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230 SIXTH, 68 & 50 EDMONDSON AVENUES, AUSTRAL

Road Traffic Noise Assessment

14 October 2016

Mott MacDonald

TH526-02F02 Road Traffic Noise Asessment (r0)

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We have prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

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1 Introduction

Renzo Tonin & Associates was engaged to conduct an environmental noise assessment of road traffic onto the proposed residential subdivision at 230 Sixth Avenue, 68 Edmondson Avenue and 50 Edmondson Avenue in Austral.

This report quantifies the noise impact from future road traffic along Edmondson Avenue to the east of the site and is to form a part of the Development Application for the residential development. Noise impacts for road traffic have been assessed in accordance with the requirements of Liverpool City Council and the New South Wales (NSW) State Environmental Planning Policy (Infrastructure) 2007 (ISEPP).

The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001. APPENDIX A contains a glossary of acoustic terms used in this report.

2 Project description

2.1 Site description and development overview

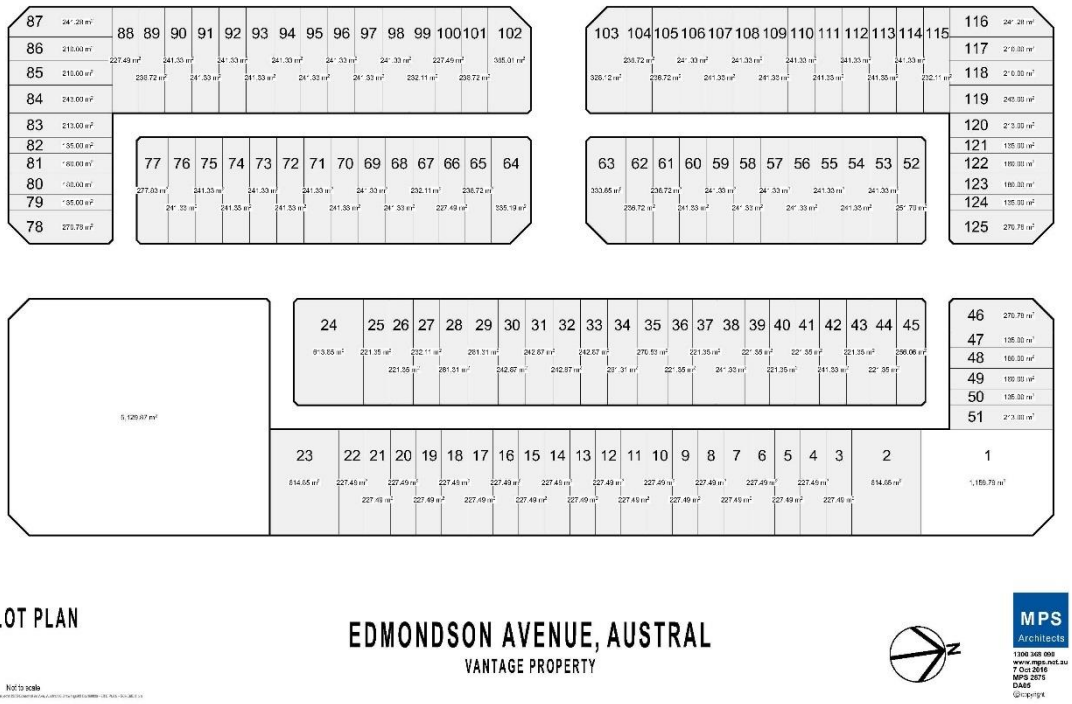
The site is situated some 38km from the Sydney CBD in the South-western Sydney suburb of Austral. Bringelly Road runs east-west approximately 360m to the south.

The residential subdivision includes the development of 133 residential lots, and is bound by rural lots on all sides (see Figure 1). With regard to road traffic, the subdivision is subject to the road traffic along Edmondson Avenue to the east.

Figure 1: Subject site

The subdivision plan is shown in Figure 2.

Figure 2: Edmondson Avenue, Austral - Lot plan



2.2 Assessment methodology

In order to assess the potential road traffic noise impact onto the subdivision site, the following methodology was used:

- Using predictive noise modelling to determine the extent of noise impact from the surrounding road network at residential facades;
- Identify where road traffic noise emission onto the site may exceed the relevant criteria;
- Where road traffic noise emission onto the site may exceed the relevant criteria, provide recommendations to reduce noise impacts onto the site; and
- Where external noise levels are predicted to exceed the noise criteria, in-principle recommendations are provided for building envelope design in order to achieve internal noise criteria.

3 Road traffic noise criteria

3.1 Liverpool City Council

Section 2.3.9 *Noise* of the Liverpool City Council Growth Centre Precincts Development Control Plan (DCP) 2014 sets out the following:

Objectives

a. To minimise the impacts of noise from major transport infrastructure, industrial and employment areas on residential amenity.

b. To achieve an acceptable residential noise environment whilst maintaining well designed and attractive residential streetscapes.

Controls

1. Figure 2-1 provides guidance to applicants on measures to mitigate the impacts of rail and traffic noise within the Precinct.

2. Development Applications must be accompanied by an acoustic report where the development is in a location, shown on the Potential noise attenuation measures figure in the relevant Precinct Schedule, such as:

3. adjacent to a railway line, arterial road, sub-arterial road, transit boulevard or other road with traffic volumes predicted to exceed (or currently exceeding) 6,000 vehicles per day;

4. potentially impacted upon by a nearby industrial / employment area; or

5. potentially impacting upon sensitive receivers such as residences within the precinct and outside the precinct.

6. The acoustic report shall demonstrate that the noise criteria in Development Near Rail Corridors and Busy Roads- Interim Guideline (Department of Planning 2008) have been considered.

7. Subdivision design on land adjacent to significant noise sources is to consider and implement measures to attenuate noise within dwellings and in external areas that are classified as Principle Private Open Space (refer to clause 4.2.7)

8. Physical noise barriers (ie. Noise walls or solid fencing) are not generally supported, and measures to attenuate noise through subdivision layout, such as setbacks, building orientation, and building design and materials selection should be implemented to achieve appropriate internal noise standards.

Section 4.2.9 *Visual and acoustic privacy* of the same document sets out the following:

Objectives

a. To site and design dwellings to meet user requirements for visual and acoustic privacy, while minimising the visual and acoustic impacts of development on adjoining properties.

b. To minimise the impact of noise of other non-residential uses such as parking and sport areas, restaurants and cafes and waste collection and goods deliveries.

Controls

1. Direct overlooking of main habitable areas and the private open spaces of adjoining dwellings should be minimised through building layout, window and balcony location and design, and the use of screening, including landscaping.

