Acoustic Report

Menangle Park Urban Release Area

Planning Proposal

Prepared for Dahua Group Sydney
Report Reference: 17SYA0027 R04_1

About TTM

For 30 years, we've been at the centre of the Australian development and infrastructure industry. Our unique combination of acoustics, data, traffic and waste services is fundamental to the success of any architectural or development project.

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T: (02) 9418 3033
F: (02) 9418 3112
E: ttmnsw@ttmgroup.com.au

Acoustics Data Traffic Waste

Revision Record

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Executive Summary

TTM conducted a noise assessment for the Menangle Park Park Urban Release Area (URA), located approximately 65km from Sydney CBD for APP Corporation on behalf of Dahua Group. Noise monitoring of existing road traffic and rail noise levels were conducted across the site and noise impact levels were predicted using noise prediction modelling.

The URA is predicted to adhere to the recommendations of the Campbelltown (Sustainable City) Development Control Plan (DCP) 2015 – *Volume 2, Part 8 Menangle Park DCP* with the inclusion of acoustic design to future dwellings affected by high road traffic and rail noise levels.

The implementation of a six-metre high acoustic barrier as a noise mitigation measure has proven to be unreasonable and impractical, when considering the noise mitigation benefits versus the overall adverse social, economic and environmental effects, including the cost of the abatement measure.

This report demonstrates that the site is suitable for the development of residential lots and is feasible while keeping an appropriate acoustic amenity and controlled noise impact onto the local community.

Contents

Table Index

Figure Index

1 Introduction

TTM Consulting has been engaged by APP Corporation on behalf of Dahua to prepare a noise assessment for the Menangle Park Urban Release Area (URA), located approximately 65 km from Sydney CBD. The purpose of the report is to support an amendment to Campbelltown Local Environmental 2015 (Campbelltown LEP 2015).

1.1 Background

Menangle Park is a rural-residential suburb located in Sydney's south west within the Greater Macarthur Priority Growth Area. It is approximately 5.5km to the south-west of the Campbelltown, 23km from the Liverpool Strategic Centre and 65km from Sydney CBD.

The Menangle Park Urban Release Area (URA) includes 498 ha of land owned or under the control of Dahua Group (Aust) Pty Ltd (Dahua) and 6 additional lots owned or under the control of other landowners.

The URA was rezoned from rural land to urban purposes on 18 November 2017 to accommodate approximately 3,400 residential lots, a retail/commercial town centre, employment lands and community and recreational facilities.

This report will focus on the noise impact assessment of the surrounding transport corridors on the Menangle Park URA.

1.2 Scope

The report has addressed the following local and state planning policies and plans:

- Campbelltown DCP 2015 – *Volume 2, Part 8 Menangle Park DCP*
- NSW Road Noise Policy[1]
- NSW Rail Infrastructure Noise Guideline[2]
- NSW SEPP Infrastructure[3]
- Masterplan Menangle Park layout, as presented in Appendix A
- Noise measurements, modelling, analysis and calculations conducted by TTM.

[1] NSW Department of Environment, Climate Change and Water (2011), NSW Road Noise Policy

[2] NSW Environment Protection Authority (2013), Rail Infrastructure Noise Guideline

[3] NSW Department of Planning, State Environmental Planning Policy (SEPP) (Infrastructure) 2007

2 Study Area

The land to which the proposed LEP amendment and planning proposal relates (the site) includes all land owned or under the control of Dahua and six additional properties on the eastern side of Cummins Road owned or under the control of other landowners. The Structure Plan, as proposed to be amended, continues to relate to all land within the Menangle Park URA.

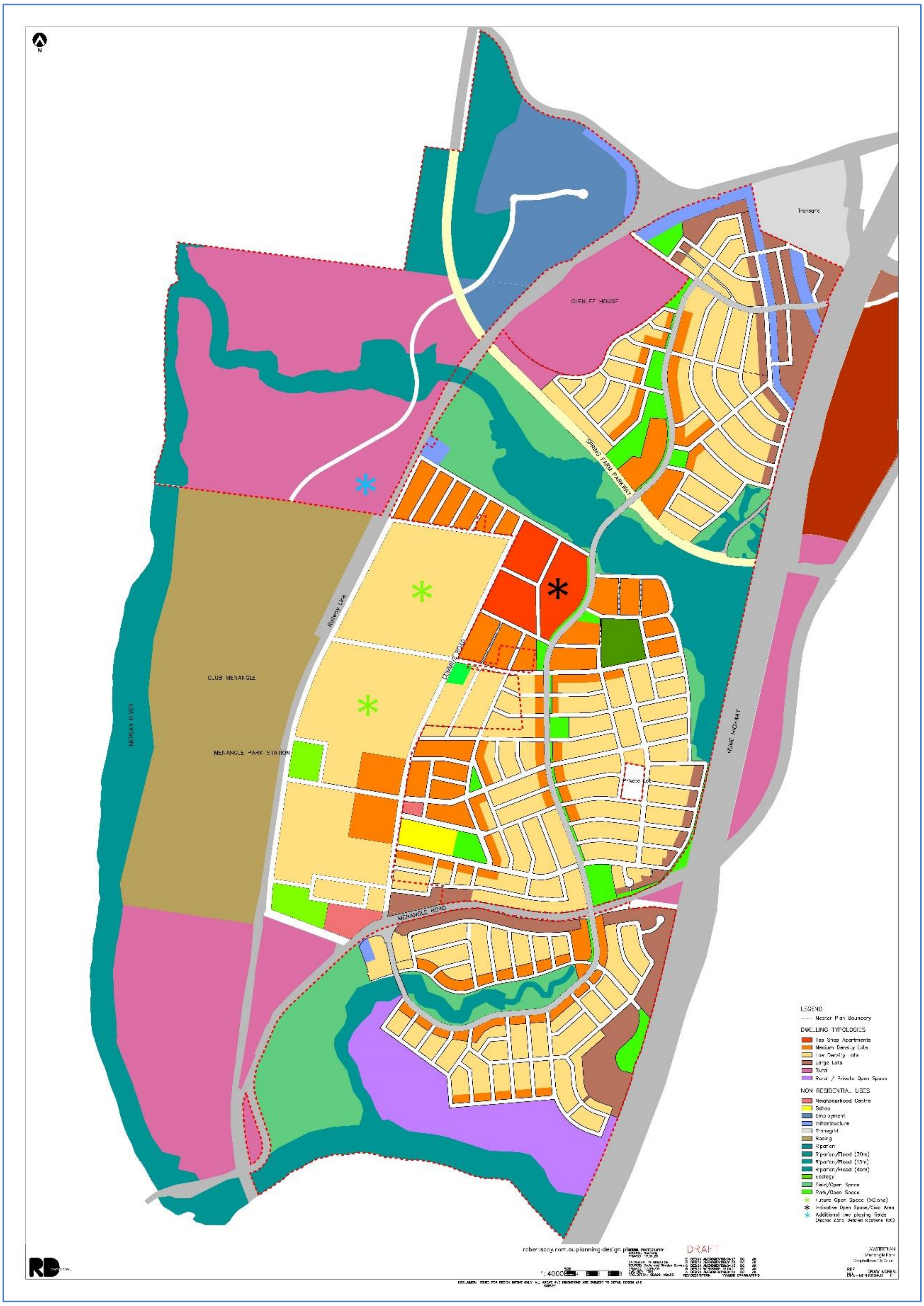
The proposed amendment builds upon the previous rezoning and associated Structure Plan to create a new sustainable, healthy and high quality residential community comprising:

- 5,250 dwellings (an increase of 1,850 dwellings)
- a new major town centre comprising 30,000m² of retail / employment gross floor area
- a new neighborhood centre (approximately 3,500m² of employment floor space)
- a revised road and street network to provide better permeability throughout the site
- sporting fields and parks
- integrated passive recreation area within a riparian corridor network
- land for environmental conservation
- community facilities to support the proposed increase to the population, and
- primary school.

For the purposes the report, an assessment of the proposal's impact on the site and broader area has been undertaken as the potential impact of the proposal may extend beyond the boundaries of the master plan and / or land to which the planning proposal relates.

The boundary of the site is shown in Figure 1.

Figure 1: Site's Boundary



2.1 Description of Acoustic Environment

The main noise sources currently impacting the site are road traffic noise from the Hume Highway and Menangle Road, and rail noise from the Southern Highlands line.

On the eastern border of the site, road traffic noise from the Hume Highway, currently carrying a traffic volume of approximately 52,000 vehicles Annual Average Daily Traffic (AADT), is the dominant noise source. Traffic counts on the Hume Highway showed that traffic reduces significantly during the night-time assessment period (10pm to 7am), while, the percentage of heavy goods vehicles (HGVs) increases significantly during that same period.

Menangle Road cuts across the southern portion of the site. The road currently carries a traffic volume of approximately 11,300 vehicles per day during weekdays and approximately 4,500 vehicles per day on the weekend. The weekday traffic flow has a very pronounced AM peak (8am to 9am) with approximately 1,400 vehicles and a slightly lower PM peak (4pm to 5pm) flow of approximately 1,100 vehicles. Traffic flows during the evening journeys are more spread out.

The main Southern Highlands rail line intersects the north-east part of the Dahua acquired land. The masterplan shows development to the east of the rail line. No development is planned within the riparian corridor and the Glenlee Homestead estate, which occupy the majority of the Dahua land adjacent the east side of the rail line. Consequently, there are only small pockets of residential development close to the rail that are potentially at risk from rail noise impact line. There is currently no development planned to the west of the rail line.

3 Noise Survey

Road traffic and rail noise measurements were undertaken on site between Tuesday the 25th July and Wednesday the 2nd August 2017. The acoustic environment has not changed since and therefore the noise measurements conducted during that period are still representative of the existing environment. Both attended and unattended noise measurements were conducted generally in accordance with the recommended methodology outlined in Australian Standard AS1055[4].

3.1 Equipment

The equipment used to measure existing noise levels are summarised in Table 1.

Table 1: Acoustic Equipment

Purpose	Equipment	Serial Number	Location (Refer to Figure 2)
Unattended road traffic noise	ARL EL316 Environmental Noise Logger	16-707-045	Location 1 – Northern section of site, north of Menangle Road
	ARL EL316 Environmental Noise Logger	16-004-037	Location 2 – Southern section of site, south of Menangle Road
Unattended rail noise	Norsonic Nor140, Noise Logger	1406507	Location 3
Attended rail noise	Brüel & Kjær Model 2250, Type 1 Sound Level Meter	3004473	Next to corresponding noise logger
	Norsonic Nor140, Noise Logger	1406506	
Calibrator	Brüel & Kjær Model 4231, Sound Calibrator	3009809	-

All equipment was calibrated by a National Association of Testing Authorities (NATA) accredited laboratory. The equipment was calibrated before and after the measurement session. No significant drift from the reference signal was recorded.

3.2 Noise Monitoring Methodology

Three noise monitors were installed on site to conduct unattended noise monitoring of road traffic and rail noise levels. The noise monitoring locations are shown in Figure 2.

The microphones for all three monitors were in a free-field position at a height of 1.5 metres above ground level.

Average, maximum and statistical noise parameters were recorded by the noise monitors at 15-minute intervals in fast response. The weather throughout the monitoring period was described as fine with light winds.

[4] AS 1055.1:1997. Acoustics - Description and measurement of environmental noise - General procedures

3.2.1 Unattended Road Traffic Noise

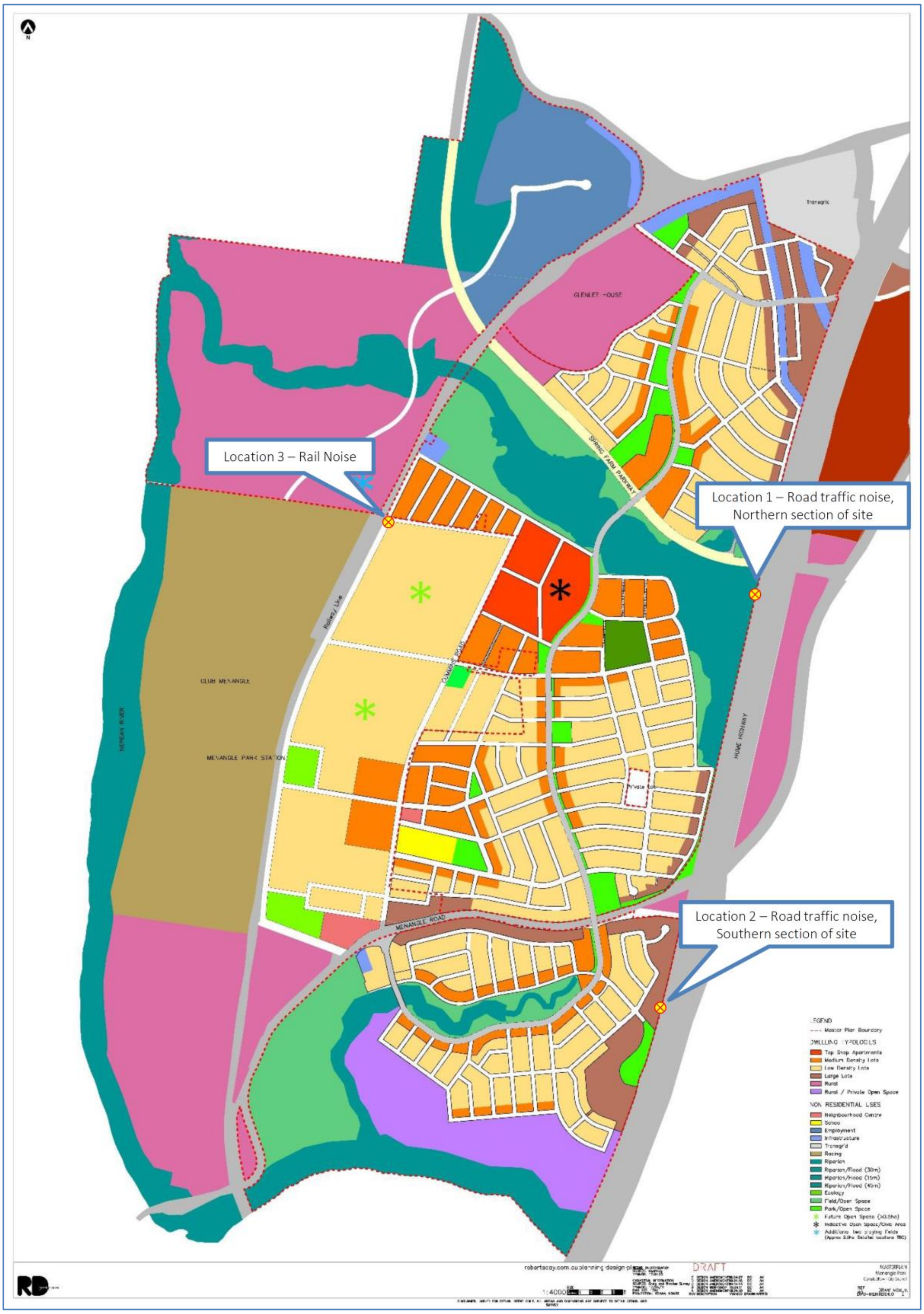
The first monitor was installed in the northern section of the site, north of Menangle Road. The noise monitor was placed as close as possible to the Hume Highway considering access, uneven topography and safety of equipment to capture road traffic noise levels from the road, shown as Location 1 on Figure 2. The monitor was approximately 57 metres from the edge of the closest lane of the Hume Highway, and approximately one kilometre north of Menangle Road. At that location, the monitor had an unobstructed view of the road to capture representative road traffic noise levels across the northern section of the site.

The second monitor was installed to capture road traffic noise levels in the southern section of the site, south of Menangle Road. The noise monitor was again placed as close as possible to the Hume Highway considering access and safety of equipment to capture road traffic noise levels from the road, shown as Location 2 on Figure 2. The monitor was approximately 53 metres from the edge of the closest lane of the Hume Highway, and approximately 460 metres south of Menangle Road. The monitor had an unobstructed view of the road to capture representative road traffic noise levels across the southern section of the site.

3.2.2 Unattended Rail Noise

The third monitor was placed adjacent to the Southern Highlands railway line close to the corner of Racecourse Avenue and Fitzpatrick Street, to capture rail noise levels in the area, shown as Location 3 on Figure 2. The monitor was approximately 8 metres from the middle of the closest railway line, to ensure noise levels of train pass-bys were captured with no contamination from external noise sources.

Figure 2: Noise Monitoring Locations



3.2.3 Attended Noise Measurements

Attended noise measurements were also undertaken at the monitoring locations during logger installation and collection. The measurements were taken using a Brüel & Kjær Type 2250, Type 1 Sound Level Meter (S/N 3004473). The measurements re used to verify and supplement the unattended noise monitoring data.

The Sound Level Meter was secured on a tripod and its microphone was positioned next to the microphone of the noise logger. Average, maximum and statistical noise parameters were recorded at 15-minute intervals in fast time response.

The weather throughout the attended measurements was described as fine with a light breeze. The sound level meter was checked for calibration before and after the measurement and no significant drift was observed.

3.2.4 Attended Rail Noise Measurements

Attended rail noise measurements were also undertaken at Location 3 to capture train pass-by noise levels. The measurements were taken using a Brüel & Kjær Type 2250, Type 1 Sound Level Meter (S/N 3004473) and Norsonic Nor140, Noise Logger (S/N 1406506).

The train pass-by noise measurements were started when the train noise was clearly audible and was stopped when the entire train has passed by the sound level meter. The Sound Level Meter was secured on a tripod and its microphone was positioned at 1.5 metres above ground level. Average, maximum and statistical noise parameters were recorded for the duration of each train pass-by in fast time response.

The weather throughout the attended measurements was described as fine with a light breeze. The sound level meter was checked for calibration before and after the measurement and no significant drift was observed.

3.3 Results

3.3.1 Road Traffic Noise Monitoring Results

Table 2 presents a summary of the measured noise levels at Locations 1 and 2 (Refer to Figure 2). The noise monitoring daily results are represented graphically in Appendix B. The monitoring results were used to calibrate the road traffic noise model.

Table 2: Summary of Road Traffic Noise Monitoring Results

Period	Existing Noise Levels in dB(A)			
	Rating Background Noise Levels, RBL L_{90}	L_{eq}	L_{10}	L_1
Location 1 – Close to Hume Highway, North of Menangle Park				
Day	57	66	72	75
Evening	55	66	70	74
Night	46	66	72	75

Period	Existing Noise Levels in dB(A)			
	Rating Background Noise Levels, RBL L_{90}	L_{eq}	L_{10}	L_1
Location 2 – Close to Hume Highway, South of Menangle Park				
Day	52	64	70	74
Evening	52	64	69	73
Night	43	64	70	75

Note:
- Day-time period is from 0700 to 1800 (Monday to Saturday) and 0800 to 1800 (Sundays and Public Holidays)
- Evening period is from 1800 to 2200
- Night-time period is from 2200 to 0700 (Monday to Saturday) and 2200 to 0800 (Sundays and Public Holidays)

As expected, the existing noise levels at Location 1 are similar to Location 2, being at similar distances to the Hume Highway. The measured noise levels are generally similar throughout the day, evening and night, except for the L_{90} parameter, which drops during the night-time.

The noise monitoring results have also been summarised in terms of the NSW road traffic noise descriptors and the CoRTN Method descriptor (*Calculation of Road Traffic Noise, Department of Transport, Welsh Office*, UK 1988) in Table 3.

