Greyhound Racing NSW

Acoustics Report

Noise Impact Assessment for Development Application

Prepared for: Tzannes, Greyhounds NSW

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Revision

Revision	Date	Comment	Prepared By	Approved By
001	08/09/2021	For comment	Julia Knight	ORFG
002	08/10/2021	Updated, incorporating comments	Julia Knight	ORFG
003	12/05/2022	Updated incorporating comments from peer review and updated design	Julia Knight	ORFG
004	24/05/2022	Updated with minor changes	Julia Knight	ORFG
005	22/11/2022	Updated with panel queries	Julia Knight	ORFG
006	29/11/2022	Cumulative impacts added	Julia Knight	ORFG
007	02/02/2023	Minor updates, (Table 6 note, and 5.3.2)	Julia Knight	ORFG

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1. Introduction

Greyhound Racing NSW has appointed Tzannes Architects to provide architectural services and design a new care facility for rehabilitation of ex-racing greyhounds on a site located in the Hunter Valley.

The proposal involves the design of a series of dog kennels and adjacent services buildings to facilitate the care and rehabilitation of up to 400 greyhounds for the purpose of adoption as pets. There are currently 20 kennel proposed buildings with each building containing 20 individual dog kennels.

As part of the Development Application (DA) documentation process, Stantec has been engaged to provide a noise impact assessment for the proposed Greyhound facility at Bylong Park in Martindale NSW.

This assessment discusses the likely noise impact of the proposed development upon the nearest most-affected residential receivers.

This assessment has been prepared considering the following documents:

- NSW Environment Protection Authority (EPA) Noise Policy for Industry, 2017 (NPI 2017).

This report provides:

- Project specific noise criteria.
- Results from attended and unattended noise monitoring qualifying the acoustic environment at the site location.
- Indicative recommendations for noise mitigation measures for the proposed development to meet the relevant criteria.

2. Project Overview

2.1 Site Context

The site is located in Bylong Park in the upper Hunter Valley in NSW.

Figure 1 presents the proposed site location and the nearest residential receivers from site together with the distances between the site and the nearest residential receivers. The nearest residential receivers have been nominated as R1, R2 and R3 being located respectively at 700m, 570m and 850m from the proposed site.

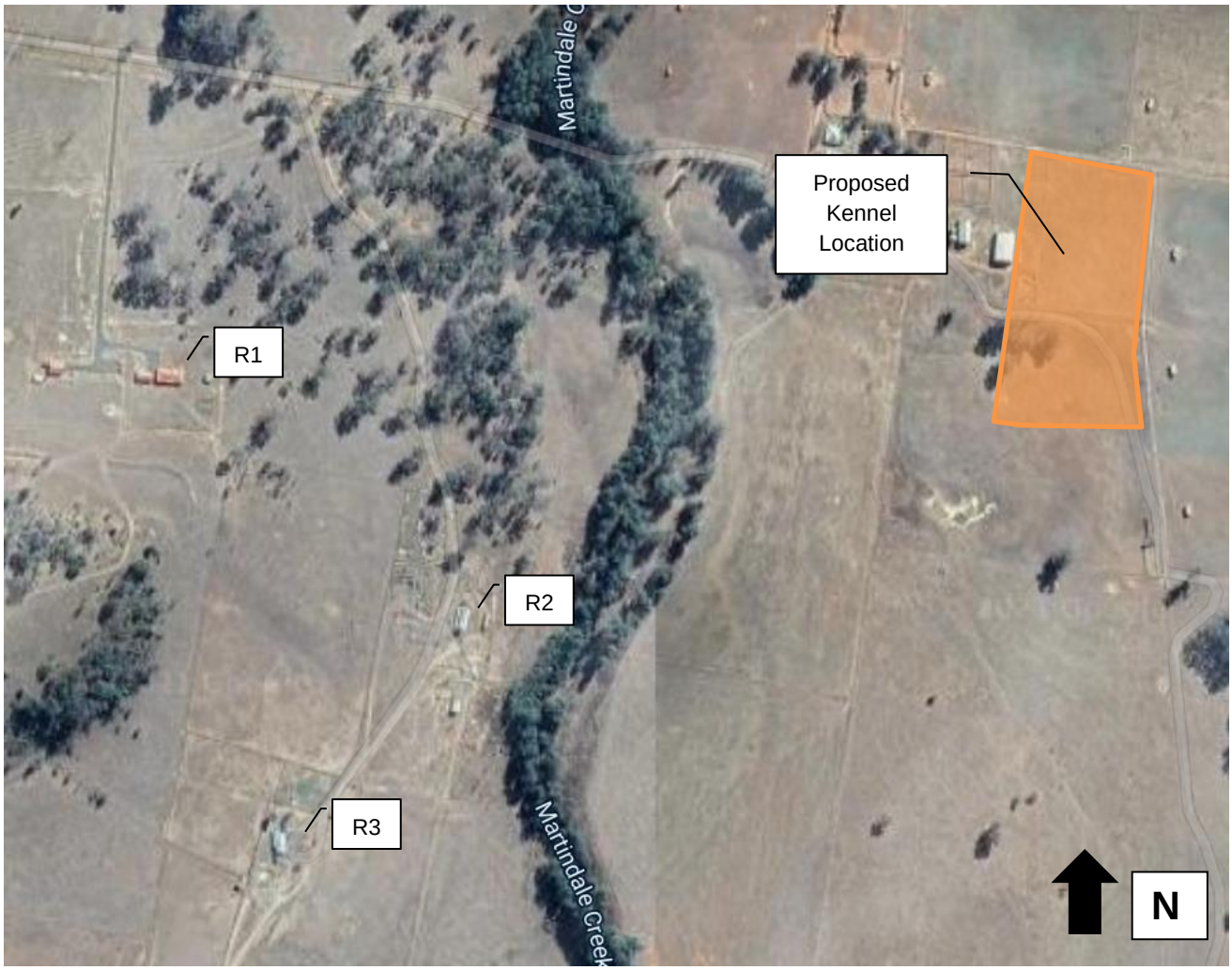

Figure 1 - Site location and nearest residential receivers

2.2 Site Proposed Layout

The proposed site layout includes the following 20 sectorised kennels arrangements each being able to accommodate up to 20 dogs.