2. Living area windows on upper floors with a direct sightline within 9 metres to the Principal Private Open Space of an existing adjacent dwelling are to:

- *be obscured by fencing, screens or landscaping, or*
- *be offset from the edge of one window to the edge of the other by a distance sufficient to limit views into the adjacent window; or*
- *have sill height of 1.7 metres above floor level; or*
- *have fixed obscure glazing in any part of the window below 1.7 metres above floor level.*

3. Balconies are not permitted on the first floor of the side and / or rear portion of the dwelling except where the balcony faces a public road, or land zoned for public recreation or drainage.

4. The design of dwellings must minimize the opportunity for sound transmission through the building structure, with particular attention given to protecting bedrooms and living areas.

5. In attached and semi-detached dwellings, bedrooms of one dwelling are not to share walls with living spaces or garages of adjoining dwellings, unless it is demonstrated that the shared walls and floors meet the noise transmission and insulation requirements of the National Construction Code.

6. No electrical, mechanical or hydraulic equipment or plant shall generate a noise level greater than 5dBA above background noise level measured at the property boundary during the hours 7.00am to 10.00pm and noise is not to exceed background levels during the hours 10.00pm to 7.00am.

7. Dwellings along sub-arterial or arterial roads, or transit boulevards, or any other noise source, should be designed to minimize the impact of traffic noise, and where possible comply with the criteria in Table 4.7.

8. The internal layout of residential buildings, window openings, the location of outdoor living areas (i.e. courtyards and balconies), and building plant should be designed to minimise noise impact and transmission.

9. Noise walls are not permitted.

10. Development affected by rail or traffic noise is to comply with Development Near Rail Corridors and Busy Roads – Interim Guideline (Department of Planning 2008). The design of development is also to consider ways to mitigate noise in Principal Private Open Space areas.

11. Architectural treatments are to be designed in accordance with AS3671 - Traffic Noise Intrusion Building Siting and Construction, the indoor sound criteria of AS2107 - Recommended Design Sound Levels and Reverberation Times for Building Interiors.

Table 4.7: Noise criteria for residential premises impacted by traffic noise

	Sleeping areas	**Living areas**
Naturally ventilated/ windows open to 5% of the floor area (Mechanical ventilation or air conditioning systems not operating)	LAeq 15 hours (day): 40dBA LAeq 9 hour (night): 35dBA	LAeq 15 hours (day): 45dBA LAeq 9 hour (night): 40dBA
Doors and windows shut (Mechanical ventilation or air conditioning systems are operating)	LAeq 15 hours (day): 43dBA LAeq 9 hour (night): 38dBA	LAeq 15 hours (day): 46dBA LAeq 9 hour (night): 43dBA

Notes:

These levels correspond to the combined measured level of external sources and the ventilation system operating normally.

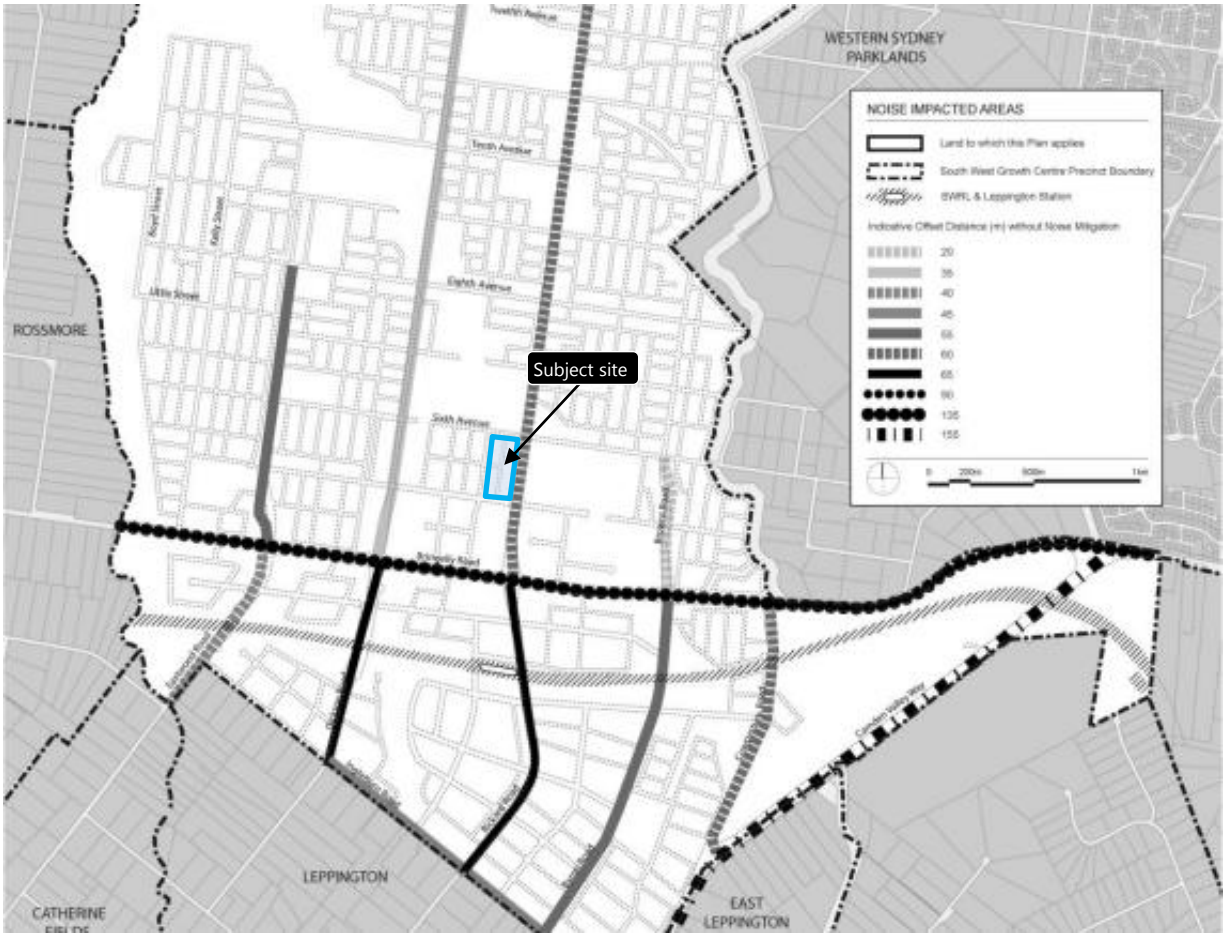
Where a naturally ventilated/windows open condition cannot be achieved, it is necessary to incorporate mechanical ventilation (clause 4.1.3 includes controls for appropriate ventilation systems).

