoborup Rd	38/35	48/45	35	+13 dB/+10 dB
R2 – 329 Karoborup Rd	33	43	35	+8 dB
R3 – 266 Karoborup Rd	27	37	35	+2 dB
R4 – 14 Trian Rd	22	32	35	Complies
R5 – 26 Trian Rd	25	35	35	Complies
R6 – 403 Karoborup Rd	25	35	35	Complies
R7 – 377 Karoborup Rd	26	36	35	+1 dB
R8 – 61 Carabooda Rd	23	33	35	Complies
R9 – 49 Carabooda Rd	22	32	35	Complies
R10 – 30 Carabooda Rd	26	36	35	+1 dB

* Adjusted by + 10 dB for music.

From the above it is evident compliance is achieved at 5 of the 10 identified receivers during night time. During the day (7.00am to 7.00pm), Monday to Saturday, the assigned level increases by 10 dB such that compliance would be achieved at all but one location.

5.3. Scenario 3 - All Mechanical Plant (L₁₀)

Table 5-3 assesses the noise levels for Scenario 3. As mechanical plant may run after 10pm then the critical night time criteria is applicable. Intrusive characteristics such as tonality are expected and therefore the noise levels have been adjusted by + 5 dB.

Table 5-3: Scenario 3 Assessment, dB(A)

Receiver	Predicted	Adjusted*	Assigned Level	Assessment
R1/1A – 293 Karoborup Rd	28/30	33/35	35	Complies
R2 – 329 Karoborup Rd	24	29	35	Complies
R3 – 266 Karoborup Rd	20	25	35	Complies
R4 – 14 Trian Rd	15	20	35	Complies
R5 – 26 Trian Rd	19	24	35	Complies
R6 – 403 Karoborup Rd	17	22	35	Complies
R7 – 377 Karoborup Rd	18	23	35	Complies
R8 – 61 Carabooda Rd	20	25	35	Complies
R9 – 49 Carabooda Rd	16	21	35	Complies
R10 – 30 Carabooda Rd	17	22	35	Complies

* Adjusted by + 5 dB for tonality.

From the above it is evident compliance is achieved.

5.4. Scenario 4 - 55 car doors all closing simultaneously (L_{max})

Table 5-4 assesses the noise levels for Scenario 4. As events may run past 10.00pm then the critical night-time criteria is applicable. The door closing will be impulsive in nature and have therefore been adjusted by + 10 dB.

Table 5-4: Scenario 4 Assessment, dB(A)

Receiver	Predicted	Adjusted*	Assigned Level	Assessment
R1/1A – 293 Karoborup Rd	40/38	50/48	55	<i>Complies</i>
R2 – 329 Karoborup Rd	34	44	55	<i>Complies</i>
R3 – 266 Karoborup Rd	28	38	55	<i>Complies</i>
R4 – 14 Trian Rd	24	34	55	<i>Complies</i>
R5 – 26 Trian Rd	30	40	55	<i>Complies</i>
R6 – 403 Karoborup Rd	26	36	55	<i>Complies</i>
R7 – 377 Karoborup Rd	26	36	55	<i>Complies</i>
R8 – 61 Carabooda Rd	30	40	55	<i>Complies</i>
R9 – 49 Carabooda Rd	27	37	55	<i>Complies</i>
R10 – 30 Carabooda Rd	28	38	55	<i>Complies</i>

* Adjusted by + 10 dB for impulsiveness.

From the above it is evident compliance is achieved.

6. DISCUSSION / RECOMMENDATIONS

The only scenario where non-compliance is evident is scenario 2 when events are held in the middle and western entertainment area. Patronage noise from the middle area is expected to be 37 dB(A) at R1, which is a 2 dB exceedance, however the amplified music is predicted to be 30 dB(A) here which may be audible, thus resulting in a +10 dB penalty. If the music is inaudible at any of the 5 identified receivers where non-compliance is predicted then the +10 dB penalty is not applicable and compliance is achieved at the most stringent time.