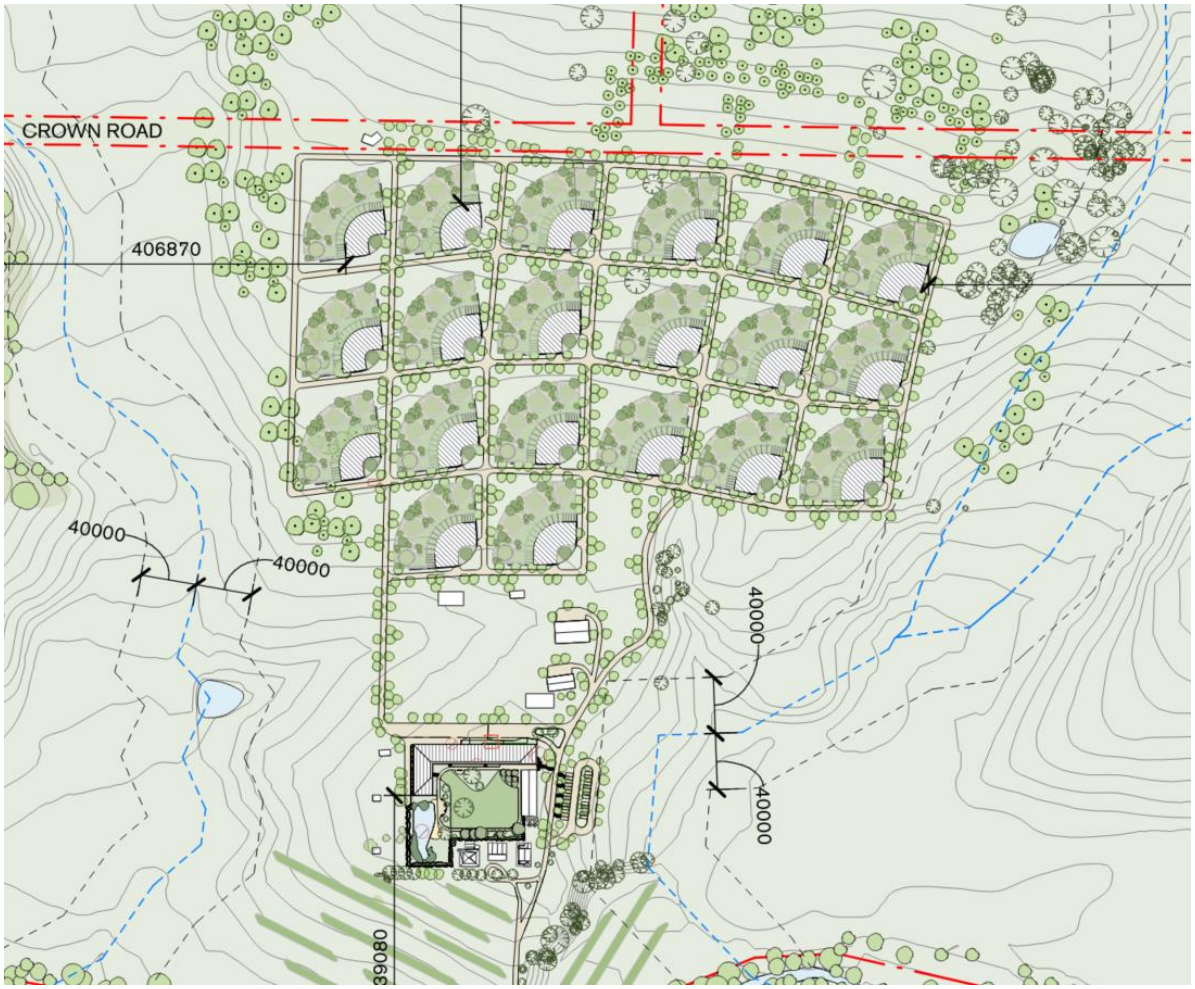

Figure 2 - Proposed Site Layout

2.3 Site Weather Conditions

It is understood that there are often strong winds on the site typically travelling West to East. With the absence of localised annual wind and weather data, the acoustic assessment considers worst case weather conditions to account for environmental effects due to weather. See Section 5.4.1 for discussion of temperature inversions.

3. Noise Survey

3.1 Instrumentation

The equipment used for the noise survey was the following:

- Hand-held sound spectrum analyser Casella S/N 1488204
- Brüel & Kjær Sound Calibrator, S/N 2709826
- Brüel & Kjær Type 2250 Environmental Noise Logger, S/N 410151
- Brüel & Kjær Type 2250 Environmental Noise Logger, S/N 973279

All equipment was calibrated before and after the measurements and no significant drift was found. All equipment carries current traceable calibration certificates that can be provided upon request.

3.2 Measurement Locations

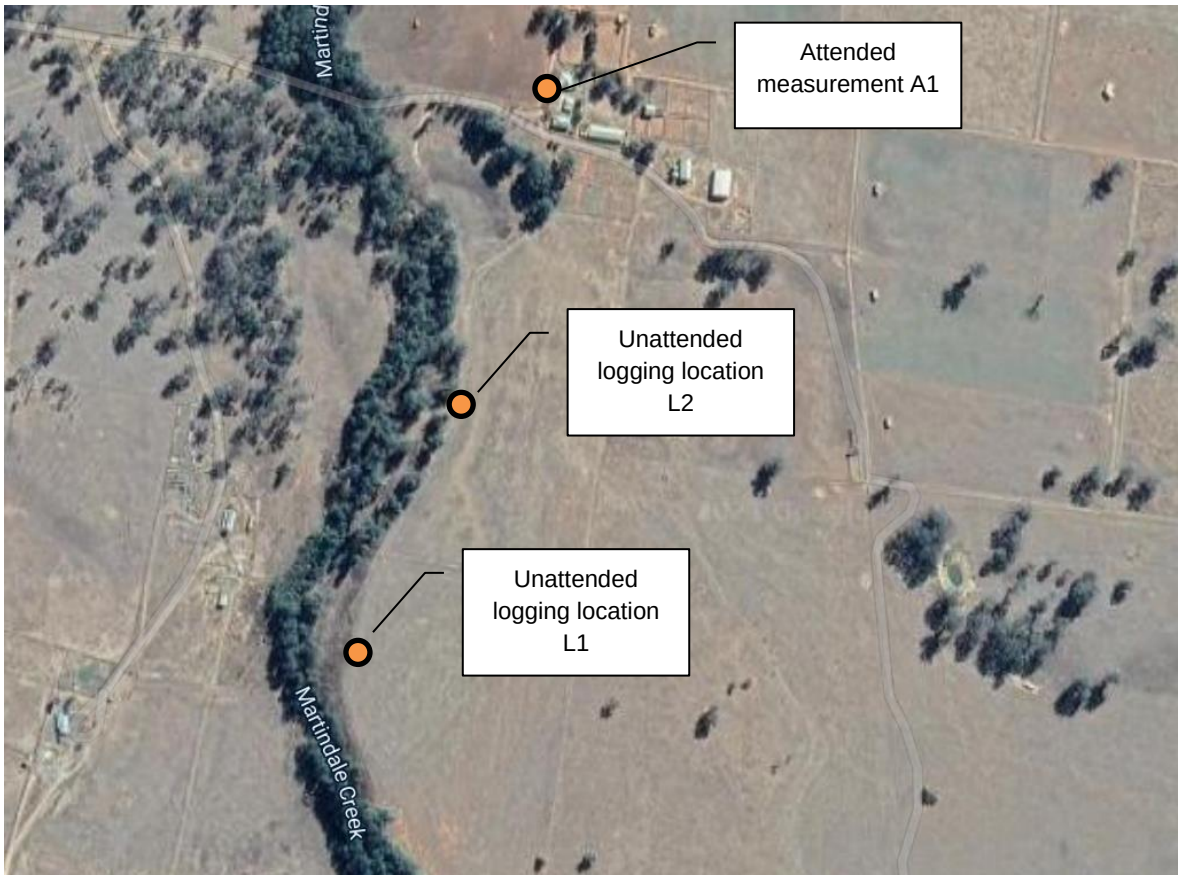

Figure 3 - Locations of noise measurements

3.3 Attended Noise Survey Results

An attended noise measurements of 15-minutes duration was conducted on site to characterise the acoustic environment at the site to verify/support the unattended noise logging. Results of the attended noise measurement taken at the proposed development site are provided in Table 1.