LAeq 1 hour noise levels shall be determined by taking as the second highest LAeq 1 hour over the day and night period for each day and arithmetically averaging the results over a week for each period (5 or 7 day week, whichever is highest)

Within the Liverpool Growth Centre Precincts DCP 2014 – Schedule 1 (Austral & Leppington North Precincts), indicative distances from noise sources such as road and rail lines are provided. The indicative distances are provided to indicate areas which may require noise mitigation measures. The indicative offset distances are provided in Figure 2.9 of the DCP.

The subject site is approximately 360m north of Bringelly Road, while the eastern boundary is located less than 60m from Edmondson Avenue. Therefore, Edmondson Avenue has been identified as the road which has the greatest potential to cause road traffic noise intrusion into the subject site as well as determining the requirement for noise mitigation measures. Figure 2.9 of the DCP has been reproduced in Figure 3 below.

Figure 3: Potential noise attenuation measures



3.2 State Environmental Planning Policy (Infrastructure) 2007 noise limits

In NSW the SEPP (Infrastructure) 2007, also known as the Infrastructure SEPP ('ISEPP'), commenced on 1 January 2008 to facilitate the effective delivery of infrastructure across the State. The aim of the policy includes identifying the environmental assessment category into which different types of infrastructure and services development fall, and identifying matters to be considered in the assessment of development adjacent to particular types of infrastructure.

Clause 102 of the ISEPP states as follows:

> *102 Impact of road noise or vibration on non-road development*
>
> *1. This clause applies to development for any of the following purposes that is on land in or adjacent to the road corridor for a freeway, a tollway or a transitway or any other road with an annual average daily traffic volume of more than 40,000 vehicles (based on the traffic volume data published on the website of the RTA) and that the consent authority considers is likely to be adversely affected by road noise or vibration:*
>
> - *a building for residential use,*
> - *a place of public worship,*

- *a hospital,*
- *an educational establishment or child care centre.*

2. *Before determining a development application for development to which this clause applies, the consent authority must take into consideration any guidelines that are issued by the Director-General for the purposes of this clause and published in the Gazette.*
3. *If the development is for the purposes of a building for residential use, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded:*
   - *in any bedroom in the building--35 dB(A) at any time between 10 pm and 7am,*
   - *anywhere else in the building (other than a garage, kitchen, bathroom or hallway)-- 40 dB(A) at any time.*
4. *In this clause, "freeway", "tollway" and "transitway" have the same meanings as they have in the Roads Act 1993.*

3.2.1 ISEPP Guideline

To support the Infrastructure SEPP, the NSW Department of Planning released the *Development in Rail Corridors and Busy Roads – Interim Guideline* (December 2008). The Guideline assists in the planning, design and assessment of developments in, or adjacent to, major transport corridors in terms of noise, vibration and air quality. Whilst the ISEPP applies only to roads with an AADT greater than 40,000 vehicles, the guideline is also recommended for other road traffic noise affected sites.

3.2.1.1 Clarification of ISEPP noise limits

The Guideline clarifies the time period of measurement and assessment. As stated in the Guideline in Section 3.4 '*What Noise and Vibration Concepts are Relevant*' and Table 3.1 of Section 3.6.1, noise measurements are determined over the following relevant time periods:

- Daytime 7am-10pm $L_{Aeq(15hr)}$
- Night-time 10pm-7am $L_{Aeq(9hr)}$

L_{Aeq} is the Equivalent Continuous Noise Level and accounts for both the level of fluctuating noise and also the number of noise events over the time period. The noise criteria nominated in the ISEPP are internal noise levels with windows and doors closed and the requirements are stated in the following table.

Table 1: ISEPP internal road traffic noise criteria

Internal space	Time period	Noise metric	Internal criteria^
Bedrooms	7am - 10pm	$L_{Aeq(15hrs)}$	40*
	10pm to 7am	$L_{Aeq(9hrs)}$	35
Other Habitable Rooms	Any Time	$L_{Aeq(15hrs)}$ and $L_{Aeq(9hrs)}$	40

Notes: ^ With windows and doors closed.

* Whilst not specified in the ISEPP, daytime criteria for bedrooms are set to 40dB(A), as per the other habitable rooms.

The Guideline in Section 3.6.1 'Airborne Noise' states as follows:

> *"If internal noise levels with windows or doors open exceed the criteria by more than 10dBA, the design of the ventilation for these rooms should be such that occupants can leave windows closed, if they so desire, and also to meet the ventilation requirements of the Building Code of Australia."*

As noise modelling is undertaken for external locations, the above criteria and guidelines have been used to establish equivalent external noise criteria. This external noise criterion is used to determine which building facades may require specific acoustic treatment to meet the requirements of the ISEPP. External goals have been calculated on the basis of nominal 10dB(A) reduction through an open window to a free-field position. Windows open to 5% of floor area in accordance with the BCA 2016 requirements.

Table 2: ISEPP road traffic noise criteria for new residential development

Room	Location	$L_{Aeq, 15hr}$ Day 7am – 10pm	$L_{Aeq\ 9hr}$ Night 10pm – 7am
Living rooms*	Internal, windows closed	40	40
	Internal, windows open	50	50
	External free-field (allowing windows to remain open)^	60	60
Bedrooms*	Internal, windows closed	40	35
	Internal, windows open	50	45
	External free-field (allowing windows to remain open)^	60	55

Notes: * Requisite for 40,000AADT Roads only under ISEPP 2007.

^ ISEPP Guideline states that where internal noise criteria are exceeded by more than 10dB(A) with windows open mechanical ventilation is required. External goals have been calculated on the basis of nominal 10dB(A) reduction through an open window to a free-field position. Windows open to 5% of floor area in accordance with the BCA 2016 requirements.

3.3 Project noise criteria

We note that the ISEPP criteria differ to the DCP requirements, primarily for the living rooms. The ISEPP permits higher internal noise levels of up to 50dB(A) with windows open; however, when exceeding this level, it sets a more stringent internal noise goal. For the subject site, the ISEPP noise goals have been adopted as they are considered the most current road traffic noise policy for new residential development in NSW.

4 Road traffic noise assessment

4.1 Road design and traffic flow

Peak period traffic flows for the Year 2036 [ref: Post_Exhibition_Addendum_Traffic_Report, dated 4 July 2012] have been predicted by AECOM for the Austral and Leppington North Precincts.