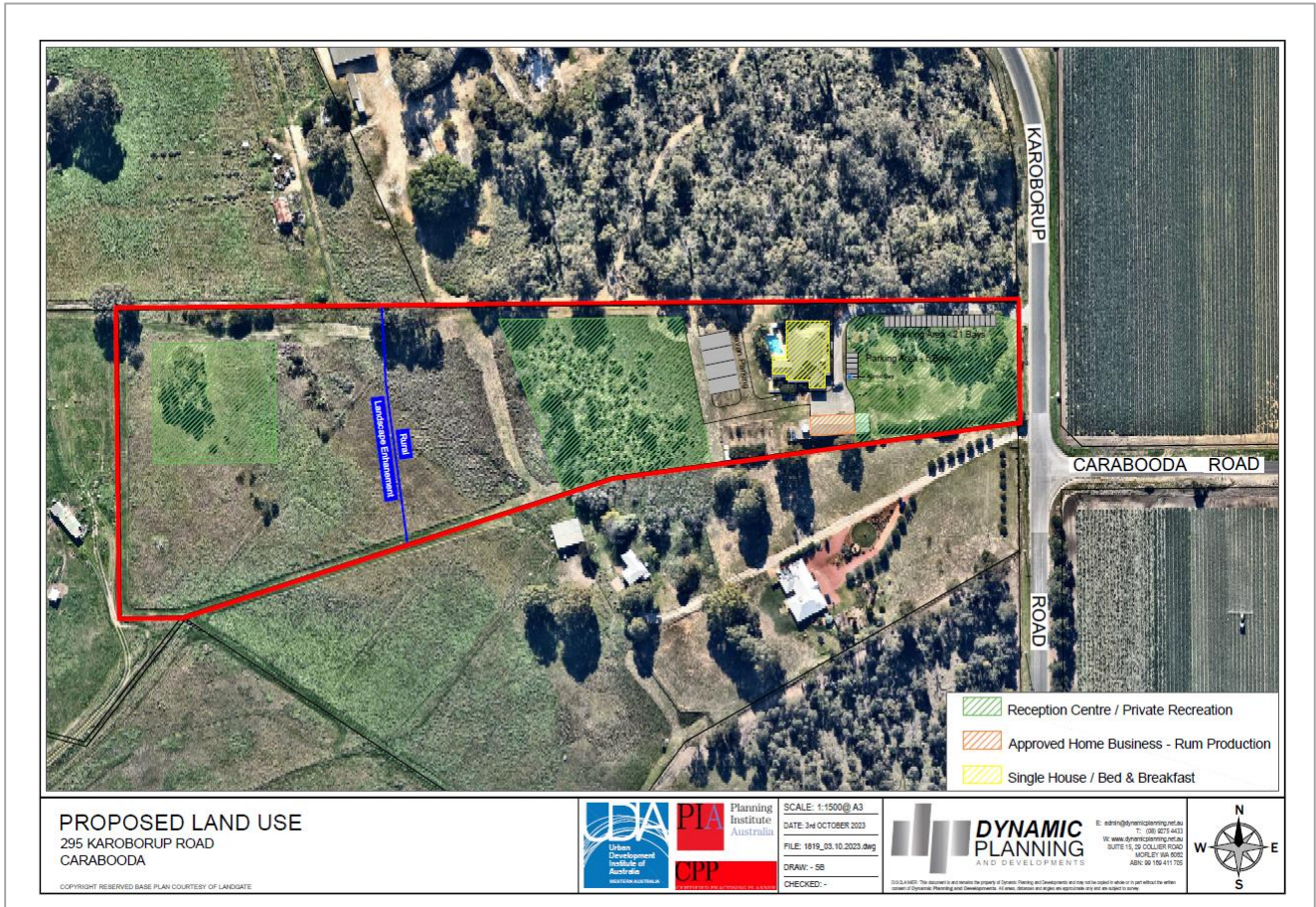
To achieve compliance for scenario 2, a 13 dB reduction is required to the overall L_{A10} noise level. To achieve this, the following sources must be reduced as described:

- Amplified music source is reduced to a level where music is inaudible at all receivers. This may be achievable by reducing the noise level to below the modelled SPL of 70 dB(A) @ 5m distance to front of speakers to 57 dB(A) or even lower after 10 pm. Investigation and experimentation can be carried out onsite before any events to set the correct levels on the equipment to achieve this outcome. Speakers should be orientated towards the ground and where possible away from any neighbouring residents.
- Patronage noise in the middle entertainment area is reduced by 2 dB by ensuring that the numbers are reduced here to a maximum of 40 patrons after 10.00 pm.

The noise can also be managed by the following:

- Air-conditioning shall have a 'night' / 'quiet' mode option, in case required for prior to 7.00am operation, subject to final detailed analysis;
- All plant shall be selected for quiet operation;
- All plant is to be appropriately vibration isolated to 95% isolation efficiency;
- Orientate musical instruments and amplified speakers away from nearest residents and keep their height as close to ground level as possible;
- Hold events during normal daytime hours where practicable;
- Limit the noise level of amplified music. Indicative calculations show a level of 57 dB(A) @ 5m would be a reasonable starting point but should be lowered if any complaints are received;
- Ensure no amplified music in the outdoor area in the night, Sundays and public holidays;
- Consider use of movable noise barrier for use during events as required;
- Music levels to not be excessive so attendees can still enjoy the space or limited to as far as practicable;
- Noise complaints are to be handled by the approved manager at the time and investigated in a timely manner;
- Complaints are to be entered in the complaint log file;
- Attendees exiting after events, where necessary, be politely asked to consider neighbours and leave quietly.

Appendix A – Development Plans



Appendix B – Influencing Factor Calculation

The assigned levels combine a baseline assigned level with an influencing factor, with the latter increasing the assigned level on the basis of the existence of significant roads and commercial or industrial zoned land within an inner circle (100 metre radius) and an outer circle (450 metre radius) of the noise sensitive premises. The calculation for the influencing factor is:

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

where :

% Type A₁₀₀ = the percentage of industrial land within
a 100m radius of the premises receiving the noise

%TypeA₄₅₀ = the percentage of industrial land within
a 450m radius of the premises receiving the noise

% Type B₁₀₀ = the percentage of commercial land within
a 100m radius of the premises receiving the noise

%TypeB₄₅₀ = the percentage of commercial land within
a 450m radius of the premises receiving the noise

+ Transport Factor (maximum of 6 dB)