Table 1: Summary of results for attended noise survey

Location	Time	Duration	L_{Aeq} dB(A)	L_{A90} dB(A)	L_{Amax} dB(A)	Comments
A1	06/08/2021 12:16pm	15 mins	45	27.5	75.2	The controlling noise source is the wind in trees and birdlife. Rare car pass by on Martindale Rd.

3.4 Unattended Noise Survey Results

3.4.1 Background and Ambient Noise Monitoring

Unattended noise monitors were placed at positions L1 and L2 (shown in Figure 3) to measure the background and ambient noise that is representative of the surrounding noise-sensitive receivers. The noise loggers were installed from the 22nd July to the 4th August 2021. The results for the unattended background noise surveys are shown in Table 2 below (for the day, evening, and night periods). Note that any rain affected data during the period of logging has been excluded from the calculations.

Table 2: Summary of results for background and ambient noise surveys

Location	Equivalent Continuous Noise Level $L_{Aeq,period}$ - dB(A)			Background Noise Level RBL - dB(A)		
	Day	Evening	Night	Day	Evening	Night
L1 (Representing R3)	46	44	41	32	33	32
L2 (Representing R1 and R2)	49	45	42	30	31	30

Logging graphs are presented in Figure 4 and Figure 5 with excluded data shown in grey.

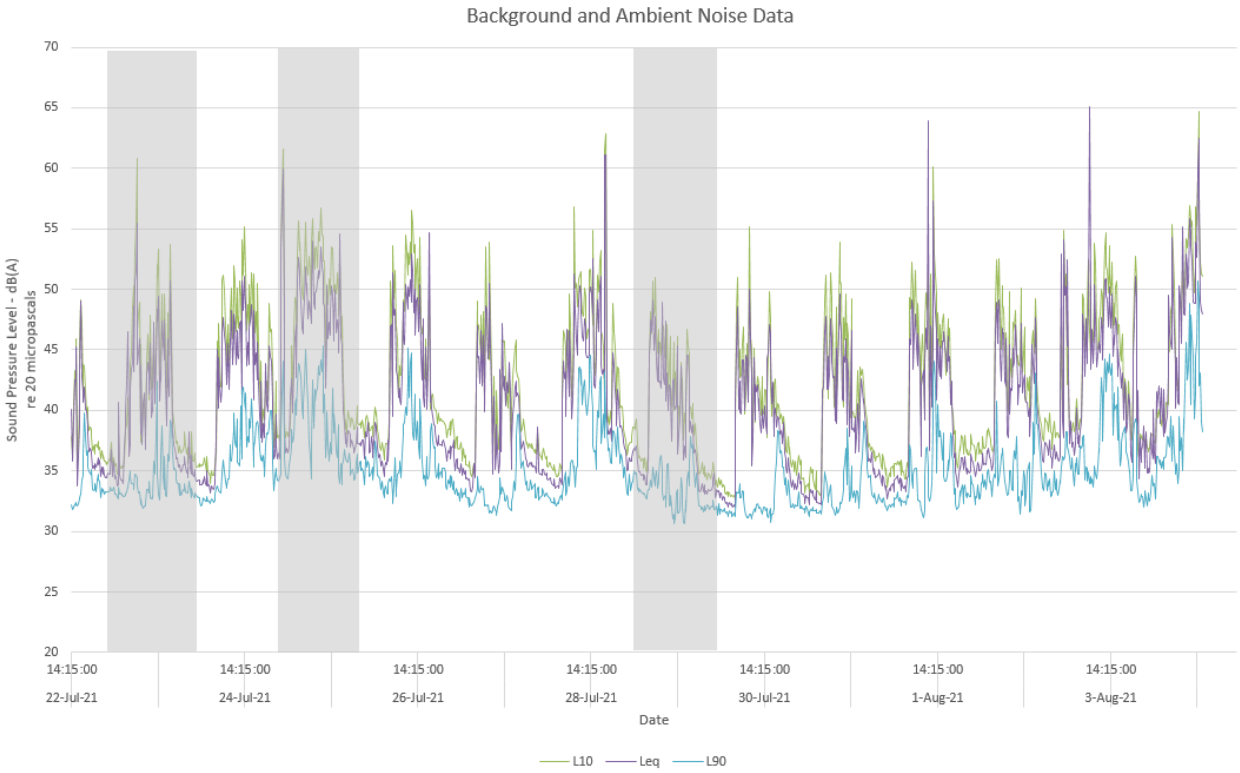

Figure 4 - Logging graph of logger location 1 (excluded data in grey)