The following assumptions were used for the road traffic noise modelling:

- Peak hour traffic volumes are 10% of the 24hr volume;
- The 15hr daytime volume is 85% of the 24hr volume,
- Renzo Tonin & Associates assumes the percentage of heavy vehicles in traffic mix to be 5%.

The traffic volumes used for the acoustic assessment are presented in Table 3. It is noted that variations in the actual traffic volumes, in particular heavy vehicle percentages, will affect the traffic noise exposure. A sensitivity assessment could be undertaken during the detail design phase of the development.

Table 3: Future road traffic volumes

Year of forecasted data	Road	Classification	Period	Traffic flow	% heavy vehicles
Edmondson Avenue					
2036	North of Bringelly Road	Transit Boulevard	24-hour	16,500	5

While both 'day' and 'night' traffic noise goals are to be satisfied, the daytime traffic goals are more likely to be exceeded in a developed residential area. This corresponds with the assumed traffic distribution. Night time road traffic noise levels are likely to create greater impact only where the night time percentage of heavy vehicles is significantly higher than the day time period.

4.2 Prediction methodology

Noise predictions are based on a method developed by the United Kingdom Department of Environment entitled '*Calculation of Road Traffic Noise (1988)*' known as the CoRTN (1988) method. The method has been adapted to Australian conditions and extensively tested by the Australian Road Research Board. As a result, it is recognised and accepted by the NSW Environment Protection Authority (EPA). The model predicts noise levels for steady flowing traffic and adjustments have been made to account for the higher source locations associated with heavy vehicle engines and exhausts.

Noise modelling for the project was carried out using CadnaA software, which applies the CORTN algorithms. The noise level calculations consist of a source model and a propagation calculation. The software generates noise contours by performing point receiver calculations on a grid of points across the assessment area. The noise prediction model takes into account the following:

Table 4: Summary of modelling inputs

Input parameters	Input used
Traffic volumes and mix	As described in Section 4.1
Vehicle speed	Edmondson Avenue - 60km/h (posted speed)
Gradient of roadways	From topographic data provided by Mott MacDonald
Source height	0.5m for car engines, exhaust and car & truck tyres, 1.5m for truck engines and 3.6m for truck exhaust as detailed within CoRTN
Ground topography at receiver and road	From topographic data provided by Mott MacDonald
Angles of view from receiver	Calculated within CadnaA
Reflections from existing barriers, structures and cuttings on opposite side of road	Calculated within CadnaA
Air and ground absorption – Values vary between 0 (hard surface) to 1 (100% absorptive)	0 has been used in this study *It is noted that where screening is calculated CoRTN uses hard surface correction.*
Receiver heights	1.5m above ground level for ground floor and 4.5m above ground level for 1st floor
Facade correction	Free field noise levels are used in this assessment as it is directly relevant to assessment against ISEPP criteria
Australian conditions correction	-0.7dB(A) free field
Acoustic properties of road surfaces	Assumed dense graded asphalt (DGA)
Roadside mounds / barriers	None were considered in this assessment

4.3 Road traffic noise results

The noise prediction results are set out in a graphical format in APPENDIX B of this report. A summary of the results is as follows:

For facades that are exposed to noise levels above the ISEPP, internal noise level criteria are required to be satisfied through appropriate design of the building envelope (eg. glazing, doors and walls). Indicative acoustic design advice for affected building envelopes is set out in Section 5.2.

4.4 List of affected lots

Table 5 sets out the identified noise affected lots. The lots were identified in accordance with the noise modelling presented in Figures 1 and 2 (APPENDIX B).

Table 5: Affected residential lots

Lot 2	Lot 3	Lot 4	Lot 5
Lot 6	Lot 7	Lot 8	Lot 9
Lot 10	Lot 11	Lot 12	Lot 13
Lot 14	Lot 15	Lot 16	Lot 17
Lot 18	Lot 19	Lot 20	Lot 21
Lot 22	Lot 23	Lot 51	

5 Noise control treatment recommendations

The noise modelling identified areas where the external noise criteria were not met. Therefore, the affected areas of residential dwellings are to be designed in accordance with the relevant internal noise criteria.

The following provides in-principle noise control recommendations to reduce road traffic noise intrusion for residential premises. As detailed dwelling designs are not available, the recommendations are based on a number of assumptions relating to the built form. Furthermore, the advice provided here is in respect of acoustics only. Supplementary professional advice should be sought in respect of fire ratings, structural design, buildability, fitness for purpose and the like.

5.1 Building layout

Dwellings constructed in traffic noise affected areas can be designed so that their layouts minimise noise in living and sleeping areas. Less sensitive rooms (such as kitchens, laundries and bathrooms) are recommended to be placed on the side of the building fronting Edmondson Avenue. These recommendations are however not requisites for development on the site.

5.2 Indicative building construction requirements

On the basis of the noise modelling, and in accordance with the internal noise criteria set out in Section 3.2.1.1, recommendations for building element constructions are presented for the following room types. It is assumed that non-habitable rooms are separated from habitable spaces by doors (ie. doors to studies, laundries and ensuites/bathrooms, etc.).

Table 6: Room parameters

Room	Item	Description
Bedroom	Dimensions (L x W x H)	4m x 4m x 2.7m
	Surface finishes	Carpeted floors with underlay, plasterboard walls and ceiling, and bed
Living room	Dimensions (L x W x H)	7m x 5m x 2.7m
	Surface finishes	Timber or tiled floors, plasterboard walls and ceiling
Lounge	Dimensions (L x W x H)	6m x 4m x 2.7m
	Surface finishes	Carpeted floors with underlay, plasterboard and ceiling

Table 6 below presents general advices for all affected lots. Acoustic treatment has been grouped into 'Treatment Categories' and the relevant treatment category for each affected facade is identified graphically in APPENDIX C.