= 2 for each secondary road (6,000 to 15,000 vpd) within 100m

= 2 for each major road (> 15,000 vpd) within 450m

= 6 for each major road within 100m

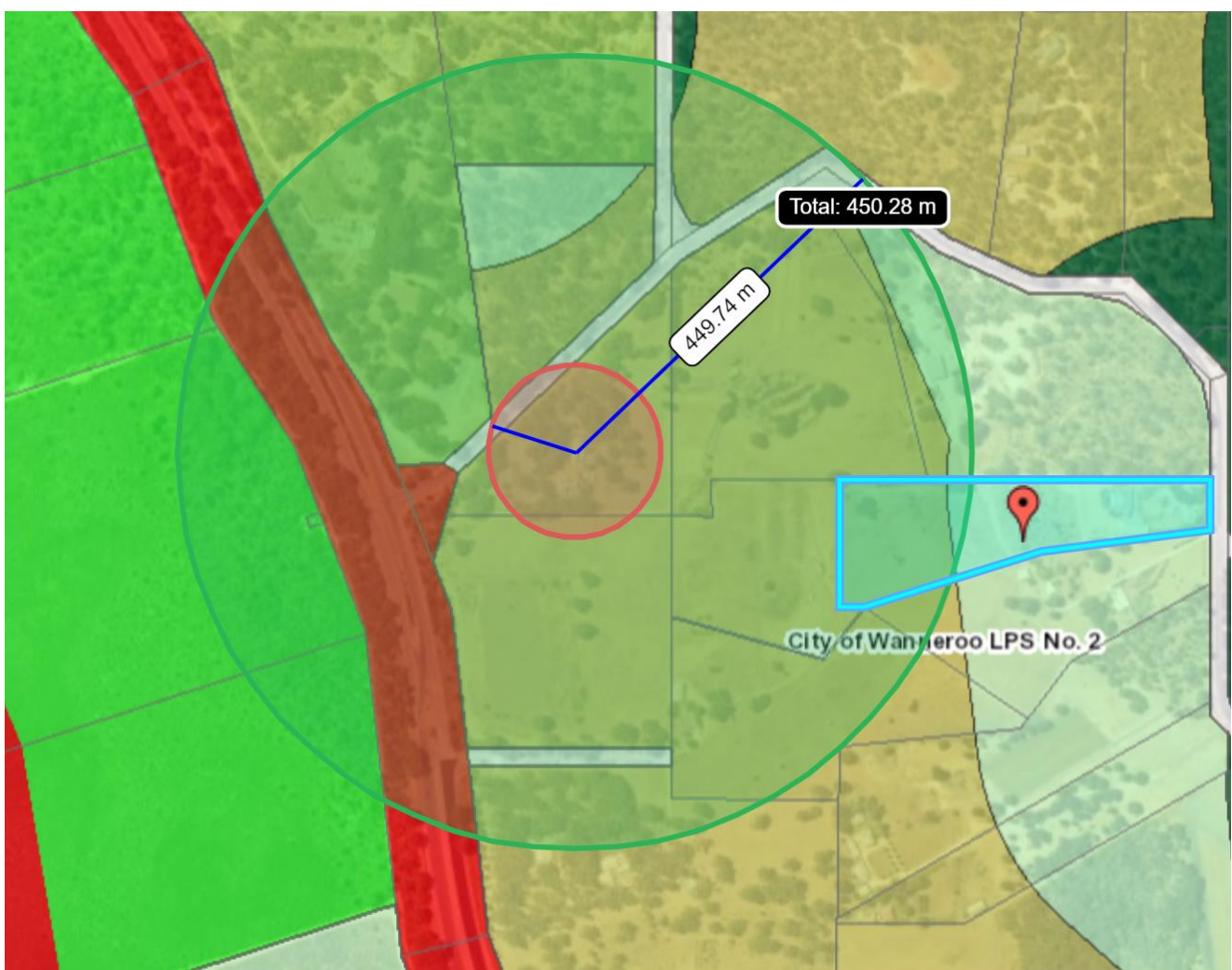
The nearest noise sensitive premises are identified as:

- R1/1A – 293 Karoborup Rd
- R2 – 329 Karoborup Rd
- R3 – 266 Karoborup Rd
- R4 – 14 Trian Rd
- R5 – 26 Trian Rd
- R6 – 403 Karoborup Rd
- R7 – 377 Karoborup Rd
- R8 – 61 Carabooda Rd
- R9 – 49 Carabooda Rd
- R10 – 30 Carabooda Rd

Table B-1 shows the percentage of industrial and commercial land within the inner (100 metre radius) and outer (450 metre radius) circles of the noise sensitive premises, with this also shown on Figure B-1 for Receiver R6 as an example.

Table B-1: Percentage of Land Types within 100m and 450m Radii

Receiver	Land Type	Within 100m	Within 450m
R1 – R10	Type A - Industrial and Utility	0	0
	Type B – Commercial	0	0

**Figure B-1: Land Types within 100m and 450m Radii of R6**

From the Main Roads WA Traffic Map there are no major or minor roads within the inner (100 metre radius) and outer (450 metre radius) circles, as such no transport IF is applicable.