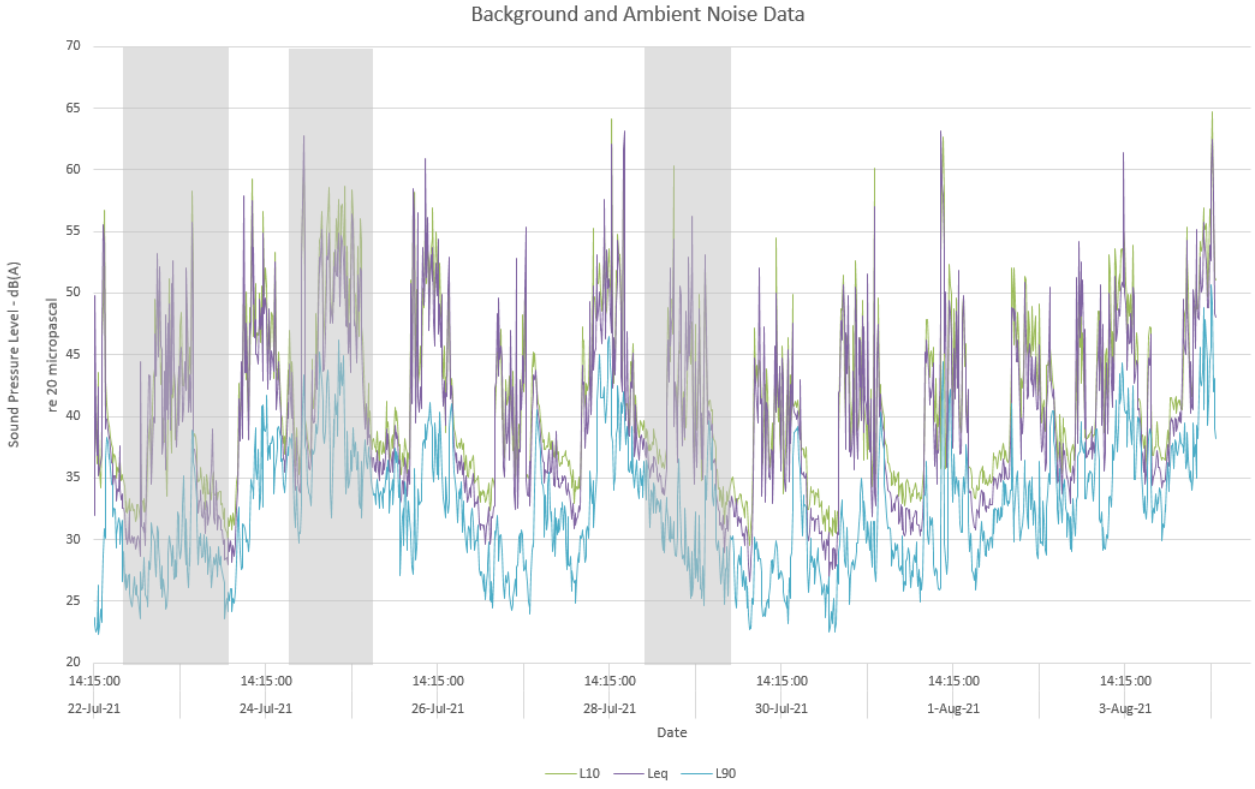

Figure 5 - Logging graph of logger location 2 (excluded data in grey)

4. Noise Criteria

4.1 External Noise Emissions

4.1.1 NSW Environmental Protection Authority (EPA) Noise Policy for Industry (NPI)

The NPI sets out noise criteria to control the noise emission from industrial noise sources.

The establishment of the relevant noise criteria are derived from the results of the ambient and background noise unattended monitoring, addressing two components:

- Controlling intrusive noise into nearby residences (Intrusiveness Criteria)
- Maintaining noise level amenity for particular land uses (Amenity Criteria)

Once both criteria are established the most stringent for each considered assessment period (day, evening, night) is adopted as the project-specific noise level (PSNL).

Intrusiveness Criteria

The NSW EPA NPI states the following:

> *"The intrusiveness of an industrial noise source may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (represented by the L_{Aeq} descriptor), measured over a 15-minute period, does not exceed the background noise level measured in the absence of the source by more than 5 dB(A)."*

The intrusiveness criterion can be summarised as follows:

$L_{Aeq,\ 15\ minute} \leq$ RBL background noise level + 5 dB(A)

The intrusiveness criterion for the closest residential receivers is presented in Table 3 below. Note the values from L1 and L2 have been used in this assessment to define the background and ambient noise level of the residential receivers.

Table 3: EPA INP Intrusiveness Criteria

Period	Noise Descriptor – dB(A)	Noise Criteria – R1 and R2 $L_{Aeq,15mins}$	Noise Criteria – R3 $L_{Aeq,15mins}$
Residential Receiver			
Daytime 7am – 6pm	$L_{Aeq,15min} \leq$ RBL + 5	40	40
Evening 6pm – 10pm	$L_{Aeq,15min} \leq$ RBL + 5	36	38
Night 10pm – 7am	$L_{Aeq,15min} \leq$ RBL + 5	35	37

Amenity Criteria

The NSW NPfI states the following:

> *"To limit continuing increases in noise levels from application of the intrusiveness level alone, the ambient noise level within an area from all industrial noise sources combined should remain below the recommended amenity noise levels specified in Table 2.2 where feasible and reasonable. The recommended amenity noise levels will protect against noise impacts such as speech interference, community annoyance and some sleep disturbance. The recommended amenity noise levels have been selected on the basis of studies that relate industrial noise to annoyance in communities" (Miedema and Voss, 2004).*

To ensure that industrial noise levels (existing plus new) remain within the recommended amenity noise levels for an area, a project amenity noise level applies for each new source of industrial noise as follows:

> *"Project amenity noise level for industrial developments = recommended amenity noise level (Table 2.2) minus 5 dB(A)"*

The applicable parts of Table 2.2: Amenity noise levels which are relevant to the project are reproduced below:

Table 4: NSW NPI Table 2.2 amenity criteria for external noise levels

Type of Receiver	Noise Amenity Area	Time of Day	L_{Aeq} , dB(A) Project amenity noise level	Adjusted Acceptable Levels $L_{Aeq,15mins}$
Residential Receiver	Rural*	Day	50	45
	Rural*	Evening	45	40
	Rural*	Night	40	35

*Rural area as defined in EPA NSW NPI Table 2.3

Sleep Disturbance

The NPI establishes sleep disturbance criteria for residential receivers near industrial noise sources during the night-time period, such vehicle movements, or for this development, dog barking. The criteria for protecting the amenity of surrounding residential receivers regarding sleep disturbance is:

- $L_{Aeq,15min}$ 40 dB(A) or prevailing RBL plus 5dB, whichever is greater, and/or
- L_{AFmax} 52 dB(A) or prevailing RBL plus 15dB, whichever is greater

Table 5 summarises the sleep disturbance criteria for the proposed development.

Table 5: Sleep Disturbance Criteria

Period	Sleep Disturbance Criteria	
	L_{AFmax} – dB(A)	$L_{Aeq,15min}$ – dB(A)
Residential Receiver		
Night (10:00pm to 7:00am)	52	40

Project Noise Trigger Levels

In summary, there are two criteria specific to this project. The overall criteria for the operation of the greyhound facility was established using the lowest values of the NPI noise levels mentioned above (the most stringent criteria). These levels are shown in Table 6 below.

Table 6: Project noise trigger levels for greyhound facility operation

Period	Descriptor	Project Specific Noise Emission Levels for R1 and R2 dB(A)	Project Specific Noise Emission Levels for R3 dB(A)
Residential Receiver			
Day (7:00am to 6:00pm)	$L_{Aeq,15min}$	40*	40*
Evening (6:00pm to 10:00pm)	$L_{Aeq,15min}$	36	38

Night (10:00pm to 7:00am)	$L_{Aeq,15min}$	35*	37
	L_{AFmax}	52	52

* Stantec maintain that the Noise Policy for Industry criteria is the appropriate assessment criteria for the project, however it was noted that The Panel had a query about criteria derived from the Noise Guideline for Local Government (NGLG) as minimum background levels are not included in the criteria derivation from that guideline. The daytime and night-time criteria in the table above have minimum background levels applied.

Should the method from the NGLG be used, the daytime criteria would be 35 dB(A) for R1 and R2, and 37 dB(A) for R3.The “Raw predicted noise levels” presented in Table 10 range from 14 – 17 dB(A) for a daytime scenario and would be even less for night-time when the dogs are enclosed in their kennels. Comparing these levels with the NGLG criteria shows that the predicted levels would still be well below criteria for day, evening, and night-time and the outcome of the assessment would remain unchanged.