Table 7: Acoustic constructions for treatment categories (ISEPP)

Category	Room	Construction element	Indicative treatment	
Category 1 (Alternative ventilation not required)	Bedrooms and adjoining ensuites	Windows/glazed doors*	Less than $4m^2$ = R_W 24	No specific glass thickness required
			$4m^2$ – $8m^2$ = R_W 27	6mm float glass with acoustic seals
		Walls/roof/ceiling	Standard constructions	
	Lounge/living rooms	Windows/glazed doors*	Less than $8m^2$ = R_W 29	6mm float glass with acoustic seals
			$8m^2$ – $16m^2$ = R_W 32	6.38mm laminated glass with acoustic seals
		Timber doors	35mm solid core timber - acoustic seals	
		Walls/roof/ceiling	Standard constructions	
Category 2 (Alternative ventilation required)	Bedrooms and adjoining ensuites	Windows/glazed doors*	Less than $2m^2$ = R_W 24	No specific glass thickness required
			$2m^2$ – $4m^2$ = R_W 27	6mm float glass with acoustic seals
			$4m^2$ – $8m^2$ = R_W 30	6.38mm laminated glass with acoustic seals
		Walls/roof/ceiling	Standard constructions	
	Lounge/living rooms	Windows/glazed doors*	Less than $4m^2$ = R_W 29	6mm float glass with acoustic seals
			$4m^2$ – $8m^2$ = R_W 32	6.38mm laminated glass with acoustic seals
			$8m^2$ – $16m^2$ = R_W 35	10.38mm laminated glass with acoustic seals
		Timber doors	40mm solid core timber - acoustic seals	
		Walls/roof/ceiling	Standard constructions	
Category 3 (Alternative ventilation required)	Bedrooms and adjoining ensuites	Windows/glazed doors*	Less than $2m^2$ = R_W 27	6mm float glass with acoustic seals
			$2m^2$ – $4m^2$ = R_W 30	6.38mm laminated glass with acoustic seals
			$4m^2$ – $8m^2$ = R_W 33	10.38mm laminated glass with acoustic seals
		Roof/ceiling	Standard constructions	

Category	Room	Construction element	Indicative treatment	
		Walls	R_W 46	Brick veneer construction, standard internal plasterboard with R1.5 wall batts Or Reverse brick veneer construction, external metal or FC cladding with R1.5 wall batts Or Metal studs with 1 layer of 16mm fire-rated plasterboard inside, metal or FC external cladding, R1.5 wall batts
	Lounge/living rooms	Windows/glazed doors*	Less than $4m^2$ = R_W 32	6.38mm laminated glass with acoustic seals
			$4m^2$ – $8m^2$ = R_W 35	10.38mm laminated glass with acoustic seals
			$8m^2$ – $16m^2$ = R_W 38	Heavy laminated glass or double glazing with acoustic seals
		Timber doors	45mm solid core timber - acoustic seals	
		Roof/ceiling	Standard constructions	
		Walls	R_W 46	Brick veneer construction, standard internal plasterboard with R1.5 wall batts Or Reverse brick veneer construction, external metal or FC cladding with R1.5 wall batts Or Metal studs with 1 layer of 16mm fire-rated plasterboard inside, metal or FC external cladding, R1.5 wall batts
Category 4 (Alternative ventilation required)	Bedrooms and adjoining ensuites	Windows/glazed doors*	Less than $2m^2$ = R_W 30	6.38mm laminated glass with acoustic seals
			$2m^2$ – $4m^2$ = R_W 33	10.38mm laminated glass with acoustic seals
			$4m^2$ – $8m^2$ = R_W 36	12.38mm laminated glass with acoustic seals
		Roof/ceiling	Tiled or metal pitched roof / 2 x 13mm plasterboard ceiling / bulk insulation in cavity	

Category	Room	Construction element	Indicative treatment	
		Walls	R_W 49	Brick veneer construction, standard internal plasterboard with R1.5 wall batts Or Reverse brick veneer construction, external metal or FC cladding with R1.5 wall batts Or Metal studs with 2 layers of 16mm fire-rated plasterboard inside, metal or FC external cladding, R1.5 wall batts
	Lounge/living rooms	Windows/glazed doors*	Less than $4m^2$ = R_W 35	10.38mm laminated glass with acoustic seals
			$4m^2$ – $8m^2$ = R_W 38	Heavy laminated glass or double glazing with acoustic seals
			$8m^2$ – $16m^2$ = R_W 41	Double glazed with acoustic seals
		Timber doors	45mm solid core timber - acoustic seals	
		Roof/ceiling	Tiled or metal pitched roof / 2 x 13mm plasterboard ceiling / bulk insulation in cavity	
		Walls	R_W 49	Brick veneer construction, standard internal plasterboard with R1.5 wall batts Or Reverse brick veneer construction, external metal or FC cladding with R1.5 wall batts Or Metal studs with 2 layers of 16mm fire-rated plasterboard inside, metal or FC external cladding, R1.5 wall batts

Notes: * Area of windows and doors shall be the total of all glazing for the given room.

The acoustic requirements for windows and doors have been provided on an R_W basis so as to allow flexibility with the developer and variations in design due to other design requirements such as thermal performance. The R_W rating sets the basis of the recommended acoustic performance and the constructions are provided for guidance only. The acoustic performance of specific building components should be confirmed by manufacturers or suitably qualified professional prior to installation.

Unless otherwise specified, the base building envelope of dwellings is considered to be of standard constructions which are assumed to consist of the following:

- Walls of brick veneer construction, double brick, or light weight clad construction which could consist of fibre-cement cladding on the outside of timber stud walls and internal plasterboard lining. All walls are assumed to have minimum R1.5 insulation in the cavity. It is noted that both brick veneer and cavity double brick construction are of significantly higher acoustic performance than light weight cladding systems. In higher traffic noise areas, there may be a requirement to upgrade light weight systems. These instances will be noted in the acoustic recommendations.
- Roof to be pitched, with concrete or terracotta tile or sheet metal roof with sarking, R3.0 insulation in the roof space (combination of below roof and above ceiling), and one layer of either 13mm thick standard plasterboard or 10mm thick ceiling plasterboard fixed to ceiling joists.
- External doors to be solid core timber or glazed, fitted with acoustic seals around the perimeter. Pivot style doors are not recommended as full perimeter acoustic seals are not readily incorporated. The performance of any external doors should have the same acoustic performance as that required for general glazing.

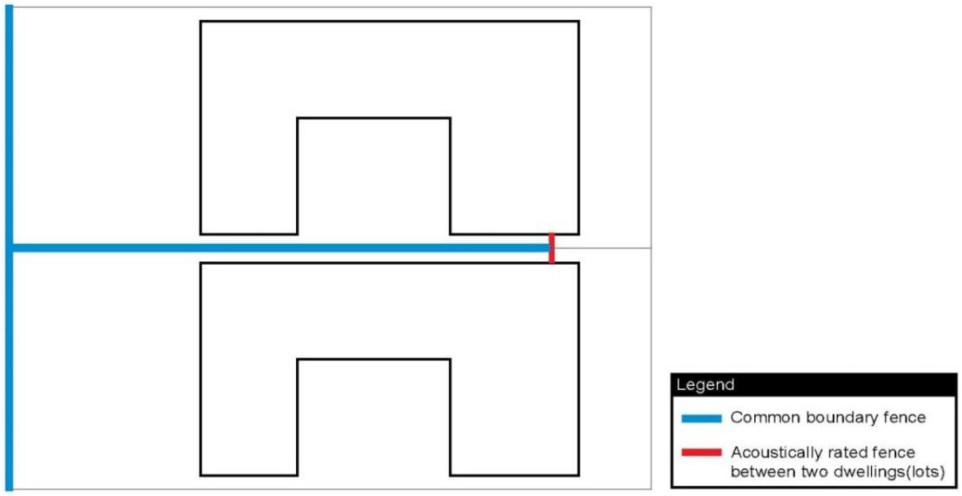
5.3 Boundary fences

1.8m high acoustically rated fence is required, as shown in Figure No. TH526-02P03 (r0) in APPENDIX C, for the following lots:

- Along the eastern boundary between the main dwelling and the garage of Lot 2
- Along the western boundary between the main dwelling and the garage of Lot 23
- Along the southern boundary between the main dwelling and the garage of Lot 51

Acoustically rated boundary fences are recommended 'between' dwellings, as illustrated in Figure 4, for lots fronting Edmondson Avenue.

Figure 4: Fence locations



The provision of solid boundary fences between residential lots can be beneficial to the ground floor of properties that are directly exposed to the roads. Acoustically rated fences are not specifically required along common boundaries between individual dwellings, unless specified above.

An acoustically rated fence can be constructed of common building materials but needs to be from a durable material with sufficient mass (min. 10kg/m^2) to prevent direct noise transmission eg. masonry, fibrous-cement, lapped and capped timber fence, polycarbonate, or any combination of such materials, provided they withstand the weather elements. A natural barrier of trees or shrubs is not an effective noise screen. The boundary fence should be continuous with no gaps between panels or underneath panels (other than that required for gates). It is recommended that rebates be incorporated into any gates.

5.4 Alternative ventilation

Where facades have been identified for acoustic treatment in Section 4.4, windows are to be kept closed to meet the internal noise goals. It is noted that windows are not required to be sealed shut/fixed and can be operable.

It is recommended that a mechanical engineer is consulted to ensure the ventilation requirements of the Building Code of Australia and Australian Standard 1668 "*The use of ventilation and air-conditioning in buildings*" are achieved. The internal noise goals are to be met with mechanical ventilation systems not operating.

Where alternative forms of ventilation are to be provided, it must be ensured that the solution does not provide a new noise leakage path into the dwelling and does not create a noise nuisance to neighbouring premises.

5.5 Scope of acoustic recommendations

The recommended mitigation measures for road traffic noise cannot take into account the specific design of each dwelling as those details are not available at this stage of development. The recommendations have been developed in order for the approvals process and cost planning, and to provide the indicative measures required for each dwelling. Furthermore, the recommendations have been provided so that individual dwellings do not require detailed acoustic assessment for their individual development applications.

It is recommended that an individual acoustic review of the 'Construction' drawings be carried out for each affected lots and buildings identified in Section 4.4 to ensure that the recommendations have been appropriately incorporated into the design.

6 Conclusion

Renzo Tonin & Associates has completed a road traffic noise assessment for the Development Application (DA) of the residential subdivision at 230 Sixth Avenue, 68 Edmondson Avenue and 50 Edmondson Avenue in Austral. The report has quantified the noise impact from future road traffic along Edmondson Avenue to the east of the site. The report has been prepared in accordance with the requirements of Liverpool City Council and the New South Wales (NSW) State Environmental Planning Policy (Infrastructure) 2007 (ISEPP).

The results of the noise modelling indicate that:

- Exceedance of the ISEPP criteria are predicted at the facades of residential dwellings exposed to Edmondson Avenue.
- For facades that are exposed to noise levels above the ISEPP, indicative building envelope design has been provided in accordance with the internal noise level criteria.
- If the internal criteria can only be achieved with windows closed, then **mechanical ventilation or air conditioning that meets the requirements of the Building Code of Australia must also be provided** to ensure fresh airflow inside the dwelling. It is important to ensure that mechanical ventilation does not provide a new noise leakage path into the dwelling and does not create a noise nuisance to neighbouring residential premises. It is noted that windows are not required to be sealed shut/fixed and can be operable.