The influencing factor is calculate as zero and the baseline assigned noise levels are applicable.

Appendix C – 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 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 level 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. 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. This is used when assessing the presence of modulation.

- **L_{APeak}**

This is the greatest absolute instantaneous sound pressure level in decibels using the A-frequency weighting.

- **L_{Amax}**

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

- **L_{A1}**

The L_{A1} level is the A-weighted noise level exceeded for 1 percent of the measurement period and is considered to represent the average of the maximum noise levels measured.

- **L_{A10}**

The L_{A10} level is the A-weighted noise level exceeded for 10 percent of the measurement period and is considered to represent the “intrusive” noise level.

- **L_{A90}**

The L_{A90} level is the A-weighted noise level exceeded for 90 percent of the measurement period and is considered to represent the “background” 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.

- **One-Third-Octave Band**

Means a band of frequencies spanning one-third of an octave and having a centre frequency between 25 Hz and 20000 Hz inclusive.

- **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.

- **L_{Amax} assigned level**

Means an assigned level, which, measured as a L_{ASlow} value, is not to be exceeded at any time.

- **L_{A1} assigned level**

Means an assigned level, which, measured as a L_{ASlow} value, is not to be exceeded for more than 1 percent of the representative assessment period.

- **L_{A10} assigned level**

Means an assigned level, which, measured as a L_{ASlow} value, is not to be exceeded for more than 10 percent 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; and
 - (b) is present for at least 10% of the representative assessment period; and
 - (c) is regular, cyclic and audible.

- **Impulsive Noise**

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

- a variation in the emission of a noise where the difference between L_{Apeak} and L_{Amax} is more than 15 dB when determined for a single representative event.

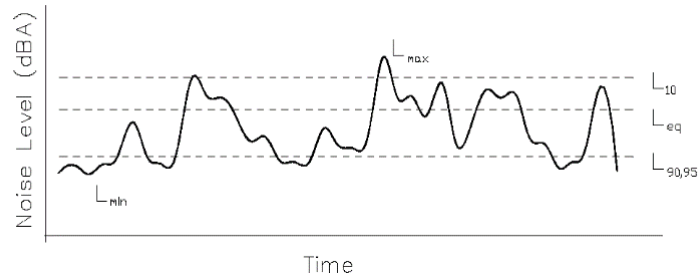
- **Major Road**

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.

• **Chart of Noise Level Descriptors**



• **Austrroads Vehicle Class**

VEHICLE CLASSIFICATION SYSTEM	
AUSTRROADS	
LIGHT VEHICLES	
1	BIKE Car, Van, Wagon, 4WD, UTV, Bicycle, Motorcycle
2	BIKE + TOWING Trailer, Caravan, Boat
HEAVY VEHICLES	
3	TWO AXLE TRUCK OR BUS *2 axle
4	THREE AXLE TRUCK OR BUS *3 axle, 2 axle groups
5	FOUR (or FIVE) AXLE TRUCK *4 (or 5) axle, 2 axle groups
6	THREE AXLE ARTICULATED *3 axle, 3 axle groups
7	FOUR AXLE ARTICULATED *4 axle, 3 or 4 axle groups
8	FIVE AXLE ARTICULATED *5 axle, 3 or 4 axle groups
9	SIX AXLE ARTICULATED *6 axle, 3 or 4 axle groups
LONG VEHICLES AND ROAD TRAINS	
10	8 DOUBLE E or HEAVY TRUCK and TRAILER *7 or 8 axle, 4 axle groups
11	DOUBLE ROAD TRAIN *7 or 8 axle, 5 or 6 axle groups
12	SINGLE ROAD TRAIN *7 or 8 axle, 7 or 8 axle groups

• **Typical Noise Levels**