Table 3: Road Traffic Noise Monitoring Results – NSW RTN Descriptors

Period (T)	Existing Noise Level in dB(A)		
	NSW Road Noise Policy descriptor		CoRTN $L_{10,18h}$ (6am to 12am)
	$L_{eq,T}$	$L_{eq,1h}$ (Average maximum 1 hour)	
Location 1 – Close to Hume Highway, North of Menangle Park			
Day (7am - 10pm)	66	68	70
Night (10pm - 7am)	66	67	
Location 2 – Close to Hume Highway, South of Menangle Park			
Day (7am - 10pm)	64	66	67
Night (10pm - 7am)	64	65	

From the noise measurements and site inspection, the eastern boundary of the site, close to Hume highway, is predominately impacted by road traffic noise from the road.

3.3.2 Rail Noise Monitoring Results

Table 4 presents a summary of the measured noise levels at Location 3 (Refer to Figure 2). The noise monitoring daily results are represented graphically in Appendix B. The monitoring results were used to calibrate the rail noise model.

Table 4: Summary of Rail Noise Monitoring Results

Period	Existing Noise Levels in dB(A)			
	Rating Background Noise Levels, RBL L_{90}	L_{eq}	L_{10}	L_{1}
Location 3 – Adjacent to the Southern Highlands railway line				
Day	36	79	59	89
Evening	36	68	52	88
Night	31	67	52	89
15-hour Day (7am - 10pm)	-	78	-	-
9-hour Night (10pm - 7am)	-	67	-	-
24-hour	-	68	-	-

Note:
- Day-time period is from 0700 to 1800 (Monday to Saturday) and 0800 to 1800 (Sundays and Public Holidays)
- Evening period is from 1800 to 2200
- Night-time period is from 2200 to 0700 (Monday to Saturday) and 2200 to 0800 (Sundays and Public Holidays)

As expected, the existing noise levels at Location 3 are similar throughout the day, due to limited human activity in the area. Train noise pass-bys are the main noise source in the area but due to the short duration of the pass-bys, the train noise sources are not reflected in the presented statistical parameters. The L_{90} parameter drops in the night-time assessment period, as expected, due to lower human activity, such as road traffic noise on the local network.

Attended train pass-bys noise measurements were also undertaken on site adjacent to east of the railway line. The railway line has two tracks and the sound level metre was positioned at approximately 10 metres to the near track and 14 metres to the far track. The measurements are summarised in Table 5.

Table 5: Summary of Train pass-bys noise measurements

Meas. Ref.	Measurement Date and Time	Duration (seconds)	Measurement Description	Track	L_{eq} (dBA)	L_{Fmax} (dBA)
R1	2017/07/17 11:30	18	2 Carriage Electric Passenger Train	Near	74	86
R2	2017/07/17 11:37	38	Freight train/Diesel Engine - ~34 Wagons	Far	83	89
R3	2017/07/17 12:14	14	2 Carriage Electric Passenger Train	Far	81	83
R4	2017/08/02 12:00	11	2 Carriage Electric Passenger Train	Near	75	84
R5	2017/08/02 12:13	19	2 Carriage Electric Passenger Train	Far	73	83
R6	2017/08/02 12:22	54	Diesel freight train ~34 Wagons	Far	82	90
R7	2017/08/02 12:46	83	Very long freight train – Only noise from wagons	Far	81	86
R8	2017/08/02 12:53	12	3 Carriage Electric Passenger Train	Near	79	88
R9	2017/08/02 13:00	9	2 Carriage Electric Passenger Train	Near	74	82
R10	2017/08/02 13:08	21	2 Carriage Electric Passenger Train	Far	73	84

The measurements show that for electric passenger trains, the noise levels are 73-81 dB(A) L_{eq} and 82-88 dB(A) L_{max}. For diesel freight trains, the noise levels are 81-83 dB(A) L_{eq} and 86-90 dB(A) L_{max}. The measurements also show that diesel freight trains are noisier than electric trains, and will emit maximum instantaneous noise, defined by the L_{max} parameter. However, as observed on site, the majority of trains using the Southern Highlands railway line are passenger trains.

The measurements will be used to assess the impact of the trains onto the site.

4 Noise Criteria

The noise criteria for the noise impact assessment for the Menangle Park site have been based on the following planning scheme, guidelines and standards:

- Campbelltown (Sustainable City) Development Control Plan (DCP) 2015 – *Volume 2, Part 8 Menangle Park DCP*
- NSW Road Noise Policy
- NSW Rail Infrastructure Noise Guideline, and
- NSW SEPP Infrastructure.

4.1 Campbelltown DCP 2015 – *Volume 2, Part 8 Menangle Park DCP*

The document specifies noise management objectives for residential and other noise sensitive development located within areas affected by road and rail noise at Menangle Park. The objectives are as follows:

- Limit environmental noise levels due to road traffic and railway noise.
- Minimise noise intrusion through the design and management of subdivisions.
- Achieve an acceptable residential noise environment whilst maintaining well designed and attractive residential streetscapes.

The DCP also requires the preparation of a noise assessment report which includes acoustic treatment requirements for dwellings by a suitably qualified professional for all subdivision and development proposals within Menangle Park affected by road and/or rail noise. Design standards and setbacks required by the relevant government road and rail authorities are to be addressed in the report and in the subdivision design process.

The relevant guidelines and standards are outlined below.

4.2 NSW Road Noise Policy

The NSW Road Noise Policy sets out noise assessment criteria for residential land uses affected by road traffic noise on freeway/arterial/sub-arterial roads, which are summarised in Table 6.

Table 6: NSW Road Noise Policy noise assessment criteria

Road type	Period	Assessment criteria
Freeway/arterial/sub-arterial (Hume Highway and Menangle Road)	Day (7am - 10pm)	60 dB(A) $L_{eq,15\ hour}$ (external)
	Night (10pm - 7am)	55 dB(A) $L_{eq,9\ hour}$ (external)

4.3 NSW Rail Infrastructure Noise Guideline

The guideline provides noise trigger levels for operational rail noise to assess the significance of rail noise on residential noise sensitive receivers near a rail line. For areas where the noise trigger levels are exceeded, noise mitigation measures, such as noise barriers or building envelope treatments, may be required to be meet the trigger levels. The noise trigger levels from airborne heavy rail for residential land uses are summarised in Table 7.

Table 7: Noise Trigger Levels – Residential Land Uses

Time Period (T)	Noise Trigger Levels (dBA) External	
	$L_{eq,T}$	L_{Fmax}
Day (7am to 10pm)	65	85
Night (10pm to 7am)	60	85

4.4 NSW SEPP Infrastructure

The SEPP has been referred to investigate the impact of road traffic noise on the proposed development.

The relevant criteria for road traffic noise impact are contained in Division 17 *Roads and traffic,* Subdivision 2 *Development in or adjacent to road corridors and road reservations,* Paragraph 102 *Impact of road noise or vibration on non-road development*.

Relevant noise criteria contained in The NSW Department of Planning, *Development near Rail Corridors and Busy Roads – Interim Guideline* also refers to the NSW SEPP Infrastructure.

The criteria are summarised as follows:

- For the development that is on land in or adjacent to the road corridor with an annual average daily traffic (AADT) volume of more than 40,000 vehicles, the development is likely to be adversely affected by road noise or vibration.
- Appropriate measures are required to be taken to ensure that the following L_{Aeq} noise levels are not exceeded for road traffic noise impact:
  - in any bedroom in the building—35 dB(A) at any time between 10 pm and 7am, and
  - anywhere else in the building (other than a garage, kitchen, bathroom or hallway)—40 dB(A) at any time.

5 Road Traffic Noise Assessment

The Menangle Park site is subject to road traffic noise intrusion from the Hume Highway and Menangle Road.

The Hume Highway is a dual carriageway with two lanes in each direction with a signed posted speed limit of 110 km/h. During the site inspection, it was observed that traffic was free flowing and vehicles were estimated to be travelling at the posted speed. The percentage of heavy vehicles was observed to be quite high (over 20%).

Menangle Road is a single carriageway with one lane in each direction with a signed posted speed limit of 80 km/h. During the site inspection, road traffic was observed to be intermittent and vehicles were estimated to be travelling at the posted speed.

5.1 Noise Prediction Model

Road traffic noise levels were predicted using the CoRTN[5] Method for the 10-year horizon from the planning stage to 2028 using SoundPLAN, a CoRTN based noise modelling software. The parameters used in the model are summarised in Table 8.

Table 8: Parameters used in SoundPLAN model

Parameter		Value
Façade correction		+2.5 dB
Façade receiver heights	Ground floor	1.5 m above ground level
	First floor	4.3 m above ground level
Speed limit	Hume Highway	110 km/h (Posted limit)
	Menangle Road	80 km/h (Posted limit)
Road surface correction		None

Current digital elevation survey data of the development site, the Hume Highway and Menangle Road were provided by APP and was used in the SoundPLAN model to represent current topography of the site for model verification purposes.

Digital elevation data of the future cut and fill model of the development was also provided. The data was used to model the future development site to predict future road traffic noise impact.

The traffic volume and growth rate information used in the SoundPLAN model was obtained from GTA Consultants *Transport Impact Assessment* Report for Menangle Park Residential Subdivision Stage 1 Development Application (Report Ref.: N124910) and further advice.

[5] Calculation of Road Traffic Noise, Department of Transport, Welsh Office, UK 1988

The advised growth rate was used to predict ultimate traffic volumes for Year 2028 for the Hume Highway and Menangle Road. The traffic volumes, growth rate and percentage of heavy vehicles (HV) used in the model are summarised in Table 9.

Table 9: Traffic data for Hume Highway and Menangle Road

Road name	Existing – Year 2017		Growth rate (%)	% HV	Ultimate – Year 2028	
	AADT	18-hour traffic (94%)			AADT	18-hour traffic (94%)
Hume Highway – Northbound	25,700	24,160	4	21	39,570	37,190
Hume Highway – Southbound	26,750	25,150	4	20	41,190	38,720
Menangle Road	11,300	10,620	4*	4#	17,400	16,350

Note:
*Growth rate assumed to be similar to Hume Highway
#Conservative assumption for a regional local road

5.1.1 Verification of road traffic noise model

The measured and predicted free-field noise levels at Location 1 (Refer to Figure 2) for the existing year (2017 situation) are shown in Table 10.

Table 10: Comparison of measured and predicted free-field noise levels – Existing Year 2017 situation

Measurement location (Refer to Figure 2)	Sound Pressure Levels, $L_{10,18h}$ in dB(A)		
	Measured	Predicted	Difference
Location 1	69.8	69.7	-0.1

The predicted road traffic noise level using SoundPLAN is 0.1 dB lower (underprediction) than the measured noise level. The model is within the accepted model variance of ±2 dB and is therefore validated.

The future predicted noise levels will be adjusted by +0.1 dB to account for the underprediction of the model.

5.2 Road Traffic Model Parameter Offsets

Road traffic noise predictions using the CoRTN Method on SoundPLAN are output in the $L_{10,18h}$ parameter. To convert to L_{eq} parameters, offsets based on the measured road traffic noise at Location 1, as shown in Table 3, have been determined. The offsets are summarised in Table 11.

Table 11: Offsets between $L_{10,18h}$ and L_{eq} parameters

Period (T)	Offset in measured noise levels, in dB	
	Between $L_{10,18h}$ and $L_{eq,T}$	Between $L_{10,18h}$ and $L_{eq,1h}$
Day (7am - 10pm)	-3.8	-1.8
Night (10pm – 7am)	-3.8	-2.8

5.3 Current Situation Model – Year 2017

The free-field road traffic noise levels have been predicted in terms of noise contours across the Menangle Park site using the SoundPLAN model, to represent the current road traffic noise impact from the Hume Highway and Menangle Road. The offsets given in Table 11 and the underprediction correction to the model have been applied to determine the L_{eq}. The masterplan layout drawing has been superimposed on the contours to represent the extent of the existing road traffic noise impact. The predicted $L_{eq,Day}$ and $L_{eq,Night}$ free-field noise contours are presented in Figure 3 and Figure 4 respectively. Note the yellow contour line represents the relevant criteria for each time period.

Figure 3: Current Situation Year 2017 Noise Contours – $L_{eq,Day}$ Free-field

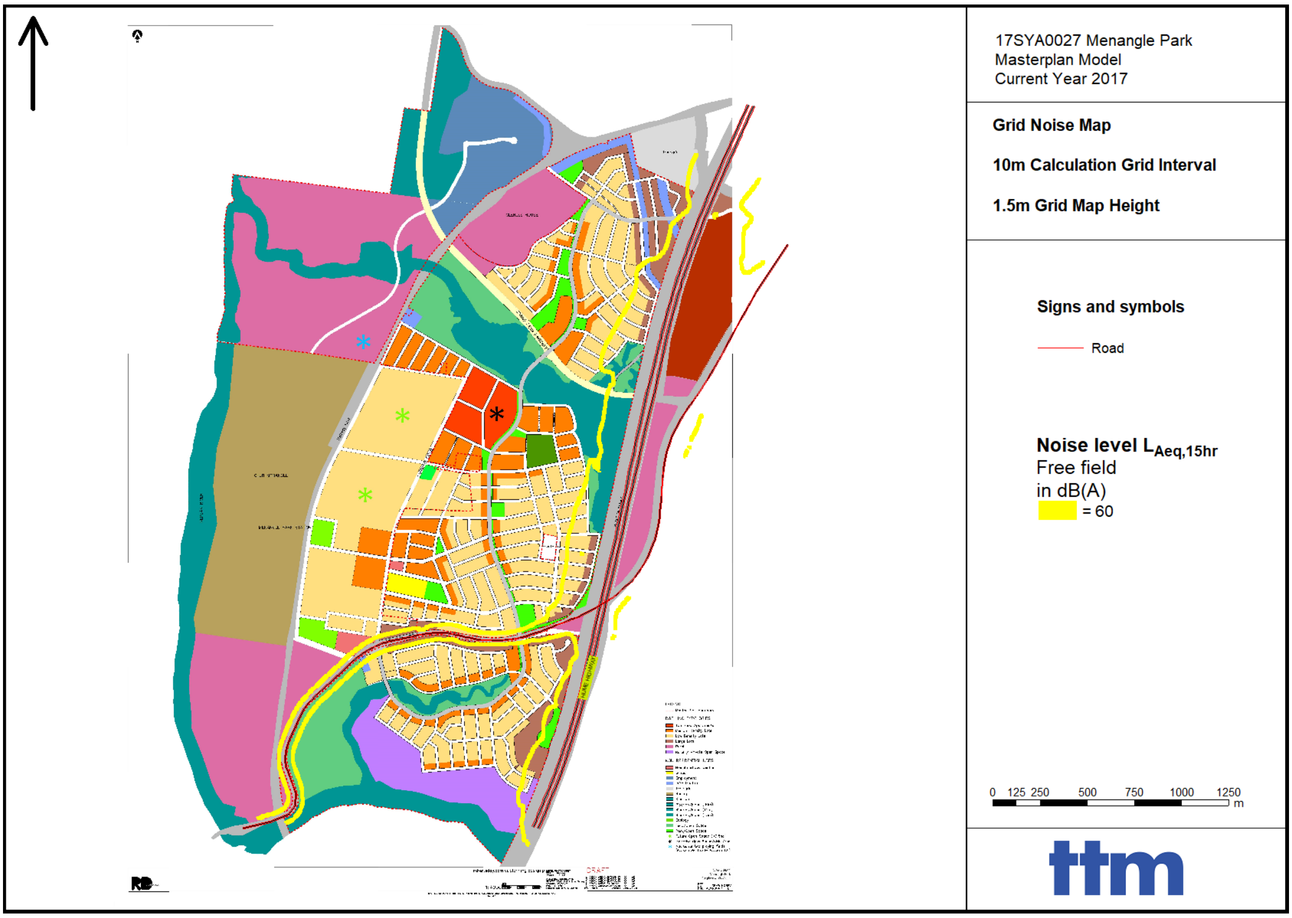
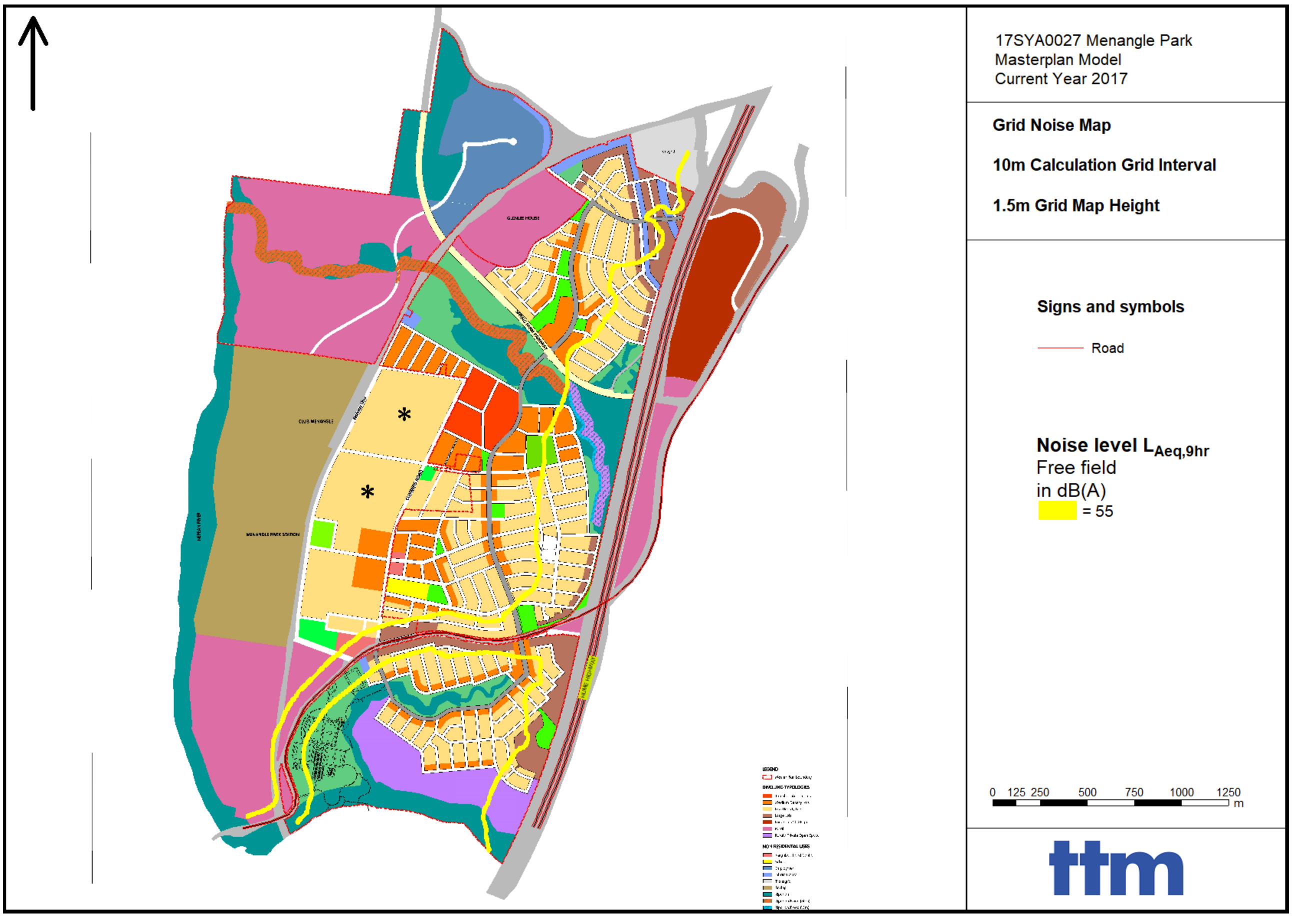


Figure 4: Current Situation Year 2017 Noise Contours – $L_{eq,Night}$ Free-field



5.4 Future Situation Model – Year 2028

The façade-corrected road traffic noise levels have been predicted in terms of noise contours across the site using the SoundPLAN model, to represent the future road traffic noise impact for Year 2028. The offsets given in Table 11, a façade correction of +2.5 dB and the underprediction correction to the model have been applied to determine the façade-corrected L_{eq}.