Corrections for annoying noise characteristics

Fact Sheet C of the NPI presents modifying factor corrections to account for different qualities of the noise being assessed.

Factors that may be relevant for dog barking include:

- Tonal noise – when the level of one-third octave band exceeds the level of adjacent bands on both sides by 5 dB or more if the centre frequency of the band containing the tone is in the range of 500-10,000 Hz. This is true for the dog barking measured at the Central Coast kennels and a modifying factor of 5 dB is relevant.
- Intermittent noise – when the source noise heard at the receiver varies by more than 5 dB(A) and the intermittent nature of the noise is clearly audible. A 5 dB modifying factor is relevant, to be applied to the night-time only.

These modifying factors will be added to the predicted levels at the receivers as part of the assessment process.

5. Noise Impact Assessment

5.1 Noise Sources

Noise sources generated by the proposed facility include:

- Dog barking
- Human voices directing the dogs
- Car and truck movements to and from site
- Mechanical noise from fans and air conditioning

Typically, sound sources are defined by their sound power levels which is used for acoustic modelling.

In order to inform the noise modelling, measurements were taken at an existing greyhound facility in the Central Coast of NSW.

Multiple measurements were taken including:

- A 15-minute average measurement, during which the dogs were excited, barking upon the arrival of visitors and the anticipation of food for approximately the first 7 minutes, then calmed and rarely barked for the remaining time. The acoustic statistic of interest for this measurement was $L_{Aeq,15min}$ of 70dB(A).
- Short measurements during peak barking events to determining the maximum sound level of a greyhound/s barking. The acoustic statistic of interest for this measurement was L_{AFmax} of 88dB(A). This was taken approximately 10 meters away from the closest greyhound.

5.2 Mechanical Noise Assessment

As the detailed design and selection of mechanical plant has not been completed, a maximum noise level assessment will be conducted.

5.2.1 Assumptions

- Each kennel will likely have a fan for ventilation. This would be for all 20 kennels.
- The main buildings would also have associated air conditioning and ventilation.
- Mechanical plant would likely run during the nighttime period, and the nighttime criteria of 35 dB(A) applies
- The closest receiver is at 570m from the site (R2)

Table 7 presents a typical scenario, as detailed design of mechanical plant is completed the specified units and locations should be incorporated into the acoustic model.

Table 7 Maximum sound power levels for mechanical plant

Mechanical plant	Number of	Maximum sound power level
Fans on kennels	20	71 dB(A) each
Condenser units	4	87 dB(A) each

The levels in Table 7 are in the range of typical levels for the equipment listed, however if the detailed assessment of selected plant indicates noise levels are higher, there are many options for noise mitigation including; enclosing noisy plant, use of acoustic louvers or barriers, and locating plant in locations where natural shielding occurs. Given the above, the assessment indicates that mechanical noise criteria (provided in Table 6) will be able to be achieved.

5.3 Traffic noise assessment

5.3.1 Traffic passing by on local road

The relevant traffic criterion comes from Table 3 of the EPA NSW Road Noise Policy (RNP):

"6. Existing residences affected by additional traffic on existing local roads generated by land use developments" The daytime assessment criteria is 55 dB(A) LAeq 1hr external.

Assessment assumptions

- Cars travel along the local road at 50kph (however likely less as it is a narrow dirt road and has a creek crossing)
- Worst case scenario would be all staff arriving (or leaving) within an hour = 30 car movements as per traffic report
- The closest resident to the local road is approximately 250m, however 200m has been used in the assessment to allow for a conservative boundary

Given the above assumptions a predicted LAeq 1hr is approximately 45 dB(A). Which is 10 dB less than the criterion.

5.3.2 Traffic movements in the carpark on site

Movements in the car park on site are part of the 'operational activity' of operating the kennels and therefore are covered by the NPI criteria (see Table 6). An assessment of the predicted noise levels due to cars in the car park has been conducted.

Assessment assumptions

- Worst case scenario would be all staff arriving (or leaving) within 15 minutes = 30 car movements as per traffic report
- This would include 30 car door slams, and 30 car engine ignition events

Given the above assumptions a predicted LAeq 15 min is approximately 22 dB(A). Which is 18 dB less than the daytime criterion.

5.4 Dog Barking Noise Assessment

The basis of the detailed assessment is to assess if the noise levels generated by the greyhounds meet the established criteria at the nearest residential receivers.

A 3D acoustic model (SoundPlan) was created for this assessment considering the following variables:

- Ground contouring/terrain around the site and receivers
- Industrial noise standard ISO 9613-2 1996
- Ground absorption of 0.8
- Barrier effect of existing and new buildings
- Distance attenuation of sound through the air
- Number of dogs and their distribution among the kennels – 400 dogs with 20 per kennel

5.4.1 Meteorological conditions

Effects of temperature inversion

A temperature inversion can occur during the night-time, usually in winter, when the air close to the ground is colder but gets warmer as the height above the ground is increased.

In this environment soundwaves can be refracted downward and can sometimes be heard over longer distances than would usually with normal environmental conditions.

Without detailed annual meteorological data, a conservative weather condition category has been selected for the assessment. CONCAWE has defines meteorological categories from Category 1 to Category 6, where Category 6 has the greatest increase of sound levels. For this assessment Category 5 (second highest category) has been selected as a conservative approach.

Table 8: Spectrum data for meteorological effects

	Meteorological effects dB								
	63Hz	**125Hz**	**250Hz**	**500Hz**	**1kHz**	**2kHz**	**4kHz**	**8kHz**	**Total increase dB(A)**
R1 (700m away)	1.1	2.9	4.5	4.5	5.1	3.1	4.6	4.6	**3.5**
R2 (570m away)	1	2.6	4.2	4.2	5.1	3.1	4.3	4.3	**3.5**
R3 (850m away)	1.2	3.2	4.9	4.9	5.1	3.0	4.8	4.8	**3.4**

Meteorological effects dB									
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	Total increase dB(A)
RX[1] (2000m away)	1.7	4.4	6.5	6.5	4.9	2.9	5.0	5.0	**3.3**

1. Note: Rx is representative of an example receiver 2000m away from the site to demonstrate the effects of temperature inversion over longer distances

Discussion

CONCAWE's category 5 was selected for this analysis as it accounts for temperature inversions as well as the wind effects for the scenario where residents are downwind from the noise source. It is understood that typically winds blow in the opposite direction, from noise source away from receivers, therefore this is a conservative approach. In the unlikely case that conditions aligning with the very worst-case Category 6 (temperature inversion and high-speed winds in direction of residents), then there would be non-significant increase in overall noise level for this scenario.