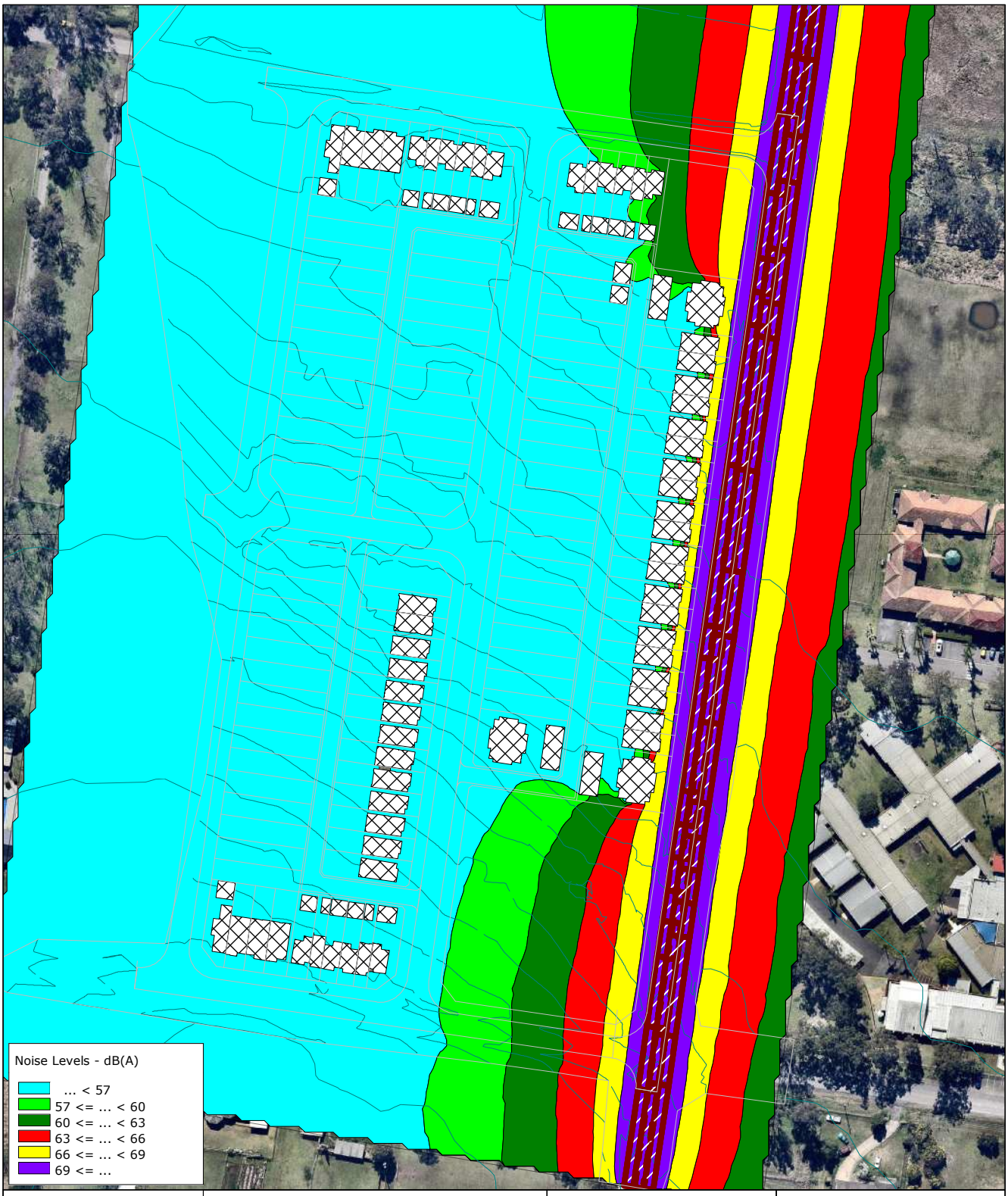
APPENDIX A Glossary of terminology

The following is a brief description of the technical terms used to describe noise to assist in understanding the technical issues presented.

Adverse weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
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 point	A point at which noise measurements are taken or estimated. A point at which noise measurements are taken 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 L_{90} noise level (see below).
Decibel [dB]	The units that sound is measured in. The following are examples of the decibel readings of every day sounds: 0dB The faintest sound we can hear 30dB A quiet library or in a quiet location in the country 45dB Typical office space. Ambience in the city at night 60dB CBD mall at lunch time 70dB The sound of a car passing on the street 80dB Loud music played at home 90dB The sound of a truck passing on the street 100dB The sound of a rock band 115dB Limit of sound permitted in industry 120dB Deafening
dB(A)	A-weighted decibels. The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.
dB(C)	C-weighted decibels. The C-weighting noise filter simulates the response of the human ear at relatively high levels, where the human ear is nearly equally effective at hearing from mid-low frequency (63Hz) to mid-high frequency (4kHz), but is less effective outside these frequencies.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Impulsive 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	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
L_{Max}	The maximum sound pressure level measured over a given period.
L_{Min}	The minimum sound pressure level measured over a given period.
L_1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.

L_{10}	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L_{90}	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L_{90} noise level expressed in units of dB(A).
L_{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
SEL	Sound Exposure Level (SEL) 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 L_{eq} sound levels over any period of time and can be used for predicting noise at various locations.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
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.

APPENDIX B Noise modelling results



legend:

- Road
- Building
- Contour Line
- Calculation Area

Client:
Mott MacDonald

Project:
230 Sixth Avenue,
68 Edmondson Avenue
&
50 Edmondson Avenue,
Austral

Description:
1.5m Grid

Consultant:

RENZO TONIN & ASSOCIATES
inspired to achieve
Acoustics, Vibration & Structural Dynamics
Sydney Melbourne Brisbane Kuwait
1/418A Elizabeth Street, SURRY HILLS NSW 2010
P: 02 8218 0500 F: 02 8218 0501

Noise levels are approximate due to interpolation of contours and should be used for reference only.

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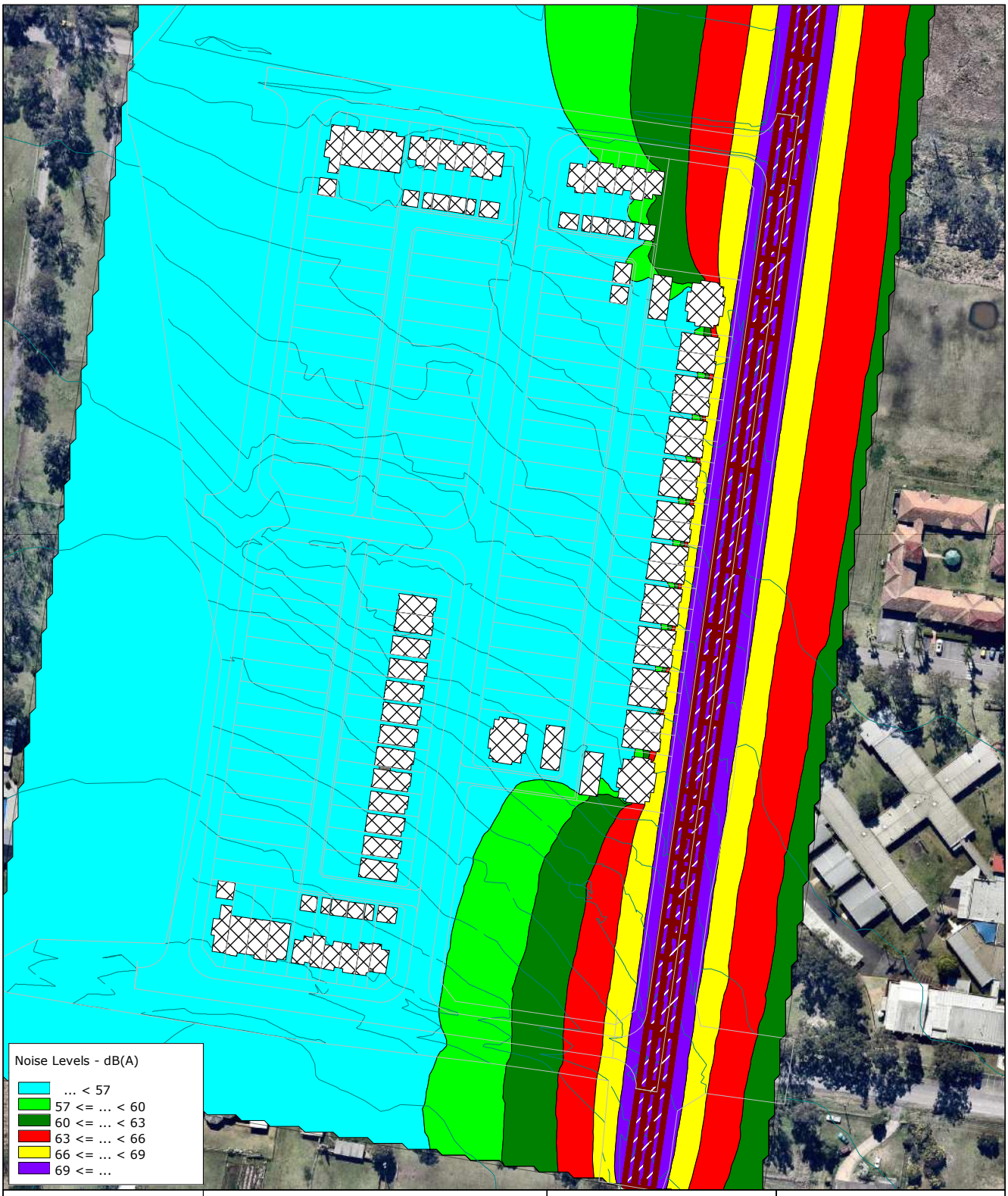
Project No.:
TH526-02