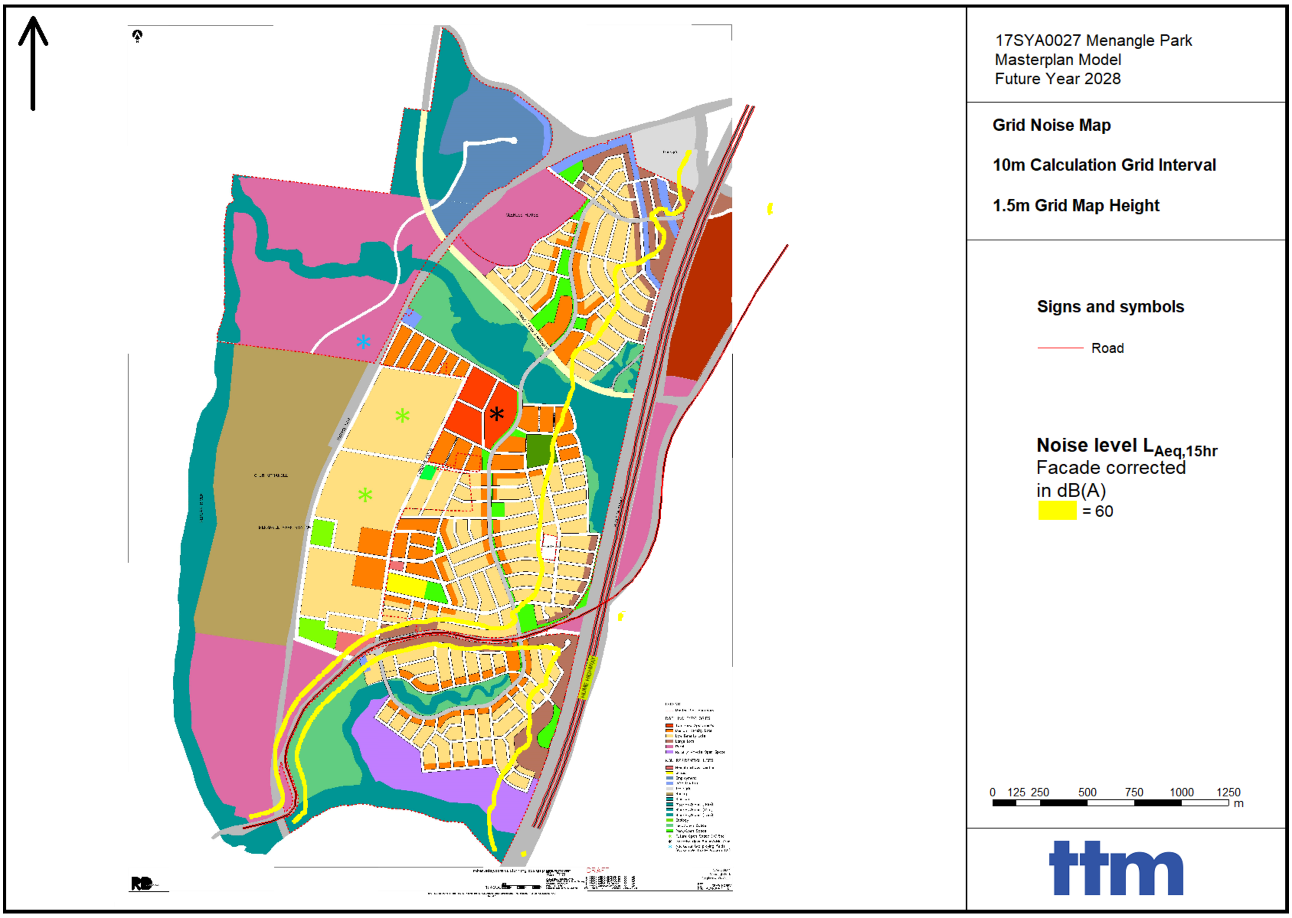
The current Year 2017 model has been updated with the following to represent the future Year 2028 scenario:

- Digital elevation data of the future cut and fill model of the development, and
- Ultimate traffic volumes for Year 2028.

5.4.1 Noise Contours Year 2028 – Façade-corrected $L_{eq,Day}$

The predicted future façade-corrected $L_{eq,Day}$ noise contours are presented in Figure 5.

Figure 5: Future Situation Year 2028 Noise Contours – $L_{eq,Day}$ Façade-corrected

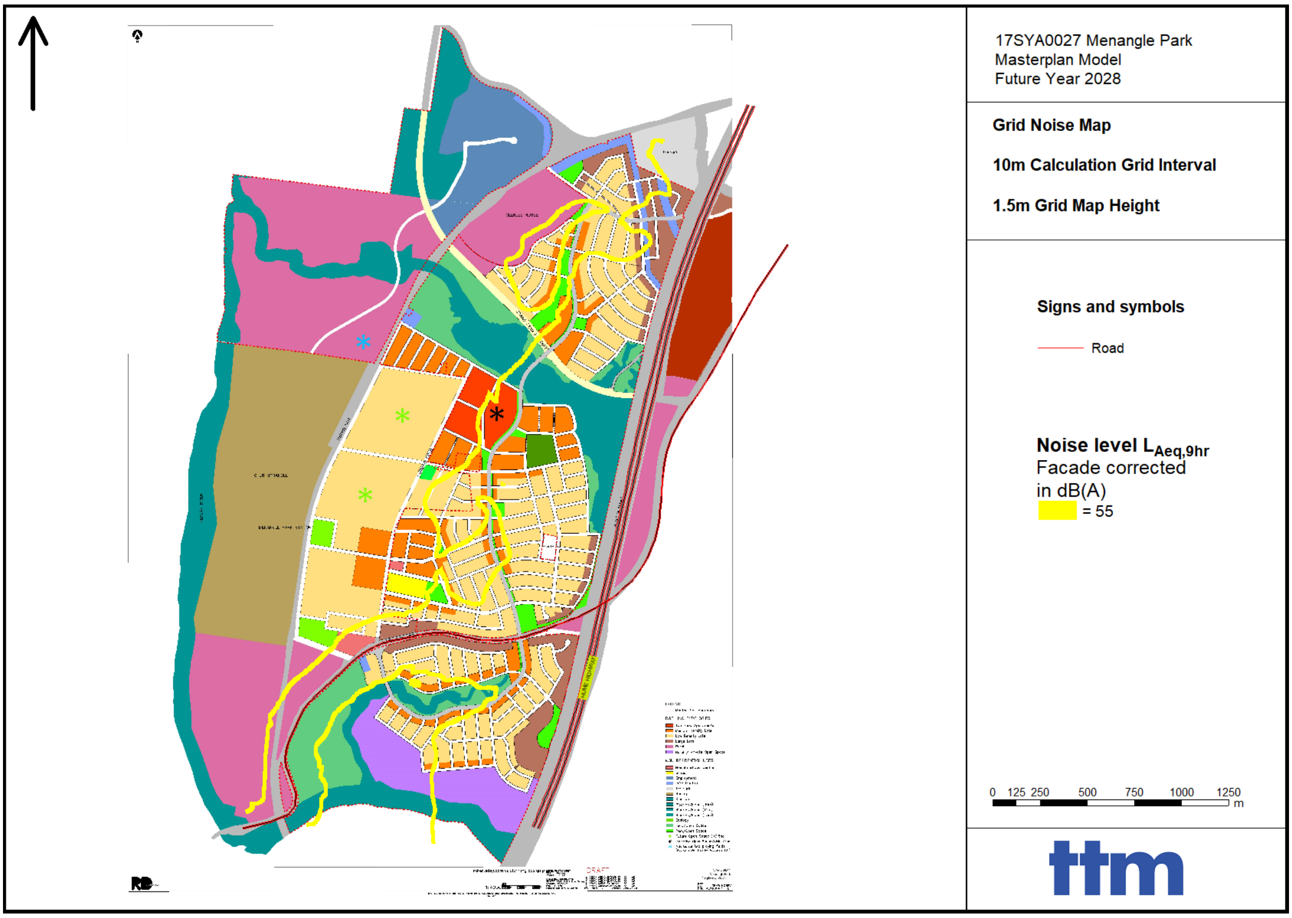


The predicted road traffic noise contours show that areas close to the Hume Highway and Menangle Road exceeds the day-time criteria of **60 dB(A)** $L_{eq,Day}$. Additional noise attenuation measures will be required for the future dwellings proposed to be built in the areas between the roads and the yellow contour line.

5.4.2 Noise Contours Year 2028– Façade-corrected $L_{eq,Night}$

The predicted future façade-corrected $L_{eq,Night}$ noise contours are presented in Figure 6.

Figure 6: Future Situation Year 2028 Noise Contours – $L_{eq,Night}$ Façade-corrected



The predicted road traffic noise contours show that the areas close to Hume Highway and Menangle Park exceeds the night-time criteria of **55 dB(A)** $L_{eq,Day}$. The extent of the area affected by high road traffic noise levels during the night time period is larger than during the day-time due to the 5dB difference in the night time and day-time criteria. Additional noise attenuation measures will be required for the future dwellings proposed to be built in the area between the yellow contour line and the roads.

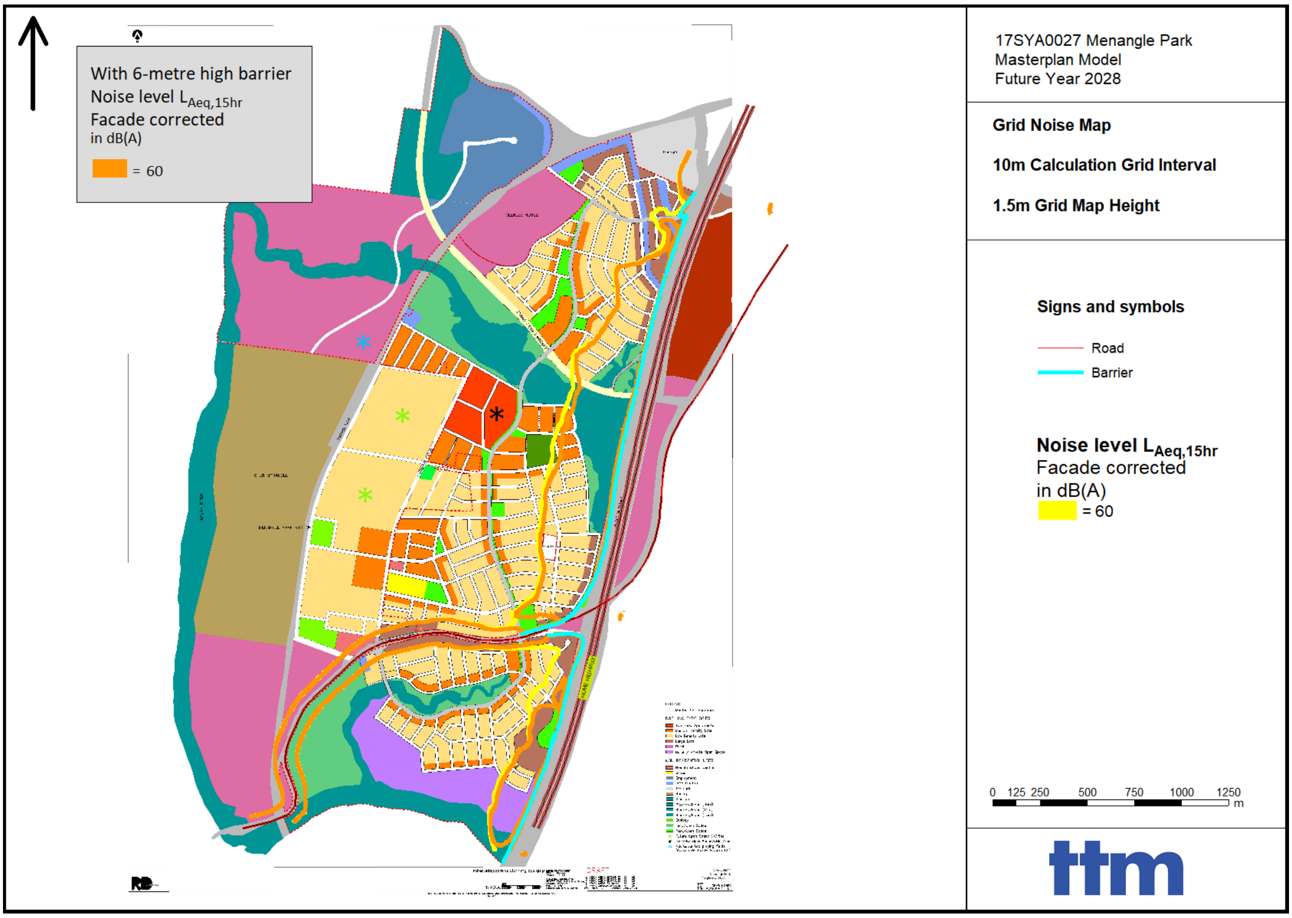
5.5 Assessment and Impact of Acoustic Barrier

The impact of an acoustic barrier on the site has been investigated to assess whether it would provide beneficial additional noise shielding within the constraints of being feasible, practical and reasonable.

A 6-metre acoustic barrier (Roads and Maritime Services maximum feasible height for practicality) along the site boundary has been modelled to assess the likely maximum noise attenuation from an acoustic barrier.

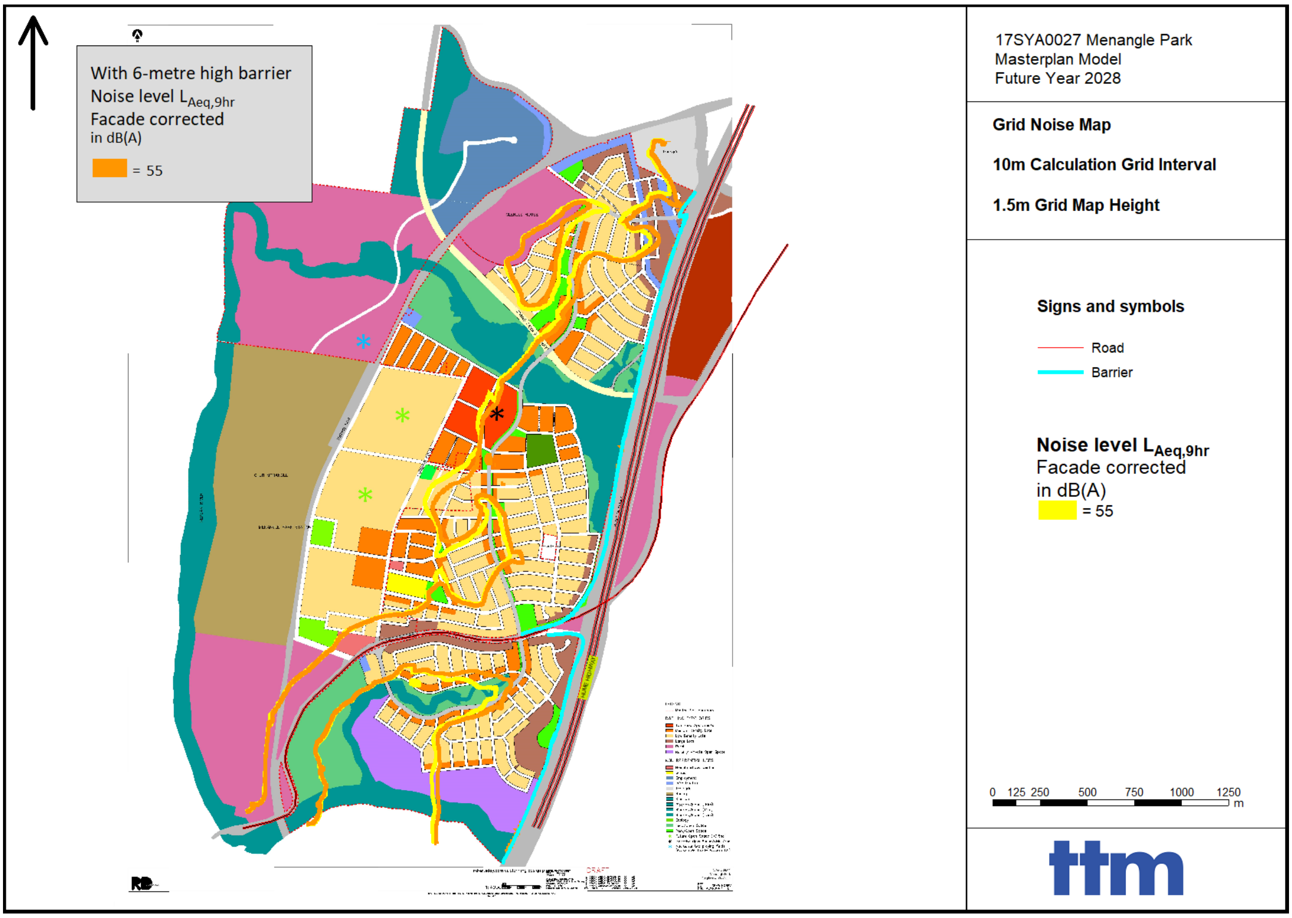
The predicted future façade-corrected $L_{eq,Day}$ noise contours with and without the installation of a 6-metre acoustic barrier are presented in Figure 7. The noise contour map shows areas of the site which complies with and exceeds the NSW Road Noise Policy day-time criteria of 60 dB(A) $L_{eq,Day}$.

Figure 7: Future Situation Year 2028 Noise Contours with 6-metre acoustic barrier – $L_{eq,Day}$ Façade-corrected



The following noise contour map on Figure 8 shows areas of the site which complies with and exceeds the NSW Road Noise Policy night-time criteria of 55 dB(A) $L_{eq,Night}$, with and without a 6-metre acoustic barrier.

Figure 8: Future Situation Year 2028 Noise Contours with 6-metre acoustic barrier – $L_{eq,Night}$ Façade-corrected



The NSW Road Noise Policy provides recommendations on reasonable road traffic noise mitigation measures. The feasibility of any acoustic barrier is judged on whether the overall noise benefits outweigh the overall adverse social, economic and environmental effects, including the cost of the abatement measure. The document states that ideally, an acoustic barrier should be able to reduce the noise levels by at least 5dB.

Based on the above recommendations of the NSW Road Noise Policy, an acoustic barrier as a noise mitigation measure is not considered feasible and reasonable. Acoustic design of the future dwelling affected by high road traffic noise levels will be required.

5.5.1 Discussion on effectiveness of Acoustic Barrier

Figure 9 and Figure 10 show a graphic representation of the effectiveness of the 6-metre acoustic barrier along the eastern boundary of the site, for the day-time road traffic impact and night-time road traffic impact respectively.

Figure 9: Comparison of day-time road traffic noise levels façade-corrected WITH and WITHOUT noise barrier.