As presented in Table 8, the overall effect of inversions for sound travelling to nearby receivers is approximately 3.5 dB(A). A 3 dB difference is the level change at which most people can identify a difference in noise level, changes under 3dB may not be perceptible to most people. This means that on these occasions where there is a temperature inversion, the sound levels may be just perceptibly higher than on other nights. While an approximately 3dB could be encountered during a temperature inversion, it is also acknowledged that people are most likely to have their windows closed during winter nights, which internally would not be noticeable.

Even at distances of 2km the average total effect due to meteorological effects is 3.3 dB(A), with this greater distance also comes further reduction through distance loss and air absorption. As the closest receivers comply, the further receivers are also expected to comply.

5.4.2 Measurements used for modelling

The frequency spectrum measured at the greyhound facility was used for the modelled noise source, see Table 9 for spectrum data.

Table 9 Frequency spectrum of measurement at greyhound facility used for modelling

L_{Zeq} – dB							
63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
51	45	46	64	69	61	47	43

5.5 Noise modelling results

Two scenarios were modelled as part of the assessment. The first is a typical scenario of an excitable event such as feeding where the greyhounds will bark for a portion of a 15-minute period. This will be used to compare with the daytime, evening, and night-time criteria from the NSW NPI.

The second modelling scenario is of maximum noise levels. This will be used to compare with the sleep disturbance criteria to determine whether barking at night-time is likely to cause disturbance to the sleep of nearby residents.

5.5.1 Scenario 1 - Average noise levels

The following assumptions were made for this modelled scenario:

- The greyhounds are roaming in the open space outside of each kennel
- There are 20 greyhounds to each kennel and 20 kennels
- Feeding and other activities that would cause excitement for the greyhounds will occur during daytime hours
- It was observed that during the feeding event at the Central Coast Kennels, that 1 in 5 dogs were barking simultaneously. For this scenario, 1 in 5 dogs are modelled barking 100 times each over a 15-minute period, equating to 8000 individual bark events. It is understood that the feeding of each kennel/pod will be staggered as staff make the food rounds and as such groups of dogs will be excited at a time.

Figure 6 presents a 'heat map' of the predicted noise levels during the scenario described above.

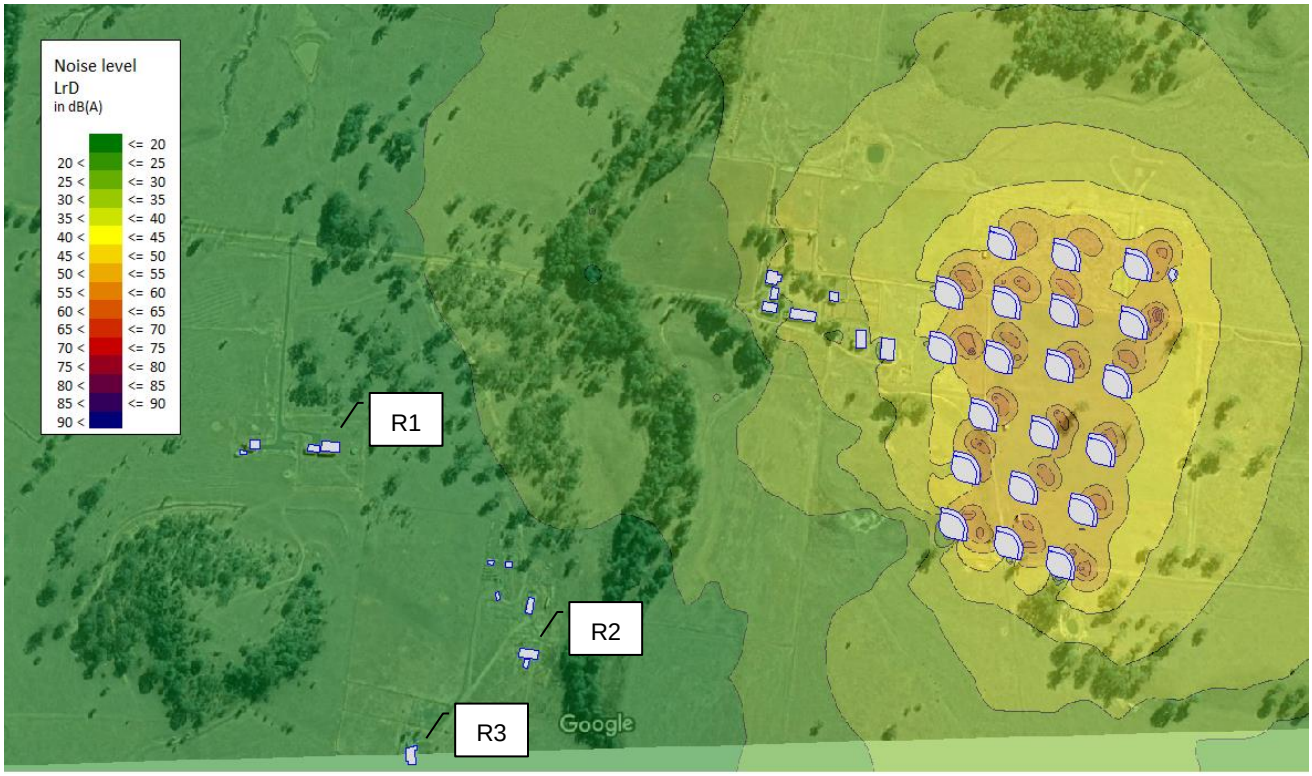

Figure 6 - Noise 'heat map' from a typical daytime scenario including an exciting event

Noise Modelling Results

The most stringent average noise criteria for the receivers is 40dB(A) from the NPI. The predicted levels are presented in Table 10.

Table 10 Noise modelling results for average dog barking

Receiver	Raw predicted levels at the receivers ($L_{Aeq,15min}$)	Predicted levels with penalties for intermittent and tonal noise (5 dB + 5 dB)	Daytime criteria dB(A) $L_{Aeq\ 15min}$	Meets criteria?
R1	17	27	40	✓ Yes
R2	17	27	40	✓ Yes
R3	14	24	40	✓ Yes

In terms of complying with the daytime, evening, and night-time criteria from the noise policy for industry, noise levels are expected to comply for all residents in all periods.