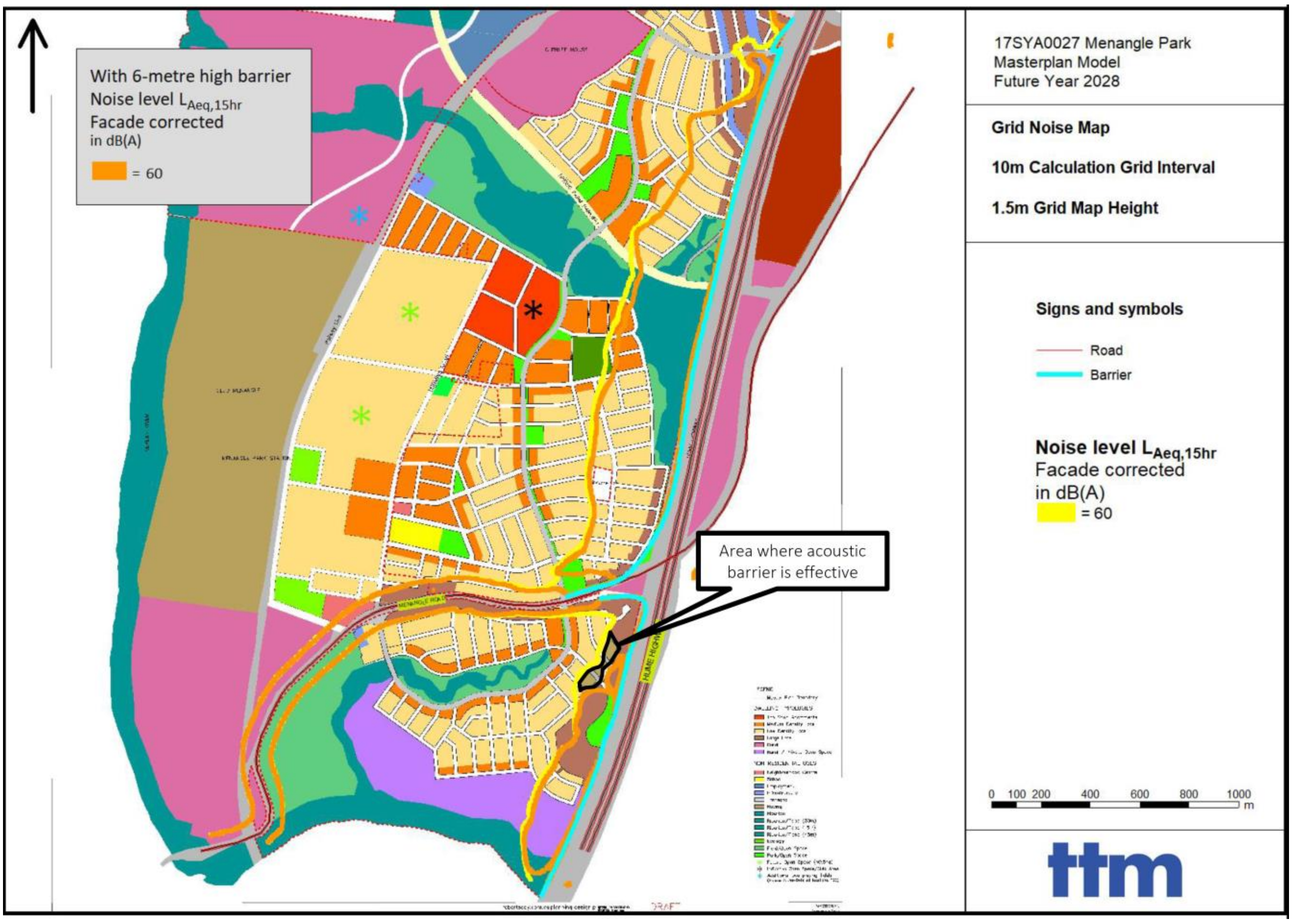
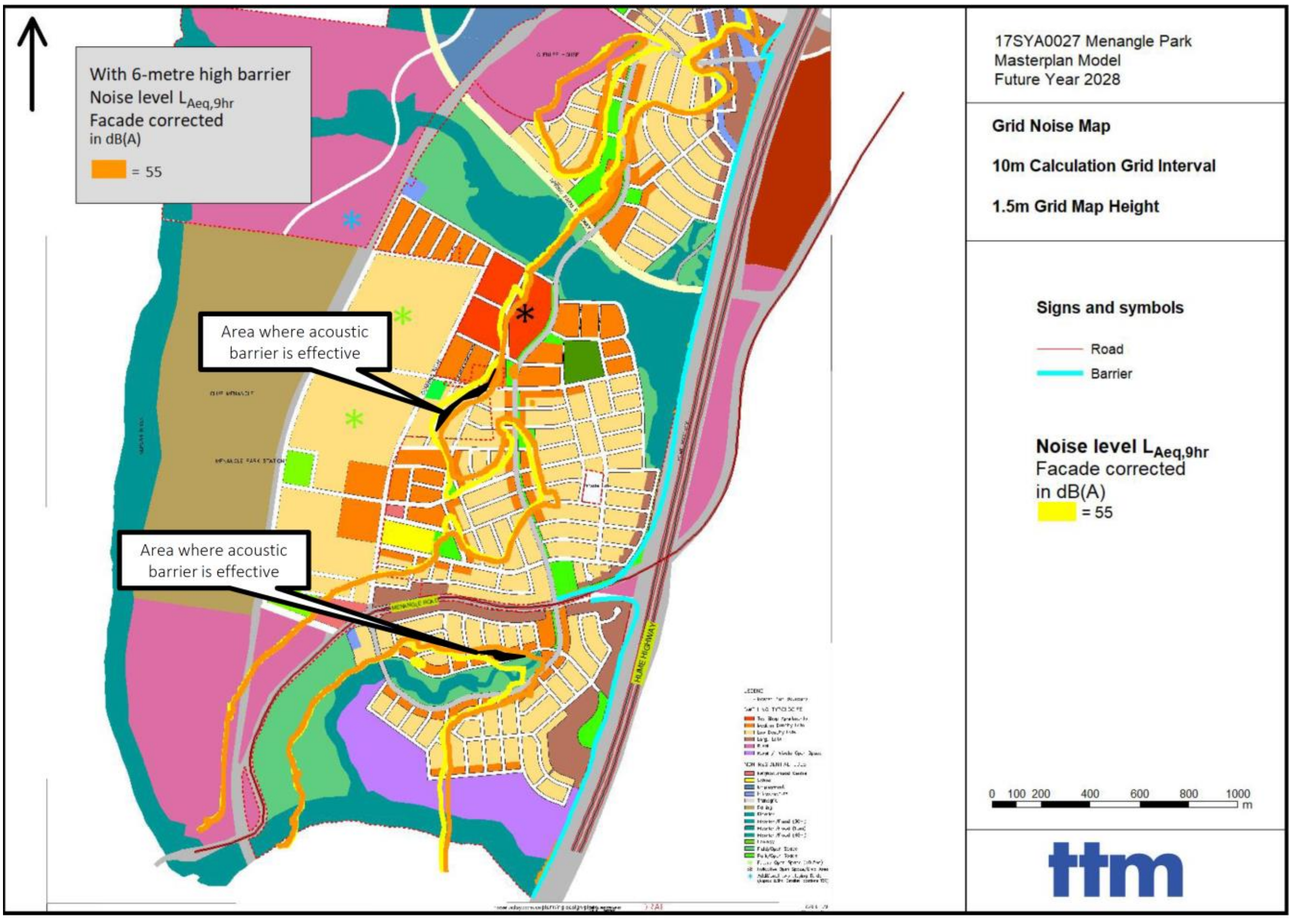


Figure 10: Comparison of night-time road traffic noise levels façade-corrected WITH and WITHOUT noise barrier



Referring to Figure 9 and Figure 10 above, the orange line shows where the day-time criterion is met without an acoustic barrier and the yellow line represents where it is met with the acoustic barrier. The greater distance between the orange and yellow contours, the greater the effectiveness of the barrier.

The area indicated on the figures shows the lots on the masterplan where a six-metre high acoustic barrier would be effective in reducing, or eliminating additional acoustic design and treatments to meet the RTN external day-time traffic noise criterion of 60 dB $L_{Aeq,15hr}$ façade-corrected.

It should be noted that depending on the dwelling size (lowset or highset), number and spacing between the eventual future residences, some additional shielding may be provided by dwellings located in front, closest to the roads. Where there is no additional shielding, typically for dwellings directly facing the roads, there may be a requirement to consider lot orientation to meet the passive recreation criterion for outdoor spaces of 55 dB $L_{Aeq,15\ hour}$.

However, in the night-time period, the results show that the 6-metre high noise barrier has no appreciable effect on reducing noise levels. This is shown by the yellow and orange contours representing the scenarios, ‘with barrier’ and ‘without barrier’ respectively, following each other very closely. The indicated area on the figures shows where the barrier is having an acoustic benefit and where the future dwellings may not require further acoustic design and treatment.

Much of the development land is relatively lower than the Hume Highway. Due to the uneven topography of the site, a very small area of the site and a small number of lots benefit from the proposed acoustic barrier located on the site boundary. An acoustic barrier directly adjacent the Hume Highway would have provided greater acoustic benefit, however this is not an option for the site. It is likely that the cost of providing acoustic design and treatments to these small number of lots would be cheaper than the cost of installation the acoustic barrier itself.

Where an acoustic barrier is not built, acoustic design in relation to lot orientation, internal space planning, and architectural and mechanical acoustic treatments, such as building envelope design and provision of mechanical ventilation, may be considered.

Moreover, any benefit from the barrier to meet the day-time criterion will be negated by having to meet the more onerous night-time criterion. Therefore, based on the findings of the noise modelling, the installation of an acoustic barrier at this location has no benefit and is not recommended.

6 Rail Noise Assessment

The western side of the Menangle Park site is subject rail noise intrusion from the Southern Highlands railway line. The Southern Highlands railway line carries passenger trains to and from Moss Vale and Campbelltown, as well as, diesel freight trains.

6.1 Noise Prediction Model

Rail noise levels were predicted using the Kilde 130 method using SoundPLAN. The parameters used in the model are summarised in Table 12.

Table 12: General Modelling Parameters used in SoundPLAN model

Parameter		Value
Façade correction		+2.5 dB
Façade receiver heights	Ground floor	1.5 m above ground level
	First floor	4.3 m above ground level

Current digital elevation survey data of the site and the railway line were provided by APP and was used in the SoundPLAN model to represent current topography of the site for model verification purposes.

Digital elevation data of the future cut and fill model of the site was also provided. The data was used to model the Menangle Park site to predict rail noise impact.

The input to the Kilde 130 model used in the SoundPLAN model for Year 2017 and Year 2028 was obtained from the Acoustic Assessment Report for Menangle Park Land Release Area, prepared by AECOM, dated 28 May 2010, Revision 5 (Document No. 60023279-PM001-REP.05), and is summarised in Table 13.

Table 13: Railway Noise Model Input Parameters

Train Type	Daily Frequency		Length (m)	Average Speed (km/hr)
	Year 2017	Year 2028 - Predicted		
Endeavour	66	~100	75	80
XPT	4	4	204	80
XPT Engine	4	4	20	80
Explorer	7	7	75	80
Freight Train Wheels	61	61	50	80
Freight Train Engine	61	61	50	80
Freight Train Wagon	61	61	1800	80
Wagon Max	61	61	1800	80

6.1.1 Verification of rail noise model

The measured and predicted free-field noise levels at Location 3 (Refer to Figure 2) for the existing year (2017 situation) are shown in Table 14.

Table 14: Comparison of measured and predicted free-field noise levels – Existing Year 2017 situation

Measurement location (Refer to Figure 2)	Sound Pressure Levels, $L_{10,18h}$ in dB(A)		
	Measured	Predicted	Difference
Location 3	68.3	68.8	+0.5

The predicted rail noise level using SoundPLAN is 0.5 dB higher (overprediction) than the measured noise level. The model is within the accepted model variance of ±2 dB and is therefore validated. The rail noise model is conservative, and therefore no adjustment was made to the predicted rail noise levels.

6.2 Rail Model Parameter Offsets

Rail noise predictions using the Kilde 130 method on SoundPLAN are output in the $L_{eq,24h}$ parameter. To convert to L_{eq} parameters, offsets based on the measured rail noise at Location 3, as shown in Table 4, have been determined. The offsets are summarised in Table 15.

Table 15: Offsets between $L_{eq,24h}$ and L_{eq} parameters

Period (T)	Offset in measured noise levels, in dB Between $L_{eq,24h}$ and $L_{eq,T}$
Day (7am - 10pm)	+10
Night (10pm – 7am)	-1

6.3 Current Situation Model – Year 2017

The free-field rail noise levels have been predicted in terms of noise contours across the site using the SoundPLAN model, to represent the current rail noise impact. The masterplan layout drawing has been superimposed on the contours for reference purposes only. The predicted $L_{eq,Day}$ and $L_{eq,Night}$ free-field noise contours are presented in Figure 11 and Figure 12 respectively.

The offsets given in Table 15 and a façade correction of +2.5 dB to the model have been applied to determine the façade-corrected L_{eq}. Note the yellow contour line represents the relevant criteria for each time period.

Figure 11: Current Situation Year 2017 Noise Contours – $L_{eq,Day}$ Free-field

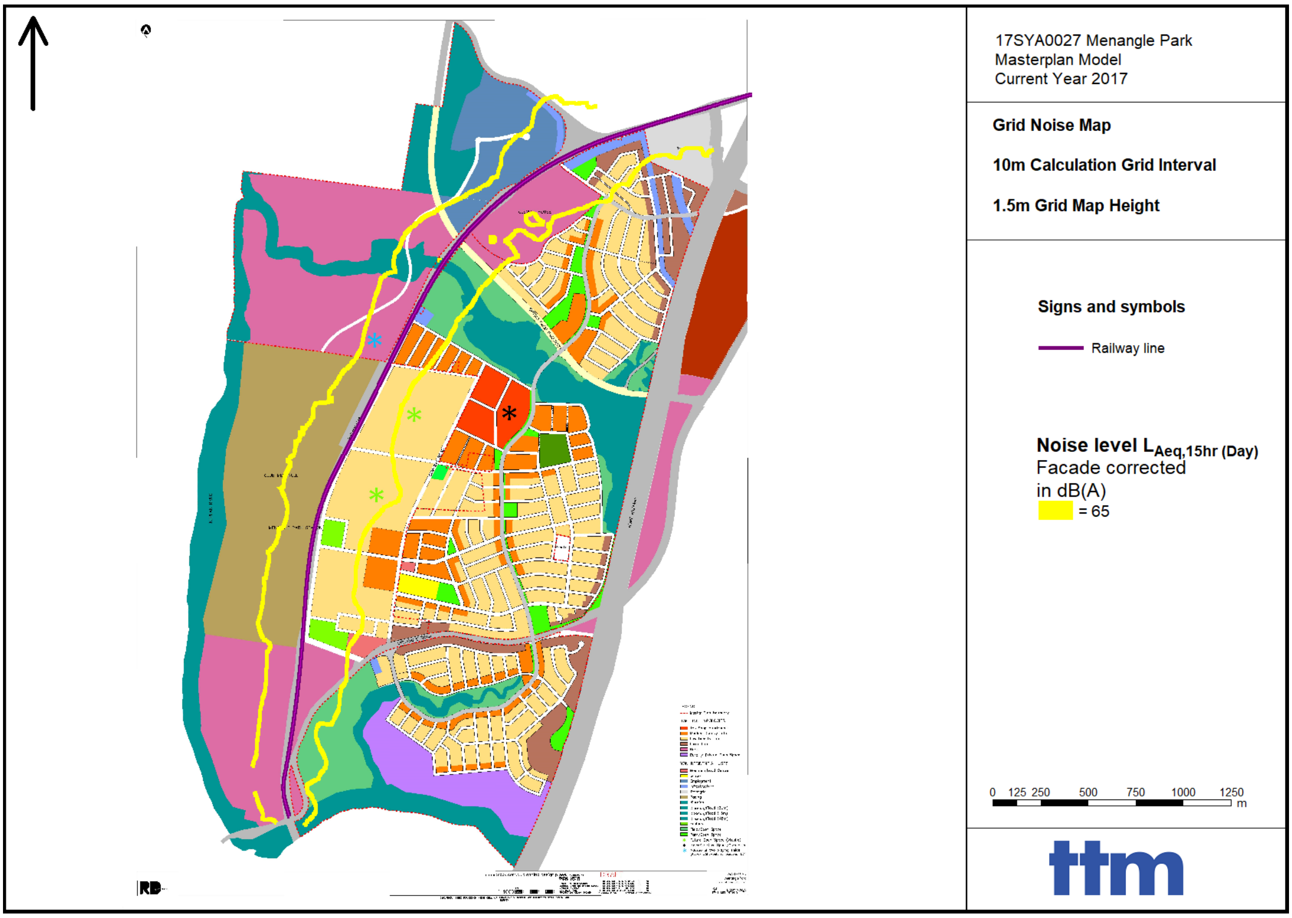
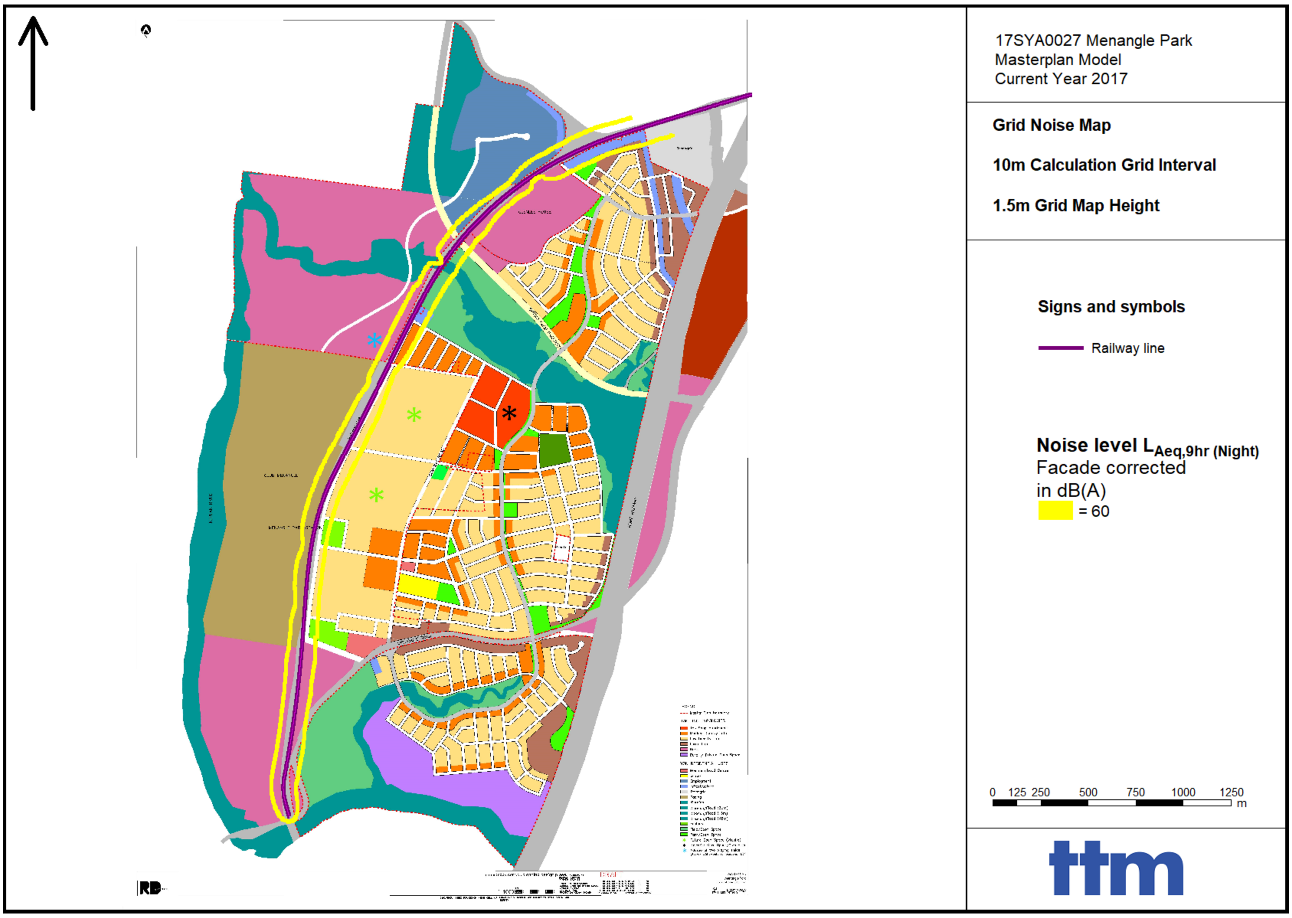


Figure 12: Current Situation Year 2017 Noise Contours – $L_{eq,Night}$ Free-field



6.4 Future Situation Model – Year 2028

The façade-corrected road traffic noise levels have been predicted in terms of noise contours across the site using the SoundPLAN model, to represent the future rail noise impact for Year 2028. The offsets given in Table 15 and a façade correction of +2.5 dB have been applied to determine the façade-corrected L_{eq}.

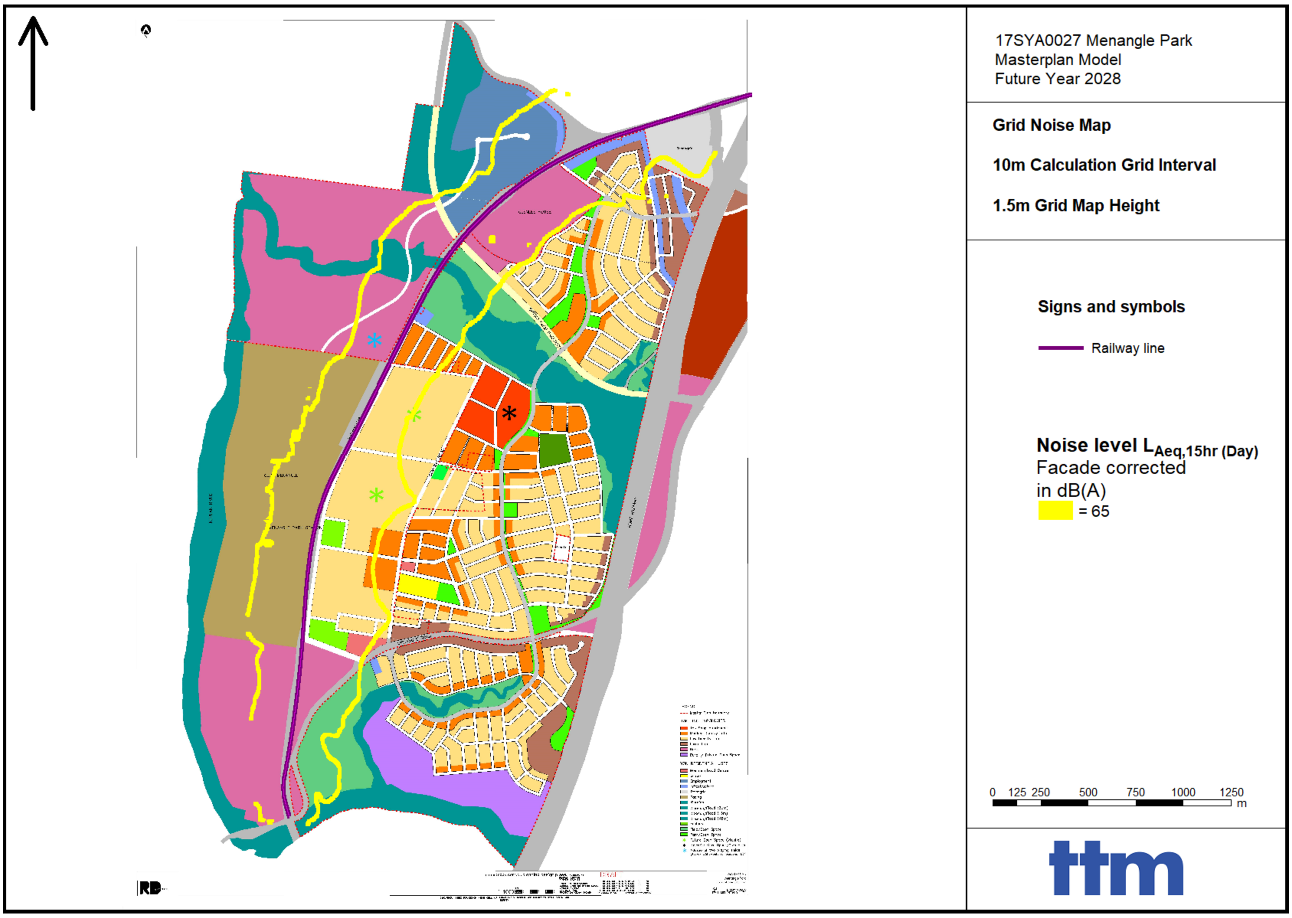
The current Year 2017 model has been updated with the following to represent the future Year 2028 scenario:

- Digital elevation data of the future cut and fill model of the development, and
- Ultimate predicted rail traffic for Year 2028.

6.4.1 Noise Contours Year 2028 – Façade-corrected $L_{eq,Day}$

The predicted future façade-corrected $L_{eq,Day}$ noise contours are presented in Figure 13.

Figure 13: Future Situation Year 2028 Noise Contours – $L_{eq,Day}$ Façade-corrected

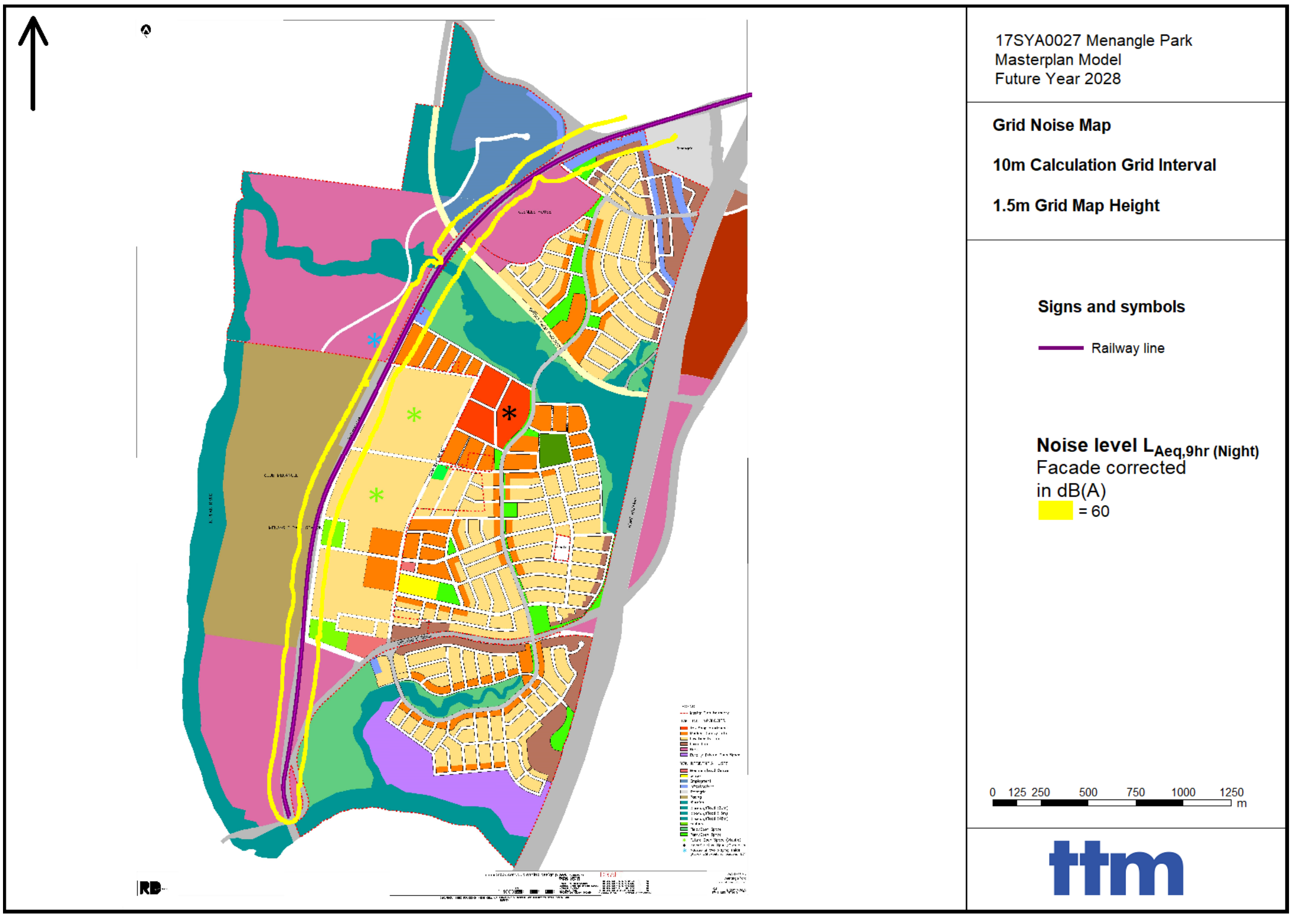


The predicted rail noise levels show that only a small area of the residential lots to the west of the site exceeds the day-time criteria of **65 dB(A) $L_{eq,Day}$**. Additional noise attenuation measures will be required for the future dwellings proposed to be built in area between the railway line and the yellow contour.

6.4.2 Noise Contours – Façade-corrected $L_{eq,Night}$

The predicted future façade-corrected $L_{eq,Night}$ noise contours are presented in Figure 14.

Figure 14: Future Situation Year 2028 Noise Contours – $L_{eq,Night}$ Façade-corrected



The predicted rail noise levels show that only a small area of the residential lots to the west of the site exceeds the night-time criteria of **60 dB(A)** $L_{eq,Night}$. Additional noise attenuation measures will be required for the future dwellings proposed to be built in area between the railway line and the yellow contour.

6.4.3 Discussion of Rail Noise Impact

Despite the night-time criterion being 5 dB more stringent than the daytime (60 dB L_{Aeq} (Night) compared to 65 dB L_{Aeq} (Day)), the predicted noise contours show that the area into the masterplan site affected by rail noise in the night-time period is less than during the day-time period. This shows that the day-time rail noise L_{Aeq} is the controlling factor in terms of additional acoustic design being undertaken.

6.4.3.1 Maximum Rail Noise Impact

In addition to the L_{Aeq} day and night-time criteria for rail noise, the *Rail Infrastruture Noise Guideline* recommends a maximum noise level of 85 dB $L_{AF,max}$ applicable for any train movement at all times. Distance loss calculations have been carried out using worst and best-case passbys noise measurements of diesel freight and electric passenger train undertaken by TTM adjacent to the rail line, as shown in Table 5. The calculations provided a range of distances from the rail line where the 85 dB $L_{AF,max}$ criterion is met, using best and worst case trains and flat ground.

The quieter electric passenger trains typically meet the $L_{AF,max}$ criterion adjacent the rail line meaning that no acoustic treatment would be required due to sufficient noise attenuation from the set back distance between the closest lots and the rail line. The criterion will still be met at approximately 75 metres from the site boundary for the noisier diesel freight trains. This means that the L_{Aeq} day-time criterion is more onerous, and will dictate the levels of acoustic design/treatment required.

An acoustic barrier along the rail line has not been modelled for this masterplan option at this stage. Other noise control design and treatments will be more practical, such as, lot orientation, internal space planning, architectural and builidng services treatments, e.g. building envelope sound insulation and mechanical ventilation to attenuate noise at the receiver.

7 TTM Recommendations

The impact of road traffic noise from the Hume Highway and Menangle Road, and rail noise from the Southern Highlands line onto the site has been assessed. Noise attenuation provided by acoustic barriers has also been investigated.

The predicted results show that a 6-metre acoustic barrier provides an insignificant acoustic benefit (maximum noise reduction of 4 dB) at the closest future dwellings to Hume Highway and Menangle Road.

As recommended in the NSW Road Noise Policy, an acoustic barrier as a noise mitigation measure is not feasible. This is because the overall noise mitigation benefits of the barrier are not significant enough to outweigh the overall adverse social, economic, visual and environmental effects, including the cost of the barrier.

It is therefore recommended to consider acoustic design of the lots and future dwellings as a more feasible, practical and reasonable noise mitigation method. This includes considering lot orientation and internal space planning, where less noise sensitive spaces, such as bathrooms and laundries, are located closest to the most exposed façade to road traffic noise, in order to shield the more noise sensitive spaces, such as bedrooms.

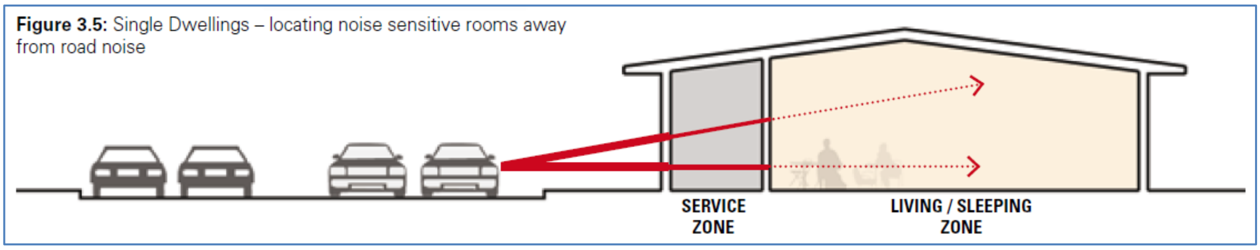
Architectural and mechanical acoustic treatments, such as building envelope design and provision of mechanical ventilation, are also recommended.

7.1 Future Dwelling Internal Layout

The NSW Department of Planning (DoP) guideline *Development Near Rail Corridors and Busy Roads* recommends particular building layouts to minimise potential noise from road traffic and rail. The document can be used as a guide to assist with internal layout design.

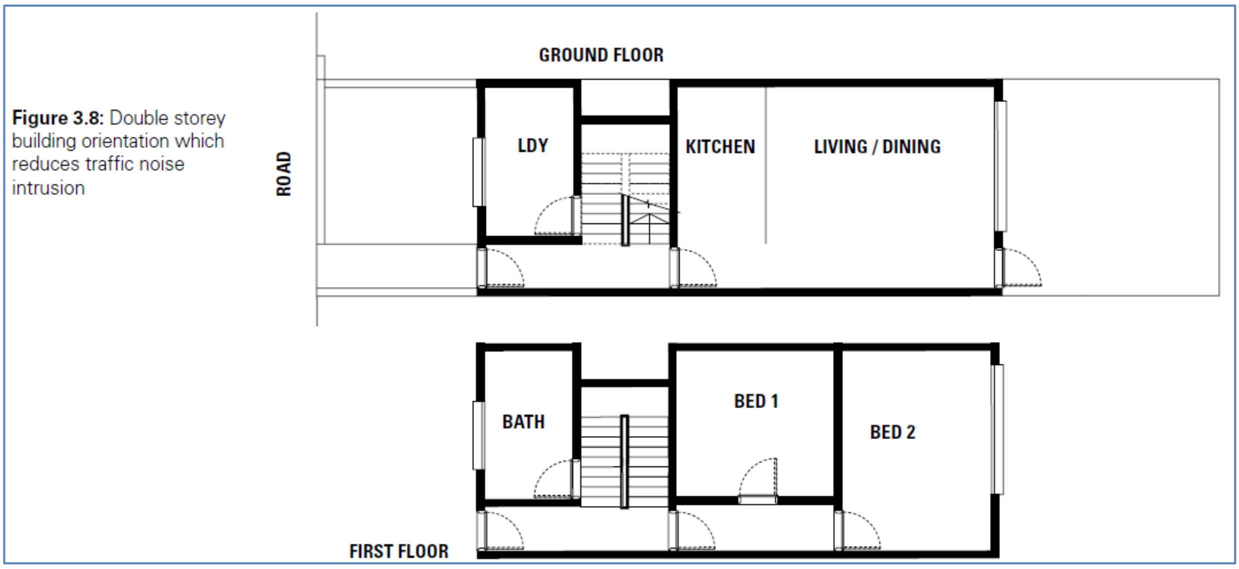
The concept of service zones (non-habitable or living/sleeping areas) could be incorporated into the future dwellings. This is particularly beneficial acoustically as the non-noise sensitive spaces facing the road traffic or rail noise source act as a noise buffer to the noise sensitive spaces, such as living rooms and bedrooms, as illustrated in Figure 15.

Figure 15: Illustration of noise buffer to noise sensitive spaces



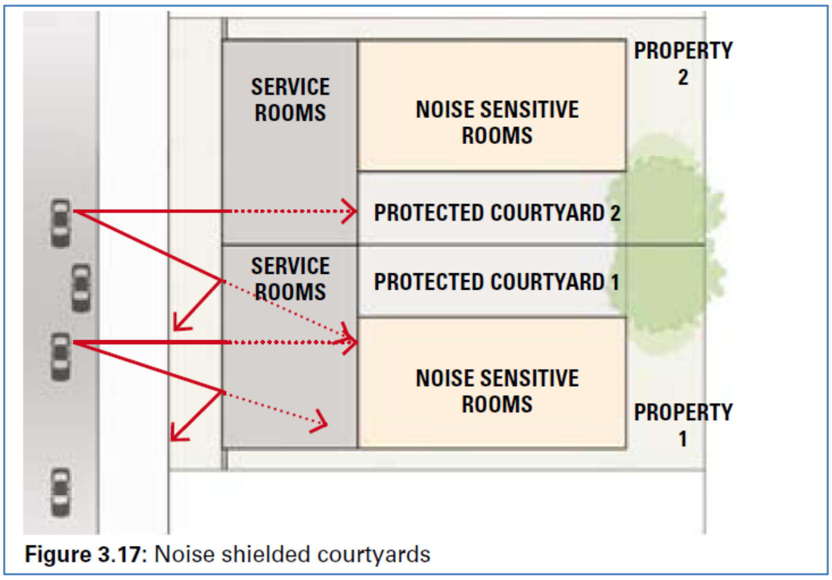
Similarly, for noise sensitive areas located on upper floors, the upstairs layout would preferably include non-noise sensitive areas positioned towards the most exposed façade to the road noise source, as illustrated in Figure 16.

Figure 16: Illustration of building orientation



For positioning of private courtyards, the principle remains the same as illustrated in Figure 17.

Figure 17: Illustration of orientation of private courtyards



For facades of the dwellings that comply with the NSW Road Traffic Noise criteria and the NSW Rail Infrastructure Noise Guideline, internal layout design is not required.

In cases where it is not possible to redesign the internal layout, it is required to incorporate acoustic treatments to the building envelope to satisfy the internal design noise levels as stated in the NSW SEPP

Infrastructure. Upgraded walls, roof, glazing and other building components is required to meet minimum acoustic ratings.

7.2 Dwelling Acoustic Treatment

The future dwellings impacted by high road traffic or rail noise will likely require building envelope acoustic design to ensure compliance with the internal design levels given the NSW DoP *Development near Rail Corridors and Busy Roads – Interim* Guideline. Acoustic design is recommended to be conducted once final architectural plans of individual dwellings on noise affected lots are available.

Building treatment requirements will ultimately be dependent on the individual building design (i.e. the ratio of glazing compared to floor area, etc.). However, based on the predicted road traffic and rail noise impact levels and a typical dwelling design, it is not expected that treatments would be onerous on the purchaser.

As a guide, the potential range of acoustic ratings for each building component have been listed in Table 16, which should be treated as a guide only and not be implemented for construction.