5.5.2 Scenario 2 – Maximum noise levels (night-time sleep disturbance)

The following assumptions were made for this modelled scenario:

- Greyhounds will be confined to the enclosed kennel or undercover portion of the kennel during the night-time period (10pm to 7am).
- 1 greyhound from each kennel will bark at the same time (this assumption is conservative as it is more likely barking will be intermittent and dispersed between kennels).
- The sound power level of 1 greyhound barking is 116 dB(A) SWL (calculated from the short-term measurements taken at the Central Coast facility)
- The undercover portion of the kennels will be lined with acoustically absorbent insulation

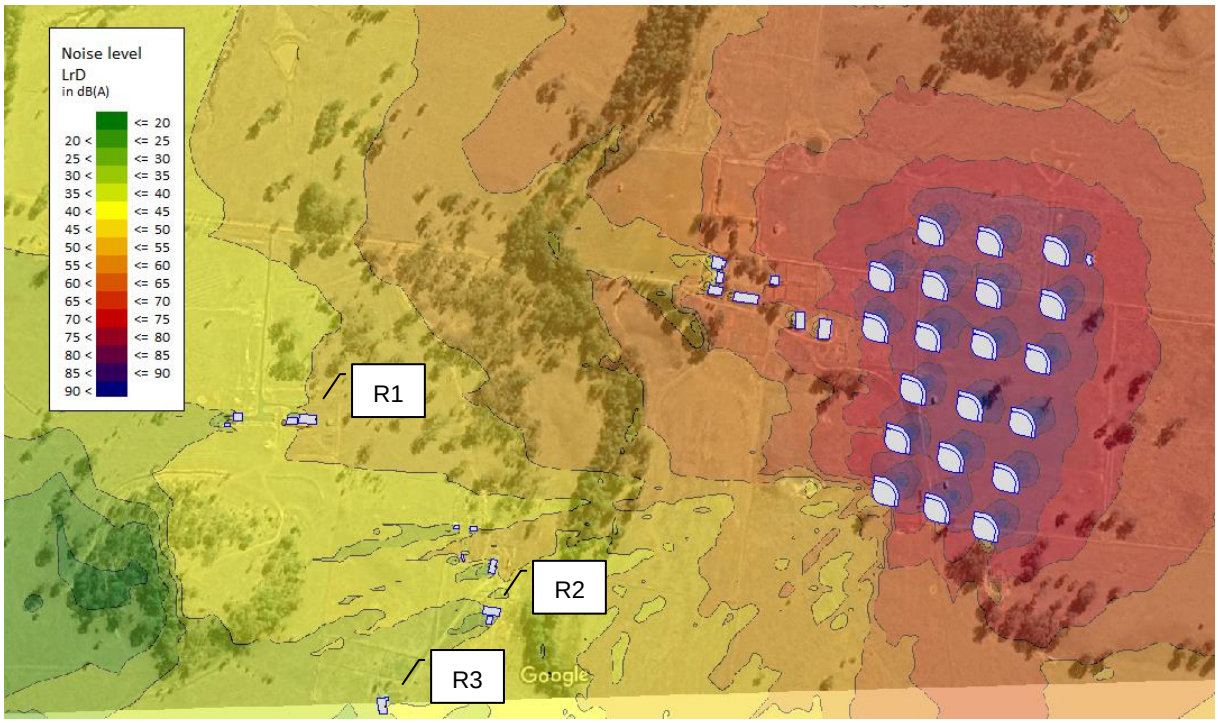

Figure 7 - Noise 'heat map' from a maximum noise level night-time scenario

Noise Modelling Results

The most stringent night-time sleep disturbance criteria is 52dB(A) L_{AFmax}. The predicted maximum noise levels are presented in Table 11.

Table 11 Noise modelling results for maximum dog barking

Receiver	Raw predicted levels at the receivers (L_{AFmax})	Predicted levels with penalties for weather inversions (+3.5 dB)	Nighttime criteria dB(A) $L_{Af,max}$	Meets criteria?
R1	45	48.5	52	✓ Yes
R2	41	44.5	52	✓ Yes

R3	40	40.5	52	✓ Yes

In terms of complying with the sleep disturbance criteria, the maximum noise levels (L_{AFmax}) are expected to comply at all three receivers.

6. Noise Mitigation Measures

6.1 Plan of Management

The following is recommended to be included within the plan of management for the purpose of noise control:

- The proposed facility will act primarily as an animal boarding facility and there will be an on-site manager. As such, the dogs will be generally under supervision and there will, therefore, be little opportunity for the dogs to be allowed to bark consistently for extended periods.
- On occasions that the greyhounds are excited and bark as a response, staff on site should attempt to settle and control the barking event.
- Greyhounds will freely access the outdoor dedicated area of their kennels during the day-time period.
- During the evening and night-time periods (6pm to 7am) the dogs will be limited to a space either within the enclosed kennel or outside underneath the kennel overhang/awning.
- All other management procedures already outlined in Appendix K: Noisy Dog Management (Operational Plan by GRNSW)

6.2 Architectural noise mitigation

The fan shaped design of the kennels facing away from the receivers has a significant effect on reducing noise to the residents. To further reduce reflected sound, it is recommended to apply an absorbent finish to areas of the inside of the kennels, both to further minimize noise emissions from the kennels and to make the environment for the greyhounds more comfortable by reducing reverberation and consequently sound build up inside the kennels.

Recommended areas for absorption are presented in Figure 8 and Figure 9.

The following absorptive products are recommended for their cleanability and resiliency:

- Stratocell Whisper
- Reapor - Pyrotek

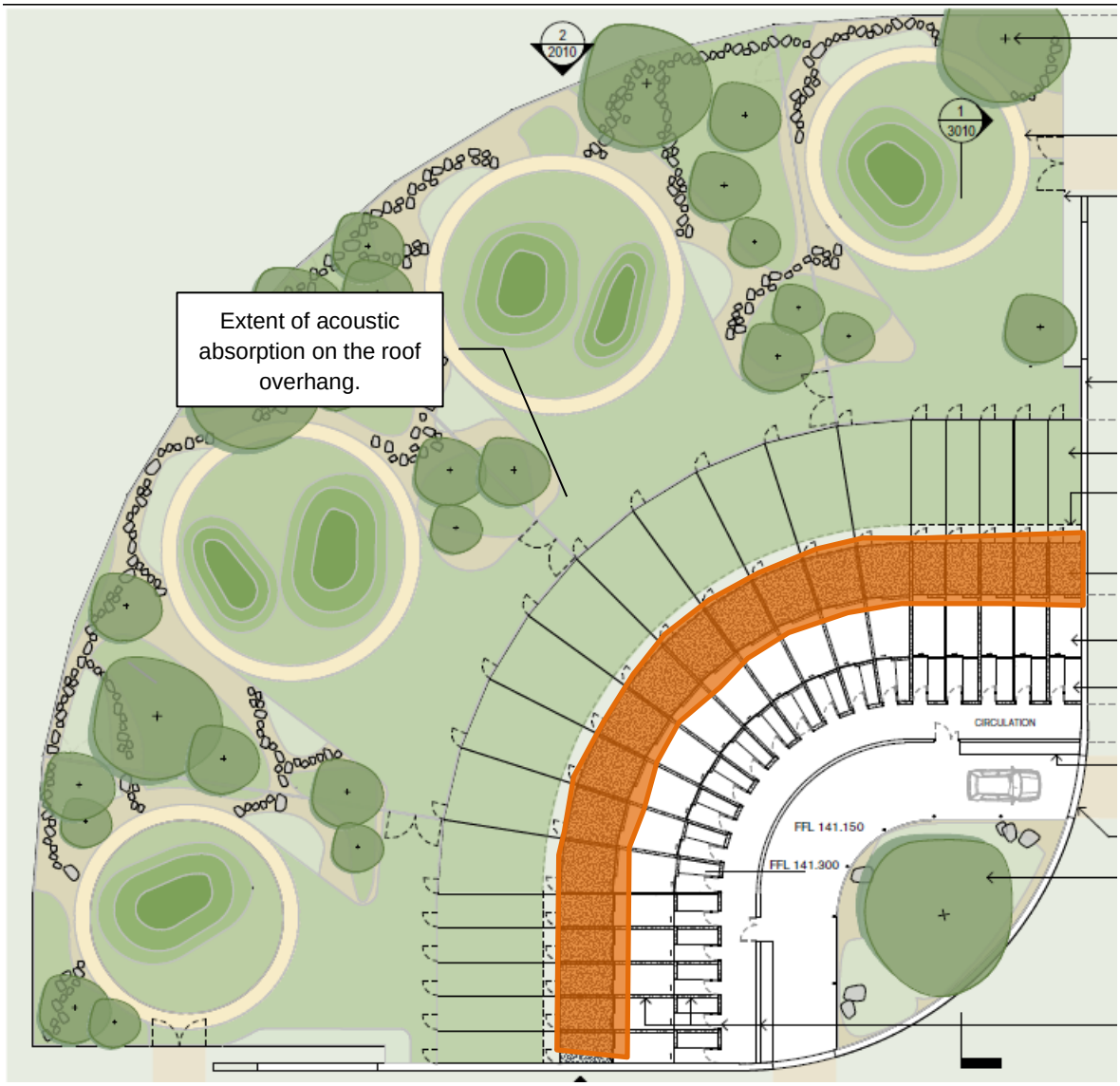

Figure 8 - Kennel design

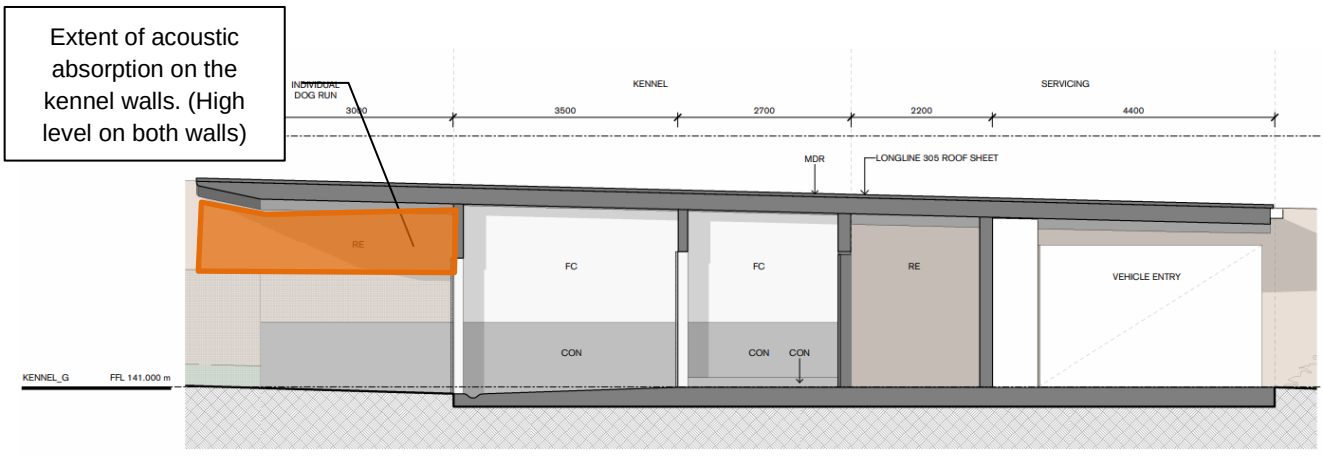

Figure 9 - Individual kennel section

7. Conclusion

This document presents a noise impact assessment for the proposed dog kennel facility to be located in Bylong Park (upper Hunter Valley Region) NSW.

The nearest residential receivers were identified, and noise logging was conducted in short term and long-term measurements. Criteria were determined based on the results of the noise logging.

An acoustic model was built to predict the noise levels at nearby residents and the results were compared with criteria for two different scenarios.

Recommendations for noise control were provided regarding a plan of management and architectural design controls.

It was determined that the noise criteria from the NSW Environmental Protection Authority can be achieved for daytime, evening, and night-time periods. As such the development should be approved by Council from an acoustic assessment perspective.

Appendix A Glossary of Acoustic Terms

NOISE	
Acceptable Noise Level:	The acceptable LAeq noise level from industrial sources, recommended by the EPA (Table 2.1, INP). Note that this noise level refers to all industrial sources at the receiver location, and not only noise due to a specific project under consideration.
Adverse Weather:	Weather conditions that affect noise (wind and temperature inversions) that occur at a particular site for a significant period of time. The previous conditions are for wind occurring more than 30% of the time in any assessment period in any season and/or for temperature inversions occurring more than 30% of the nights in winter).
Acoustic Barrier:	Solid walls or partitions, solid fences, earth mounds, earth berms, buildings, etc. used to reduce noise.
Ambient Noise:	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment Period:	The period in a day over which assessments are made.
Assessment Location	The position at which noise measurements are undertaken or estimated.
Background Noise:	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level.
Decibel [dB]:	The units of sound pressure level.
dB(A):	A-weighted decibels. Noise measured using the A filter.
Extraneous Noise:	Noise resulting from activities that are not typical of the area. Atypical activities include construction, and traffic generated by holidays period and by special events such as concert or sporting events. Normal daily traffic is not considered to be extraneous.
Free Field:	An environment in which there are no acoustic reflective surfaces. Free field noise measurements are carried out outdoors at least 3.5m from any acoustic reflecting structures other than the ground
Frequency:	Frequency is synonymous to pitch. Frequency or pitch can be measured on a scale in units of Hertz (Hz).
Impulsive Noise:	Noise having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent Noise:	Level that drops to the background noise level several times during the period of observation.
LAmax	The maximum A-weighted sound pressure level measured over a period.
LAmin	The minimum A-weighted sound pressure level measured over a period.
LA1	The A-weighted sound pressure level that is exceeded for 1% of the time for which the sound is measured.
LA10	The A-weighted sound pressure level that is exceeded for 10% of the time for which the sound is measured.
LA90	The A-weighted level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
LAeq	The A-weighted “equivalent noise level” is the summation of noise events and integrated over a selected period of time.

LAeqT	The constant A-weighted sound which has the same energy as the fluctuating sound of the traffic, averaged over time T.
Reflection:	Sound wave changed in direction of propagation due to a solid object met on its path.
R-w:	The Sound Insulation Rating R-w is a measure of the noise reduction performance of the partition.
SEL:	Sound Exposure Level is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
Sound Absorption:	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound Level Meter:	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance, and designed to measure sound pressure levels.
Sound Pressure Level:	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound Power Level:	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise:	Containing a prominent frequency and characterised by a definite pitch.

Design with
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