Table 16: Guide performance for typical Building Façade Treatments for Noise Affected Lots[6]

Building Component	Acoustic Rating Required	Indicative Requirements/Construction
Glazing	R_W24-32	4mm float to 6.38mm laminate glass with acoustic seals
Walls	R_W40-45	Standard masonry or brick veneer to upgraded lightweight constructions
Roof/ceiling	R_W40-42	Standard sheet metal with R1.5-2.0 acoustic/thermal insulation and 10mm plasterboard ceiling; or pitched concrete roof; or terracotta roof with sarking, plus R3.0 ceiling insulation

Acoustic design should be conducted by a suitably qualified acoustic consultant once building plans are available to ensure that the proposed dwellings are designed to achieve the internal design noise levels.

7.3 Mechanical Ventilation

Mechanical ventilation may be required for dwellings impacted by high road traffic or rail noise to meet the internal design sound levels. External windows and doors are to be kept closed to meet the internal noise limits. If they are opened for ventilation purposes, road traffic noise or rail noise attenuation provided by the building envelope will be significantly reduced. If it is necessary to close windows and doors to comply with NSW SEPP Infrastructure indoor design levels, building ventilation should be in accordance with the National Construction Code on the assumption that windows and doors are not openable. Mechanical ventilation or air conditioning systems complying with AS 1668.2[7] should be installed.

[6] NSW Department of Planning (2008), Development Near Rail Corridors and Busy Roads - Interim Guideline, Appendix C – Acoustic Treatment of Residences, pp.63

[7] AS 1668.2:2012. The use of ventilation and air-conditioning in buildings Mechanical ventilation in buildings

Air conditioning plant may need to be acoustically treated to prevent noise emissions from adversely impacting adjacent residential dwellings. This may include selecting the quietest plant possible, or treating the plant equipment with enclosures, barriers, duct lining and silencers, etc.

Air conditioning plant must be installed away from residential boundaries and bedroom windows, to minimise impact of noise sensitive spaces during the night-time period.

A detailed mechanical plant noise assessment should be conducted by a suitably qualified acoustic consultant for each dwelling once plant selections are made. The noise assessment should include noise source levels of plant, location, adjustments for mechanical plant noise characteristics and application of practical and effective noise control.

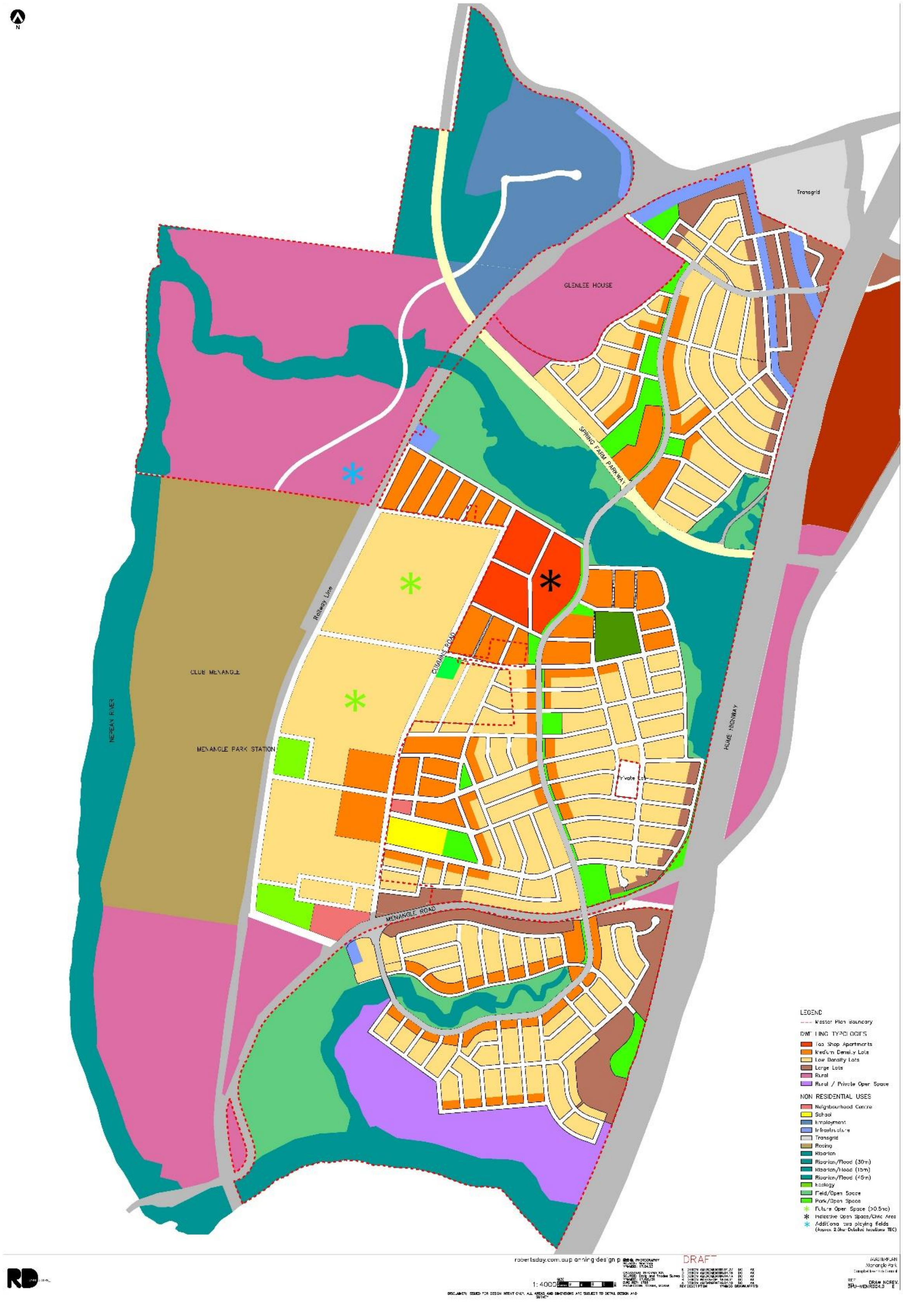
8 Conclusion

Following a noise impact assessment conducted by TTM for APP Corporation on behalf of Dahua Group for the Menangle Park subdivision, TTM concludes the following:

- Areas located adjacent to the Hume Highway and Menangle Park exceeds the NSW Road Noise Policy day-time criteria and night-time criteria.
- Areas located adjacent to the Southern Highlands line exceeds the NSW Rail Infrastructure Noise Guideline criteria.
- The implementation of an acoustic barrier as a noise mitigation measure is unfeasible and impractical.
- Acoustic design of the future dwellings affected by high road traffic or rail noise will be required.
- Mechanical ventilation may be required for future dwellings to meet the internal acoustic targets.

The assessment and recommendations contained in this report demonstrate the site is suitable for the development of residential lots and is feasible while keeping an appropriate acoustic amenity and controlled noise impact onto the local community.

Appendix A Relevant Development Plans

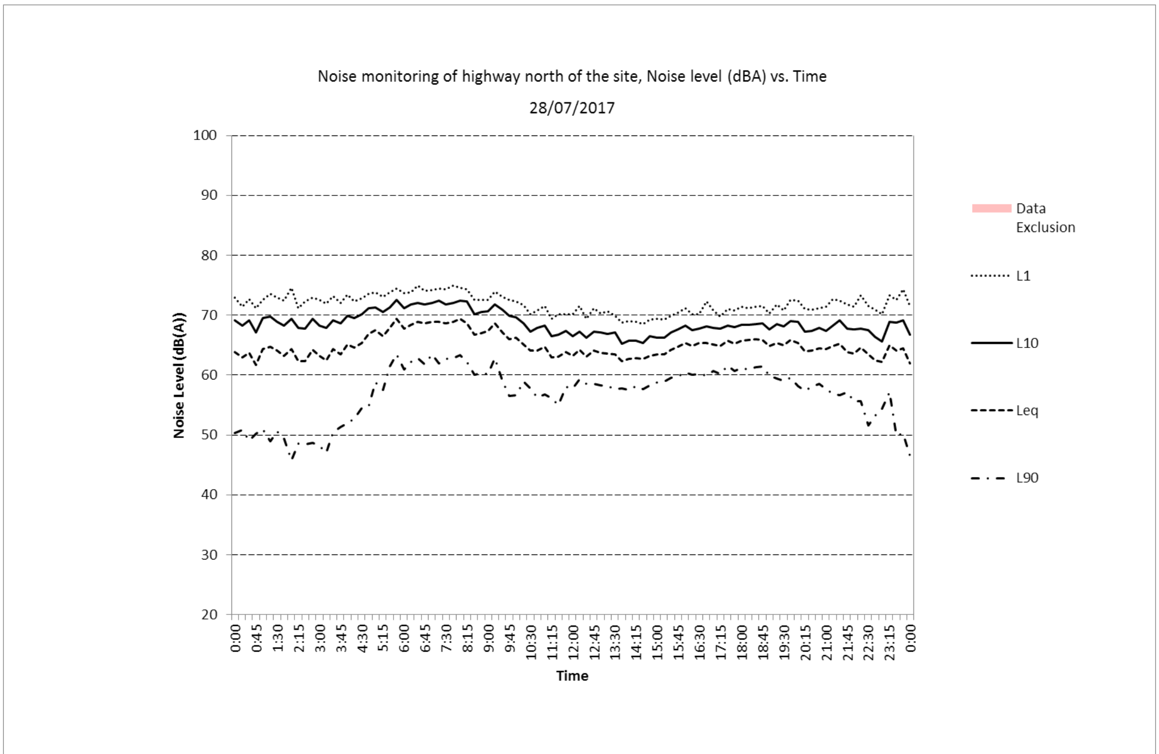


N
Transgrid
GLENLEE HOUSE
SPRING FARM PARKWAY
Railway Line
CUMMINS ROAD
CLUB MENANGLE
MENANGLE PARK STATION
NEPEAN RIVER
HUME HIGHWAY
MENANGLE ROAD
LEGEND
Master Plan Boundary
DWELLING TYPOLOGIES
Top Shop Apartments
Medium Density Lots
Low Density Lots
Large Lots
Rural
Rural / Private Open Space
NON RESIDENTIAL USES
Neighbourhood Centre
School
Employment
Infrastructure
Transgrid
Racing
Riparian
Riparian/Flood (30m)
Riparian/Flood (15m)
Riparian/Flood (45m)
Ecology
Field/Open Space
Park/Open Space
Future Open Space (>0.5ha)
Indicative Open Space/Civic Area
Additional two playing fields
(Approx 2.8ha-Detailed locations TBC)
DRAFT
robertsday.com.au planning design place
1:4000
MASTERPLAN
Menangle Park

Appendix B Noise Monitoring Graphs

Location 1 – Eastern boundary of Menangle Park, North of Menangle Road, Close to Hume Highway


Noise monitoring of highway north of the site, Noise level (dBA) vs. Time
27/07/2017
Noise Level (dB(A))
Time
Data Exclusion
L1
L10
Leq
L90


Noise monitoring of highway north of the site, Noise level (dBA) vs. Time
28/07/2017
Noise Level (dB(A))
Time
Data Exclusion
L1
L10
Leq
L90


Noise monitoring of highway north of the site, Noise level (dBA) vs. Time
29/07/2017
Noise Level (dB(A))
Time
Data Exclusion
L1
L10
Leq
L90


Noise monitoring of highway north of the site, Noise level (dBA) vs. Time
30/07/2017
Noise Level (dB(A))
Time
Data Exclusion
L1
L10
Leq
L90


Noise monitoring of highway north of the site, Noise level (dBA) vs. Time
31/07/2017
Noise Level (dB(A))
Time
Data Exclusion
L1
L10
Leq
L90
100
90
80
70
60
50
40
30
20
0:00
0:45
1:30
2:15
3:00
3:45
4:30
5:15
6:00
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11:15
12:00
12:45
13:30
14:15
15:00
15:45
16:30
17:15
18:00
18:45
19:30
20:15
21:00
21:45
22:30
23:15
0:00


Noise monitoring of highway north of the site, Noise level (dBA) vs. Time
01-08-2017
Noise Level (dB(A))
Time
Data Exclusion
L1
L10
Leq
L90
100
90
80
70
60
50
40
30
20
0:00
0:45
1:30
2:15
3:00
3:45
4:30
5:15
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11:15
12:00
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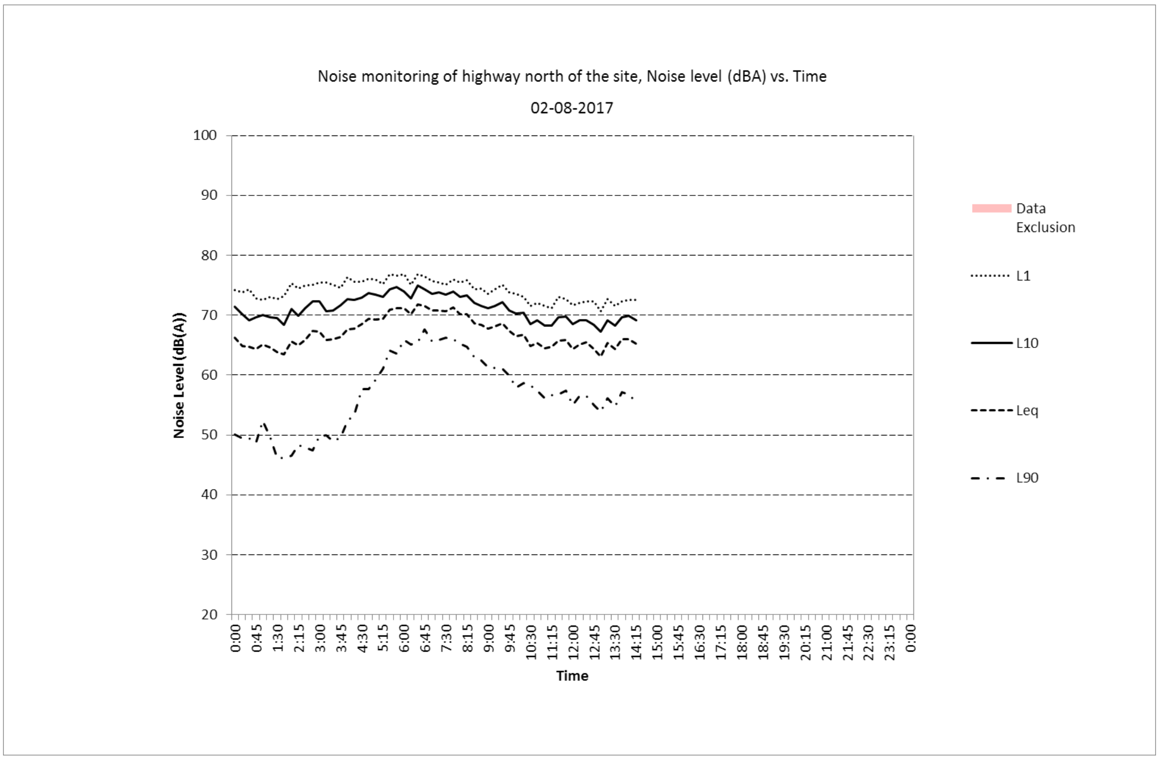
23:15
0:00


Noise monitoring of highway north of the site, Noise level (dBA) vs. Time
02-08-2017
Noise Level (dB(A))
Time
Data Exclusion
L1
L10
Leq
L90
100
90
80
70
60
50
40
30
20
0:00
0:45
1:30
2:15
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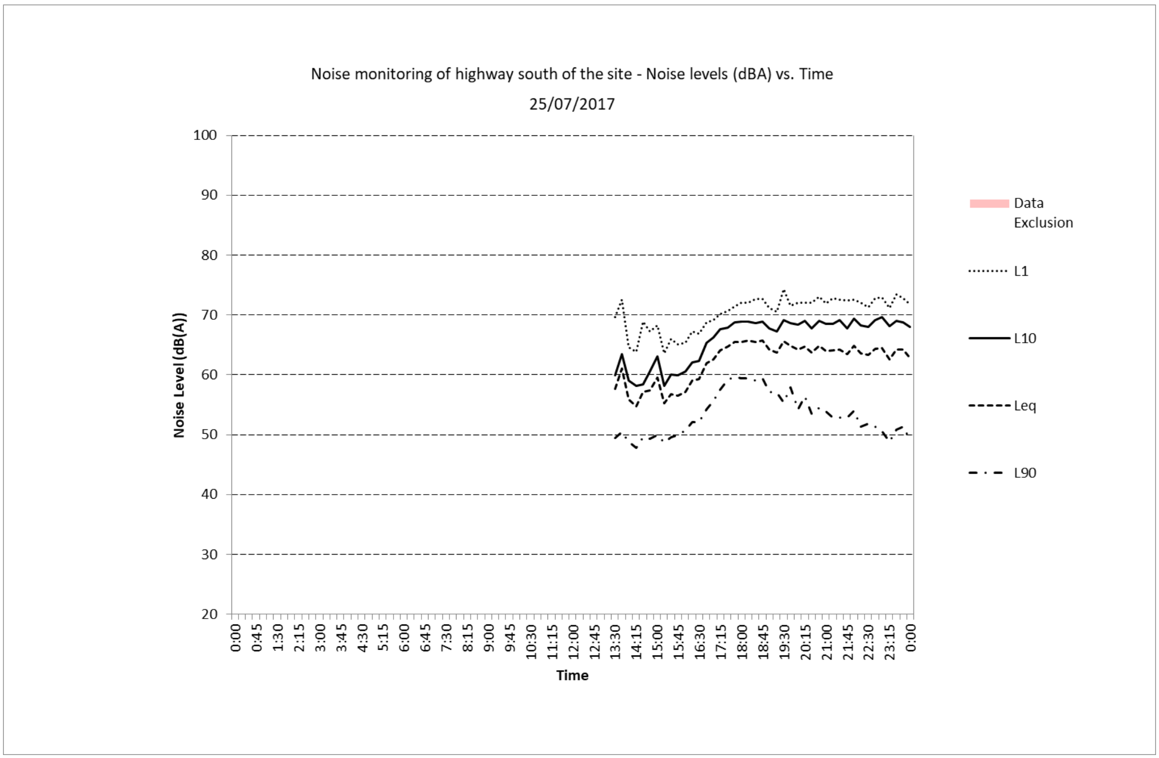
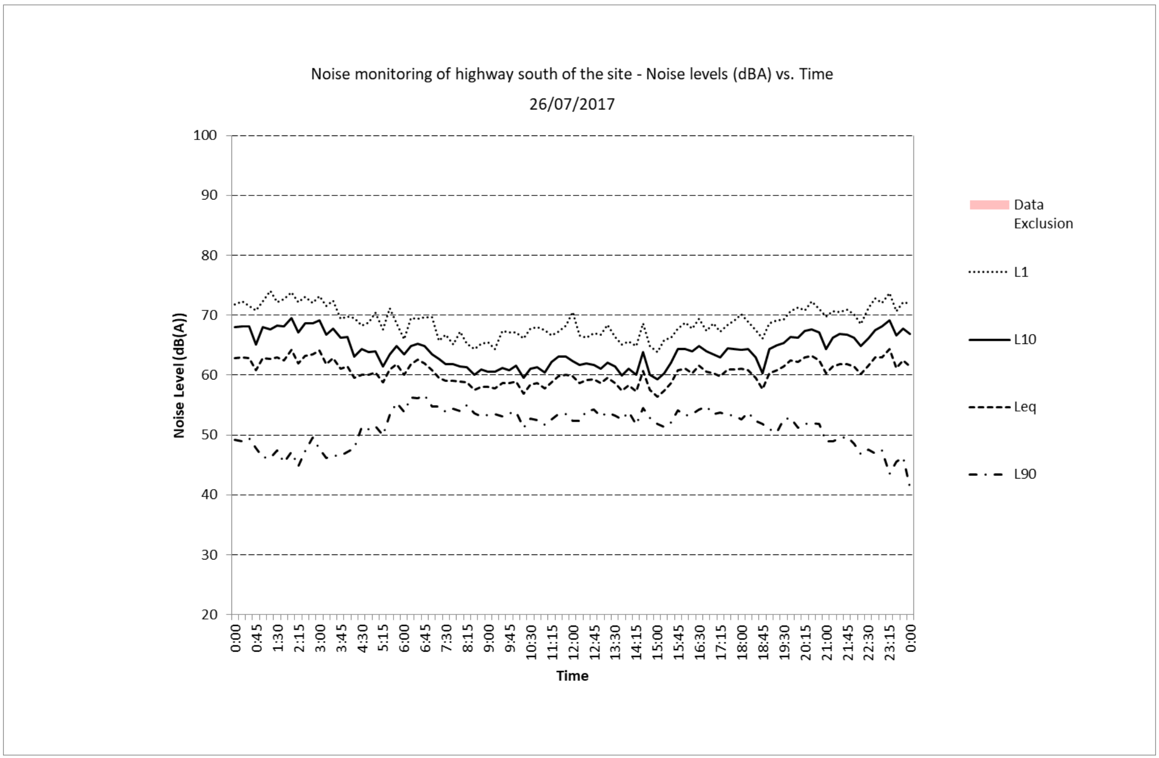
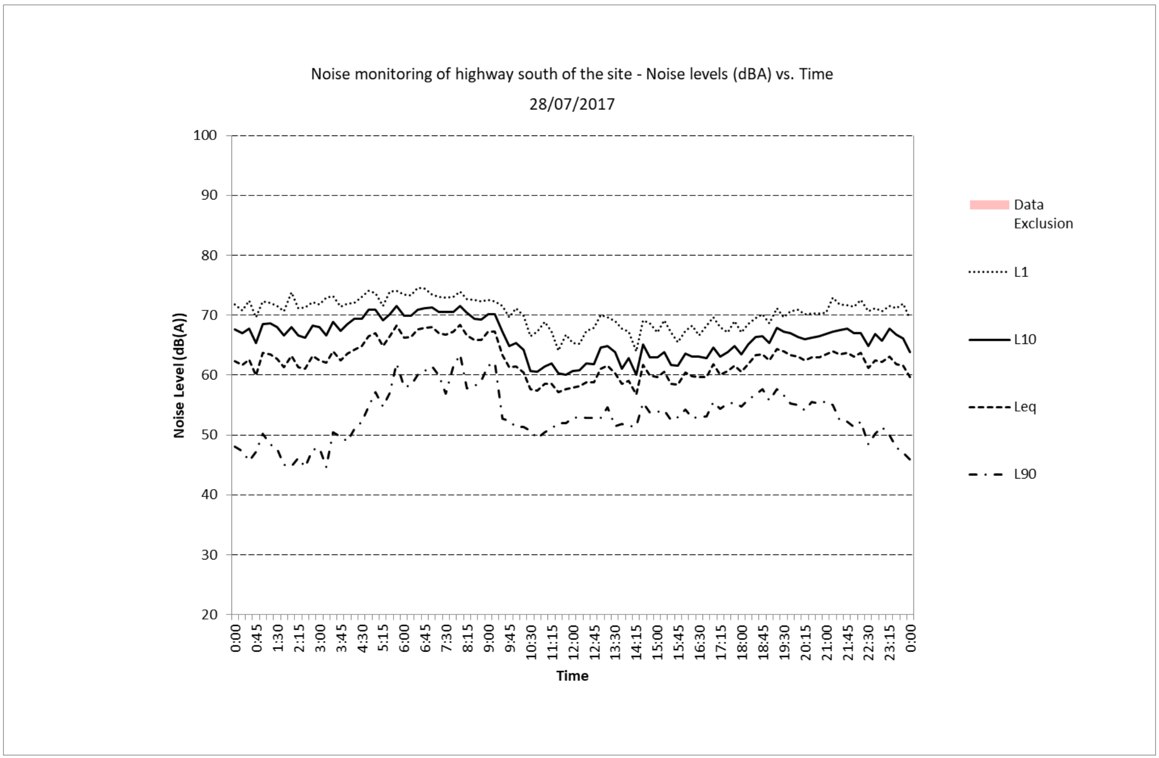
Location 2 – Eastern boundary of Menangle Park, South of Menangle Road, Close to Hume Highway



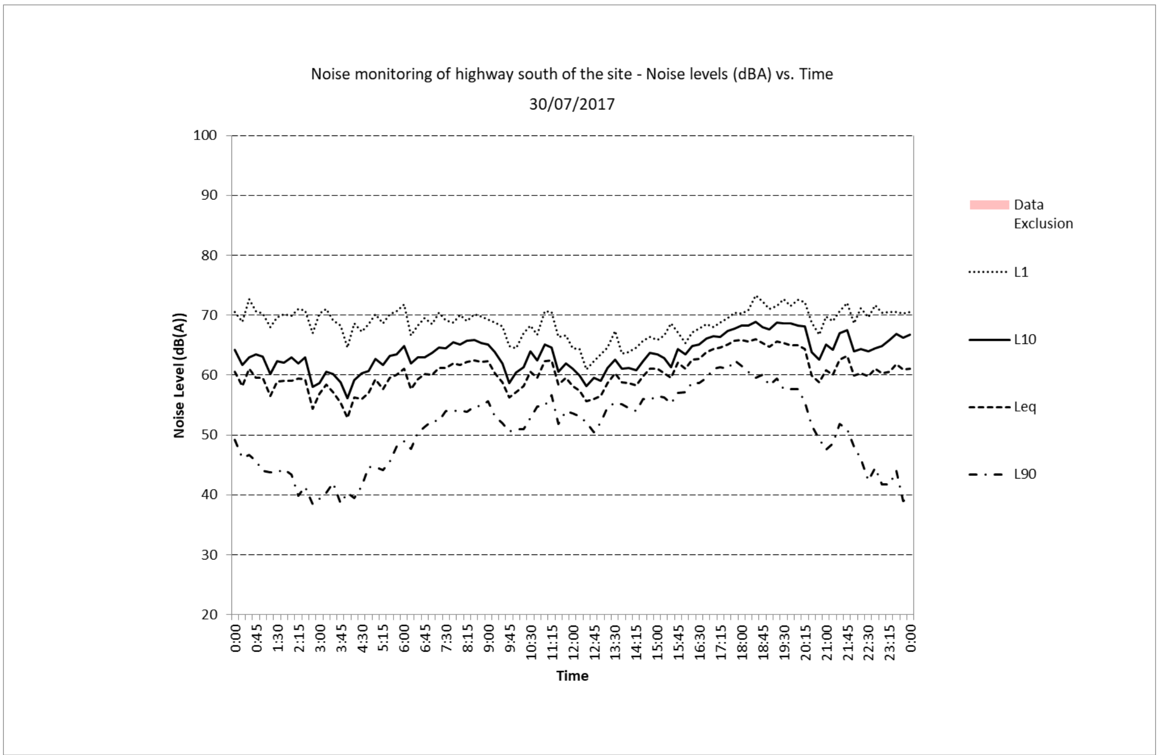


Noise monitoring of highway south of the site - Noise levels (dBA) vs. Time
27/07/2017
Noise Level (dB(A))
Time
Data Exclusion
L1
L10
Leq
L90



Noise monitoring of highway south of the site - Noise levels (dBA) vs. Time
28/07/2017
Noise Level (dB(A))
Time
Data Exclusion
L1
L10
Leq
L90

Noise monitoring of highway south of the site - Noise levels (dBA) vs. Time
29/07/2017
Noise Level (dB(A))
Time
Data Exclusion
L1
L10
Leq
L90



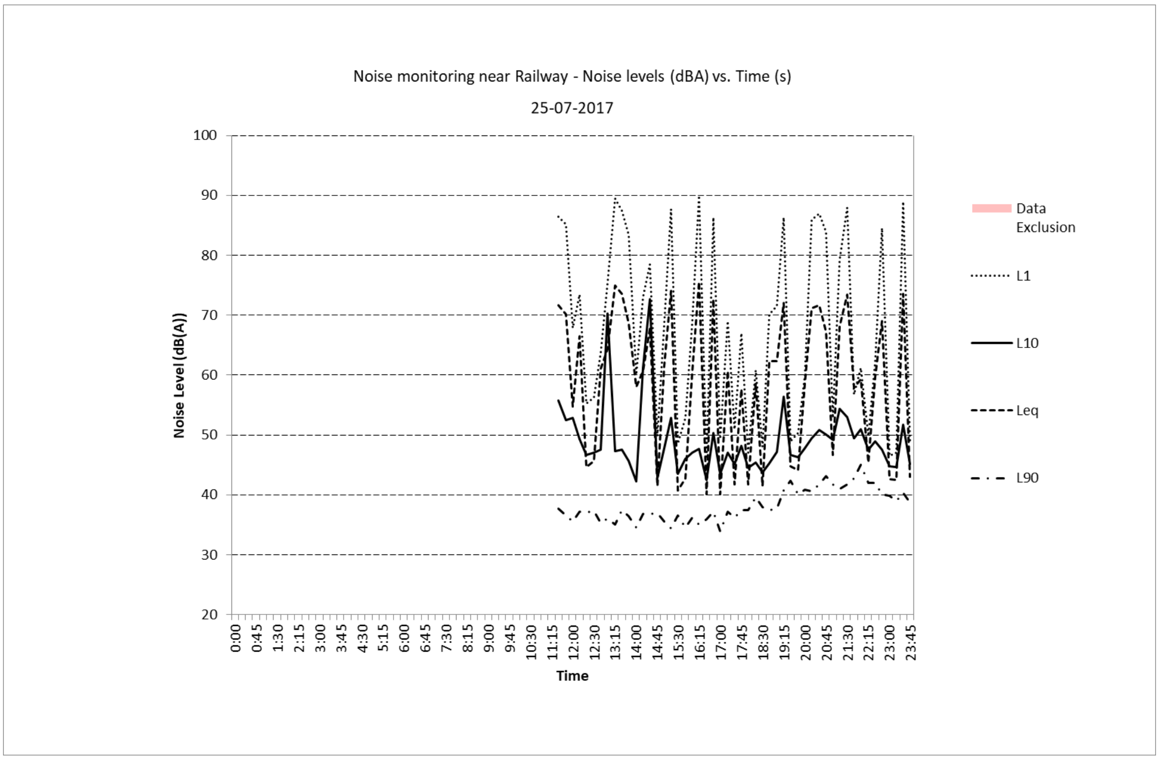
Noise monitoring of highway south of the site - Noise levels (dBA) vs. Time
30/07/2017
Noise Level (dB(A))
Time
Data Exclusion
L1
L10
Leq
L90

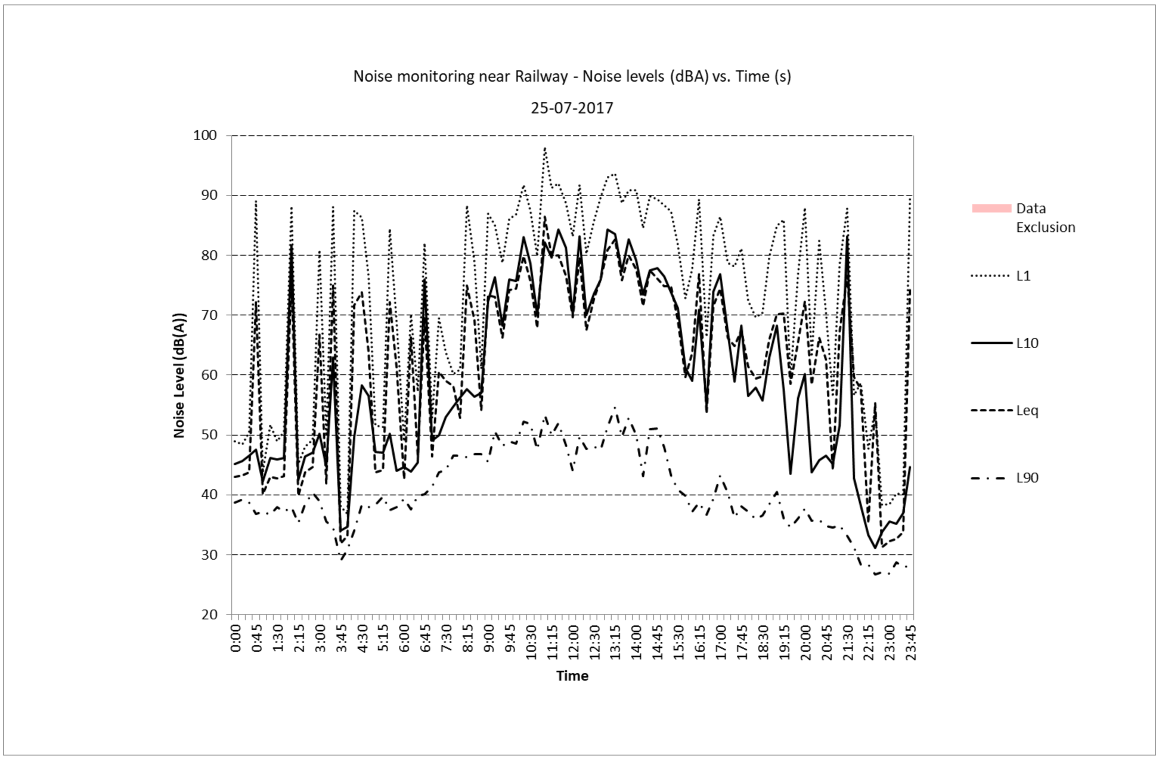
Noise monitoring of highway south of the site - Noise levels (dBA) vs. Time
31/07/2017
Noise Level (dB(A))
Time
Data Exclusion
L1
L10
Leq
L90

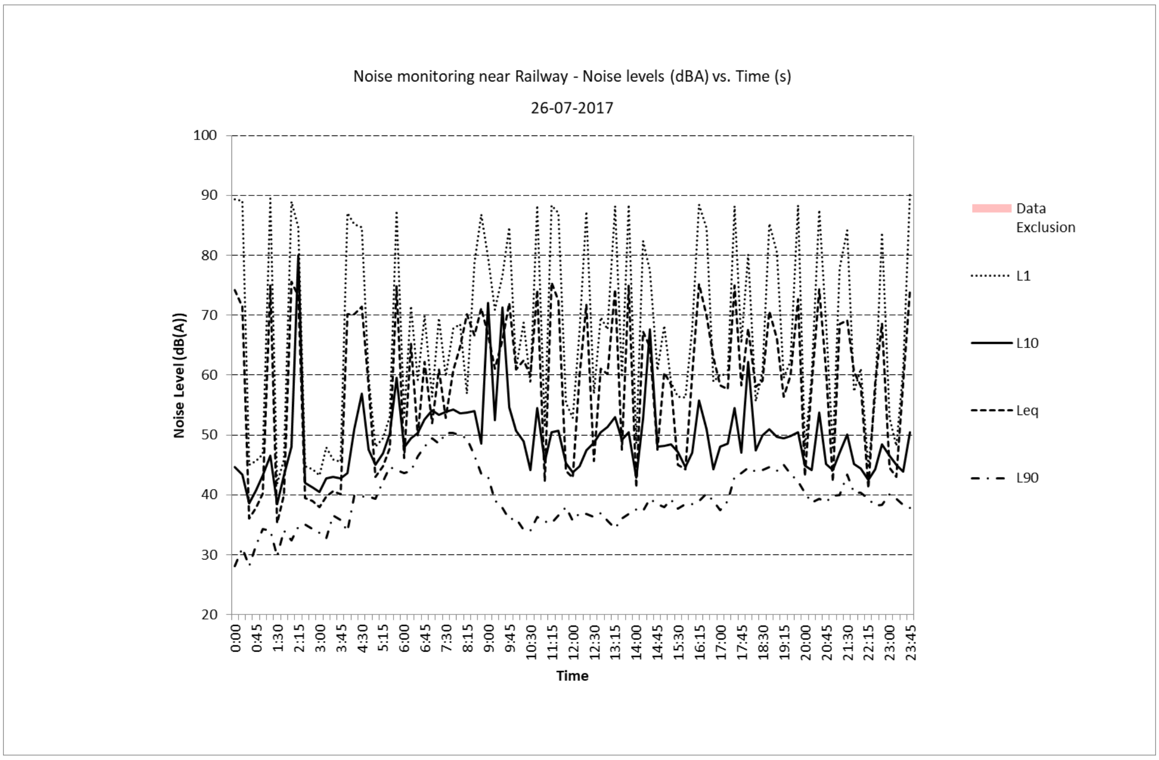
Noise monitoring of highway south of the site - Noise levels (dBA) vs. Time
01-08-2017
Noise Level (dB(A))
Time
Data Exclusion
L1
L10
Leq
L90

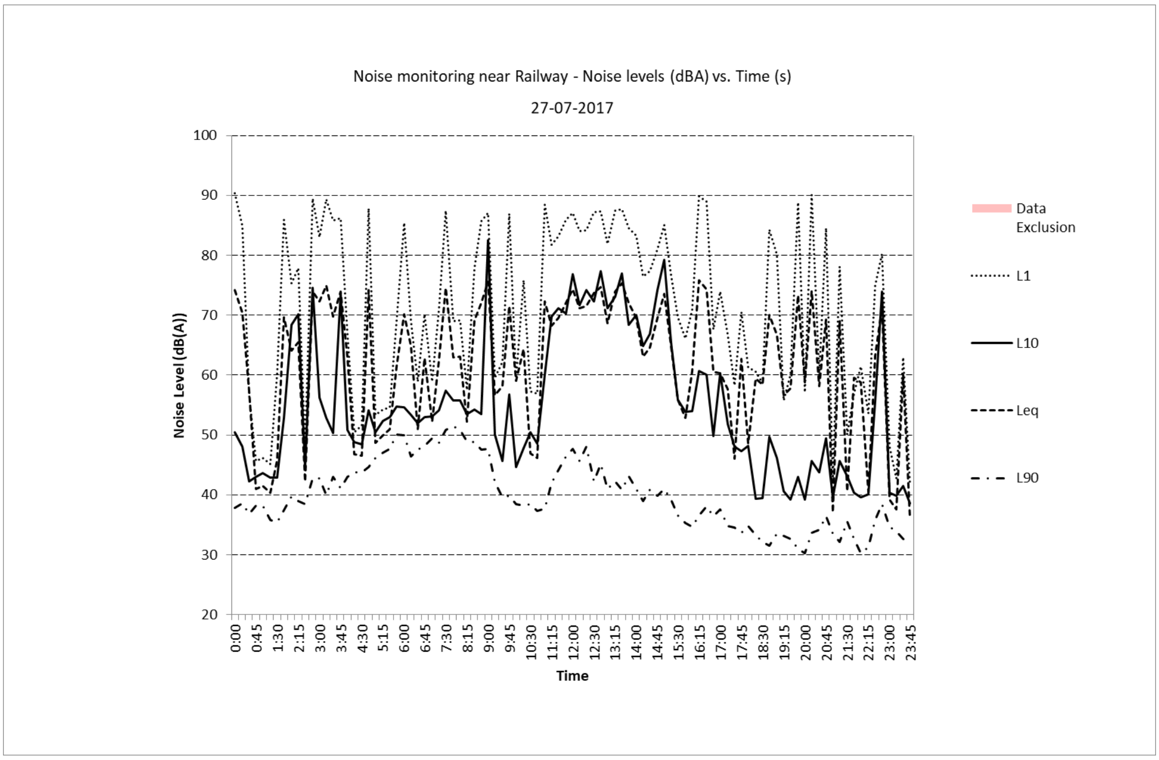
Noise monitoring of highway south of the site - Noise levels (dBA) vs. Time
02-08-2017
Noise Level (dB(A))
Time
Data Exclusion
L1
L10
Leq
L90

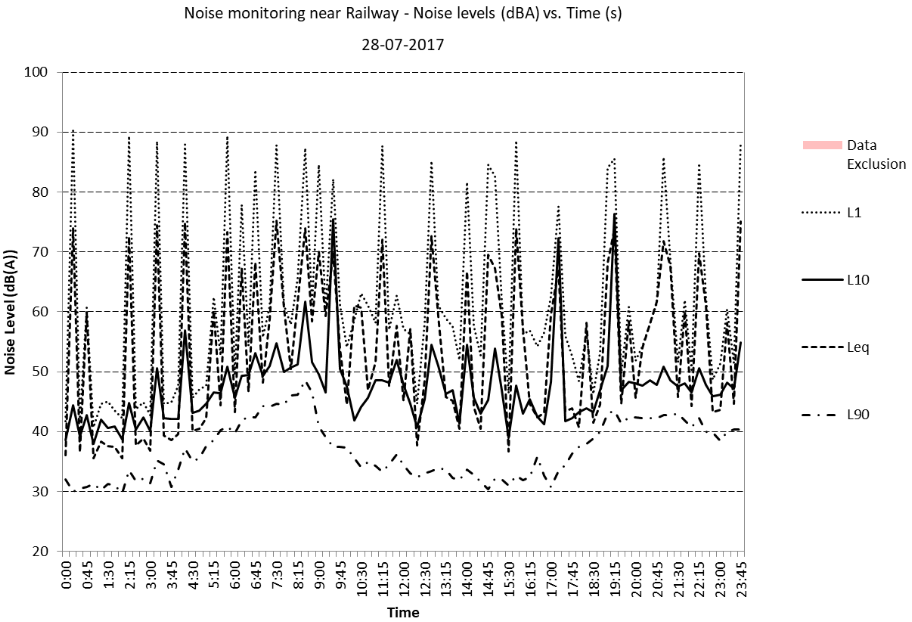
Location 3 – Western boundary of Menangle Park – Close to Railway line



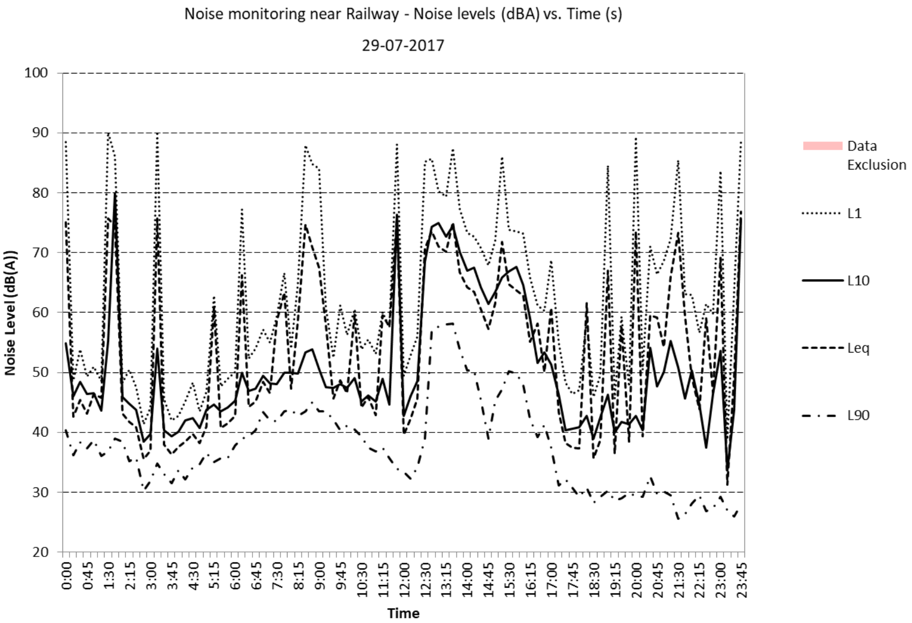



Noise monitoring near Railway - Noise levels (dBA) vs. Time (s)
26-07-2017
Noise Level (dB(A))
Time
Data Exclusion
L1
L10
Leq
L90

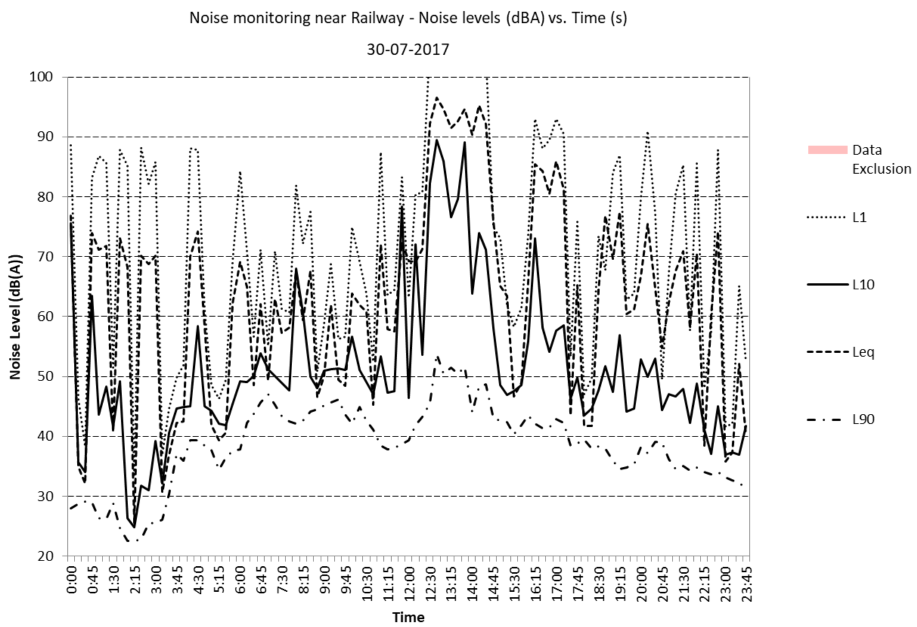

Noise monitoring near Railway - Noise levels (dBA) vs. Time (s)
27-07-2017
Noise Level (dB(A))
Time
Data Exclusion
L1
L10
Leq
L90

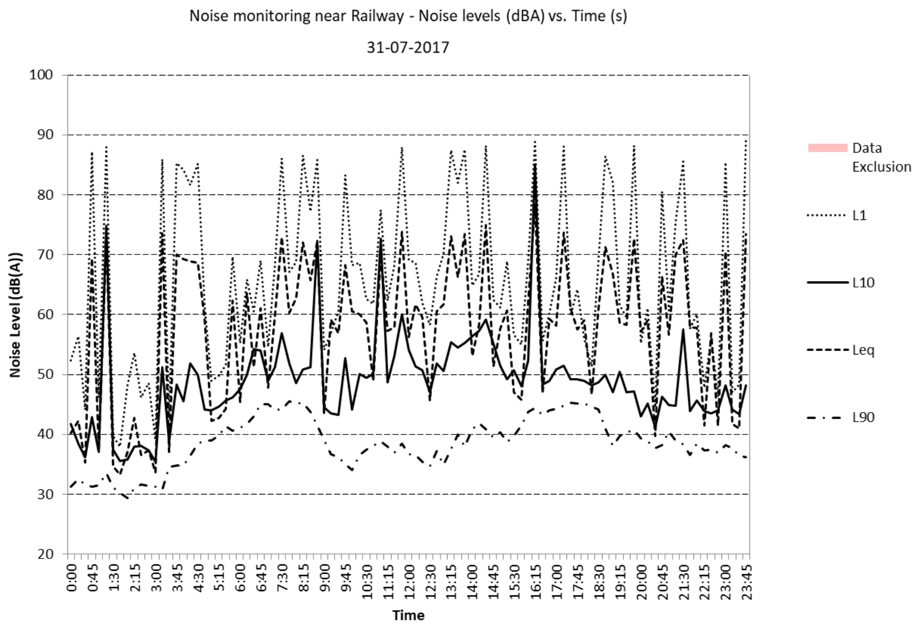


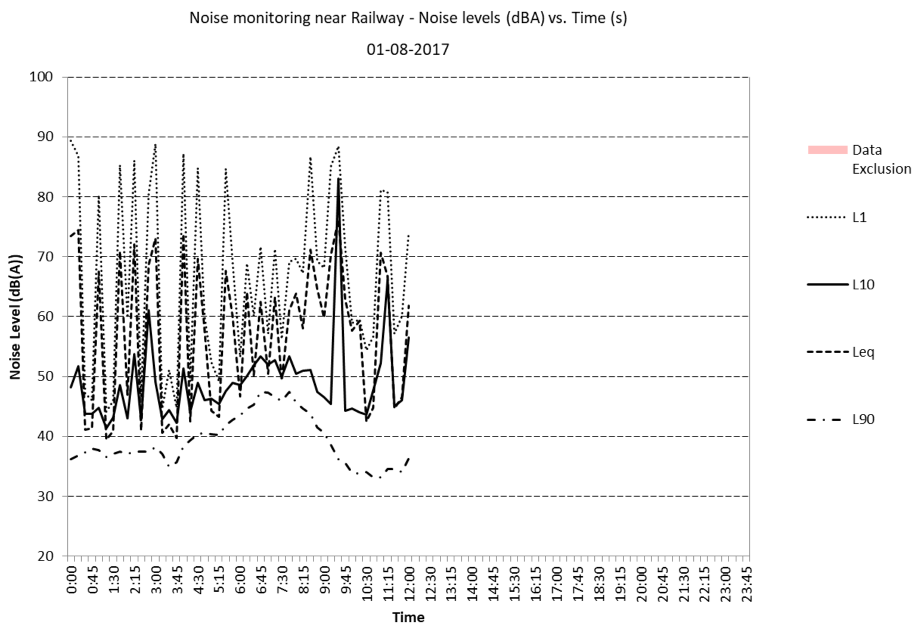
Noise monitoring near Railway - Noise levels (dBA) vs. Time (s)
28-07-2017
Noise Level (dB(A))
Time
Data Exclusion
L1
L10
Leq
L90



Noise monitoring near Railway - Noise levels (dBA) vs. Time (s)
29-07-2017
Noise Level (dB(A))
Time
Data Exclusion
L1
L10
Leq
L90


Noise monitoring near Railway - Noise levels (dBA) vs. Time (s)
30-07-2017
Noise Level (dB(A))
Time
Data Exclusion
L1
L10
Leq
L90


Noise monitoring near Railway - Noise levels (dBA) vs. Time (s)
31-07-2017
Noise Level (dB(A))
Time
Data Exclusion
L1
L10
Leq
L90



Noise monitoring near Railway - Noise levels (dBA) vs. Time (s)
01-08-2017
Noise Level (dB(A))
100
90
80
70
60
50
40
30
20
0:00
0:45
1:30
2:15
3:00
3:45
4:30
5:15
6:00
6:45
7:30
8:15
9:00
9:45
10:30
11:15
12:00
12:30
13:15
14:00
14:45
15:30
16:15
17:00
17:45
18:30
19:15
20:00
20:45
21:30
22:15
23:00
23:45
Time
Data Exclusion
L1
L10
Leq
L90

Appendix C Glossary

In this acoustic report unless the context of the subject matter otherwise indicates or requires, a term has the following meaning:

TERM	DEFINITION
ABL	The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night-time (for each day). It is determined by calculating the 10th percentile (lowest 10th percent) background level (L_{A90}) for each period.
Adverse Weather	Weather effects that increases noise (i.e. wind and temperature inversion) that occurs at a site for a significant period of time (i.e. wind occurring more than 30% of the time in any assessment period in any season and / or temperature inversion occurring more than 30% of the nights in winter).
Ambient Noise	The all-encompassing noise associated within a given environment. It is the composite of sounds from many sources both near and far.
Assessment Period	The period in a day over which assessments are made: day (0700 to 1800h), evening (1800 to 2200h) or night (2200 to 0700h) or actual operating period if only a part of a period(s).
A – Weighting Filter	A-weighting is the most commonly used of a family of curves defined in the International standard IEC 61672:2003 and various national standards relating to the measurement of sound pressure level. A-weighting is applied to instrument-measured sound levels in effort to account for the relative loudness perceived by the human ear, as the ear is less sensitive to low audio frequencies.
Background Noise	The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is excluded. Usually described using the L90 measurement parameter.
C – Weighting Filter	The C-weighting approximates the sensitivity of human hearing at industrial noise levels (above about 85 dB(A)). The C-weighted sound level (i.e., measured with the C-weighting) is more sensitive to sounds at low frequencies than the A-weighted sound level and is sometimes used to assess the low-frequency content of complex sound environments and entertainment noise.
Decibel	The ratio of sound pressures which we can hear is a ratio of 106 (one million:one). For convenience, therefore, a logarithmic measurement scale is used. The resulting parameter is called the ‘sound pressure level’ (Lp) and the associated measurement unit is the decibel (dB). As the decibel is a logarithmic ratio, the laws of logarithmic addition and subtraction apply.
dB(A)	The unit generally used for measuring environmental, traffic or industrial noise is the A-weighted sound pressure level in decibels, denoted dB(A). An A-weighting network can be built into a sound level measuring instrument such that sound levels in dB(A) can be read directly from a sound level meter. The weighting is based on the frequency response of the human ear and has been found to correlate well with human subjective reactions to various sounds. It is worth noting that an increase or decrease of approximately 10 dB corresponds to a subjective doubling or halving of the loudness of a noise, and a change of 2 to 3 dB is subjectively barely perceptible.
Equivalent Continuous Sound Level (Leq)	Another index for assessment for overall noise exposure is the equivalent continuous sound level, L_{eq}. This is a notional steady level which would, over a given period of time, deliver the

TERM	DEFINITION
	same sound energy as the actual time-varying sound over the same period, similar to the average. Hence fluctuating levels can be described in terms of a single figure level.
Extraneous Noise	Noise resulting from activities that are not typical of the area. Atypical activities may include construction, and traffic generated during holiday periods and during special events such as concert or sporting events.
Fast Time Weighting	125 ms integration time while the signal level is increasing and decreasing.
Frequency	The rate of repetition of a sound wave. The subjective equivalent in music is pitch. The unit of frequency is the Hertz (Hz), which is identical to cycles per second. A thousand hertz is often denoted kHz, e.g. 2 kHz = 2000 Hz. Human hearing ranges approximately from 20 Hz to 20 kHz. For design purposes, the octave bands between 63 Hz to 8 kHz are generally used. The most commonly used frequency bands are octave bands, in which the mid frequency of each band is twice that of the band below it. For more detailed analysis, each octave band may be split into three one-third octave bands or in some cases, narrow frequency bands.
L_{Aeq}	See equivalent continuous sound level definition above. This is the A-weighted energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environmental. This measure is also a common measure of environmental noise and road traffic noise.
$L_{Aieq,T}$	Equivalent continuous A-weighted sound pressure level over the measurement period T with impulse time weighting.
$L_{Ceq,T}$	The equivalent continuous C-weighted sound pressure level (integrated level) that, over the measurement period T, has the same mean square sound pressure (referenced to 20 µPa) as the fluctuating sound(s) under consideration.
$L_{C, Peak}$	The C weighted Peak sound pressure level during a designated time interval or a noise event.
Low Frequency	Noise containing major components in the low-frequency range (20Hz to 250Hz) of the frequency spectrum.
Maximum Noise Levels L^{max}	The maximum noise level identified during a measurement period. Experimental data has shown that the human ear does not generally register the full loudness of transient sound events of less than 125 ms (millisecond). Fast time weighting has an exponential time constant of 125 ms, which reflects the ear's response. The maximum A weighted level measured with fast time weighting is denoted as L_{AMax}, f. Slow time weighting (S) with an exponential time constant of 1second is used to allow more accurate estimation of the average sound level on a visual display. Impulse (I) time weighting has a fast rise (35 ms) and a slow decay and is intended to mimic the ear's response to impulsive sounds.
Maximum Noise Levels L_{max}	The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.
Minimum Noise Levels L_{min}	The minimum noise level over a sample period is the minimum level, measured on fast response, during the sample period.

TERM	DEFINITION
Noise Sensitive Receiver (NSR)	A noise sensitive receiver is any person or building or outside space in which they reside or occupy that has the potential to be adversely impacted by noise from an outside source, or noise not generated by the noise sensitive receiver.
Project-Specific Noise Levels	They are target noise levels for a particular noise generating facility. They are based on the most stringent of the intrusive or amenity criteria derived from the NSW Industrial Noise Policy.
RBL	The Rating Background Level for each period is the median value of the ABL values for the period over all the days measured. There is a therefore an RBL value for each period – daytime, evening and night-time.
Shoulder Periods	Where early morning (5 am to 7 am) operations are proposed, it may be unduly stringent to expect such operations to be assessed against the night-time criteria (especially if existing background noise levels are steadily rising in these early morning hours). In these situations, appropriate noise level targets may be negotiated with the regulatory/consent authority on a case-by-case basis.
Slow Time Weighting	1 second integration time while the signal level is increasing and decreasing.
Sound Reduction Index (R)	The sound reduction index (or transmission loss) of a building element is a measure of the loss of sound through the material, i.e. its attenuation properties. It is a property of the component, unlike the sound level difference which is affected by the common area between the rooms and the acoustic of the receiving room. The weighted sound reduction index, R_w, is a single figure description of sound reduction index which is defined in BS EN ISO 717-1: 1997. The R_w is calculated from measurements in an acoustic laboratory. Sound insulation ratings derived from site (which are invariably lower than the laboratory figures) are referred to as the R'_w ratings.
Statistical Noise Levels	For levels of noise that vary widely with time, for example road traffic noise, it is necessary to employ an index which allows for this variation. The L_{10}, the level exceeded for ten per cent of the time period under consideration, has been adopted in this country for the assessment of road traffic noise. The L_{90}, the level exceeded for ninety per cent of the time, has been adopted to represent the background noise level. The L_1, the level exceeded for one per cent of the time, is representative of the maximum levels recorded during the sample period. A-weighted statistical noise levels are denoted L_{A10}, dBL_{A90} etc. The reference time period (T) is normally included, e.g. $dBL_{A10, 5min}$ or $dBL_{A90, 8hr}$.
L_{A1}	The L_{A1} level is the A-weighted noise level which is exceeded for 15 of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.
L_{A10}	The L_{A10} level is the A-weighted noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.
L_{A50}	The L_{A50} level is the A-weighted noise level which is exceeded for 50% of the sample period.
L_{A90}	The LA90 level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the LA90 level for 10% of the time. This measure is a commonly referred to as the background noise level.

TERM	DEFINITION
Temperature Inversion	An atmospheric condition in which temperature increases with height above the ground.
Tonality	Noise containing a prominent frequency and characterised by a definite pitch.
Typical Levels	Some noise levels of some common noise sources are given below:

Noise Level dB(A)	Example
130	Threshold of pain
120	Jet aircraft take-off at 100 m
110	Chain saw at 1 m
100	Inside disco
90	Heavy lorries at 5 m
80	Kerbside of busy street
70	Loud radio (in typical domestic room)
60	Office or restaurant
50	Domestic fan heater at 1m
40	Living room
30	Theatre
20	Remote countryside on still night
10	Sound insulated test chamber
0	Threshold of hearing