Figure Ref:
TH526-02 1.5m Grid

Date:
2016.10.14



legend:

- Road
- Building
- Contour Line
- Calculation Area

Client:
Mott MacDonald

Project:
230 Sixth Avenue,
68 Edmondson Avenue
&
50 Edmondson Avenue,
Austral

Description:
4.5m Grid

Consultant:

RENZO TONIN & ASSOCIATES
inspired to achieve
Acoustics, Vibration & Structural Dynamics
Sydney Melbourne Brisbane Kuwait
1/418A Elizabeth Street, SURRY HILLS NSW 2010
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Noise levels are approximate due to interpolation of contours and should be used for reference only.

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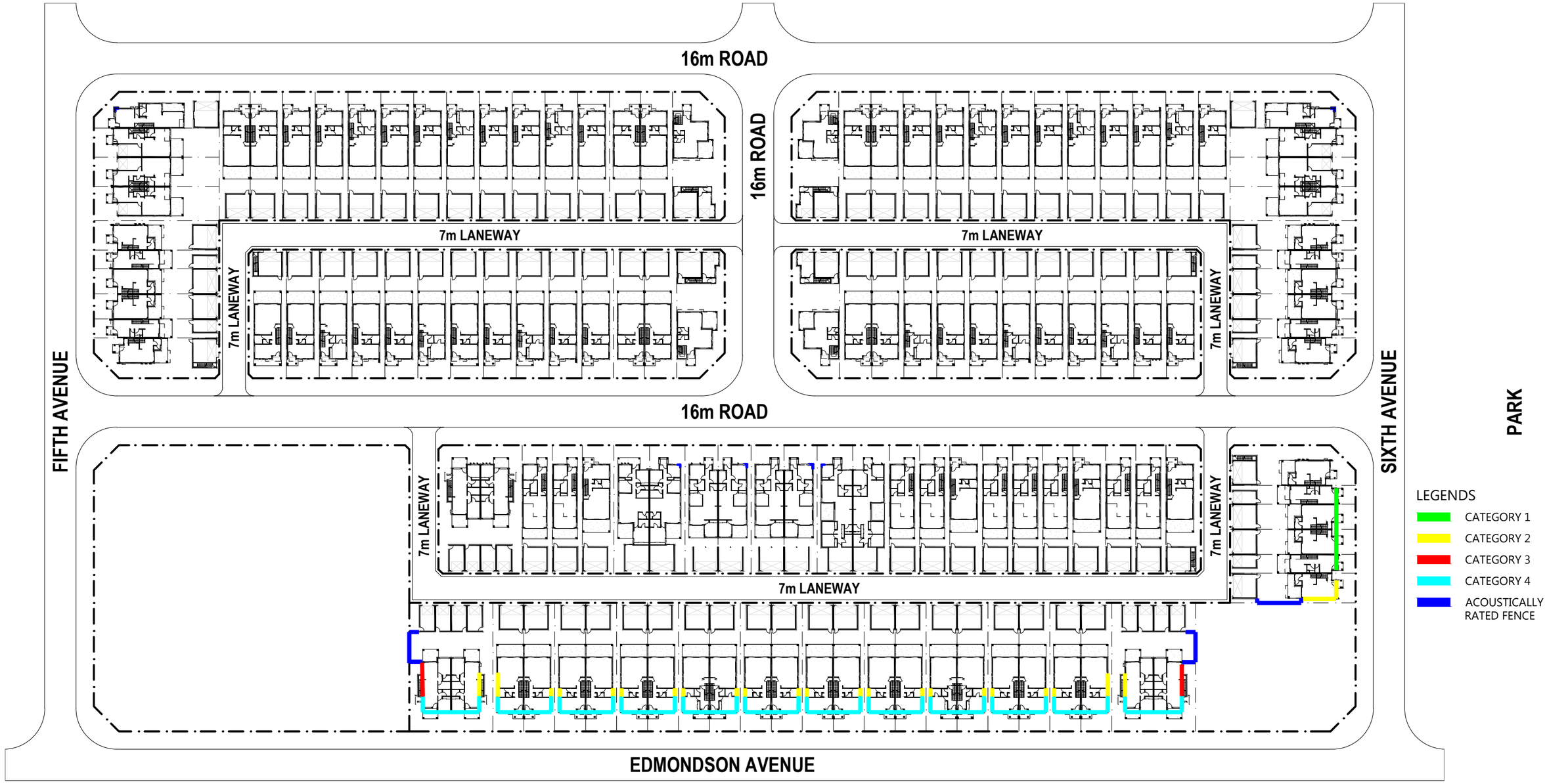
Project No.:
TH526-02

Figure Ref:
TH526-02 4.5m Grid

Date:
2016.10.14

APPENDIX C Acoustic treatment categories



No.	Date	Revision Details	Drn	Dgn	App
	14.10.2016	Prepare Drawing	THW	DS	DS

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All discrepancies shall be referred to the acoustic consultant for direction before proceeding with any works.

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES
inspired to achieve

Sydney office
1/418A Elizabeth St., SURRY HILLS, NSW 2010
Ph (02) 8218 0500 Fax (02) 8218 0501

PROJECT

230 SIXTH AVENUE, 68 EDMONDSON AVENUE & 50 EDMONDSON AVENUE, AUSTRAL

DRAWING TITLE

ROAD TRAFFIC NOISE ASSESSMENT
(1.5m HIGH)

SCALE	SHEET SIZE	DATE
NTS	A3	14-10-2016
DRAWN	DESIGNED	APPROVED
THW	DS	DS

FILE NAME:
R:\AssocSydProjects\TH501-TH550\TH526 ds Austral, Leppington North\T2 - 230 Sixth, 68 & 50 Edmondson Aves\6 Figures & CAD Out

PROJECT NO.	DRAWING NO.	REV
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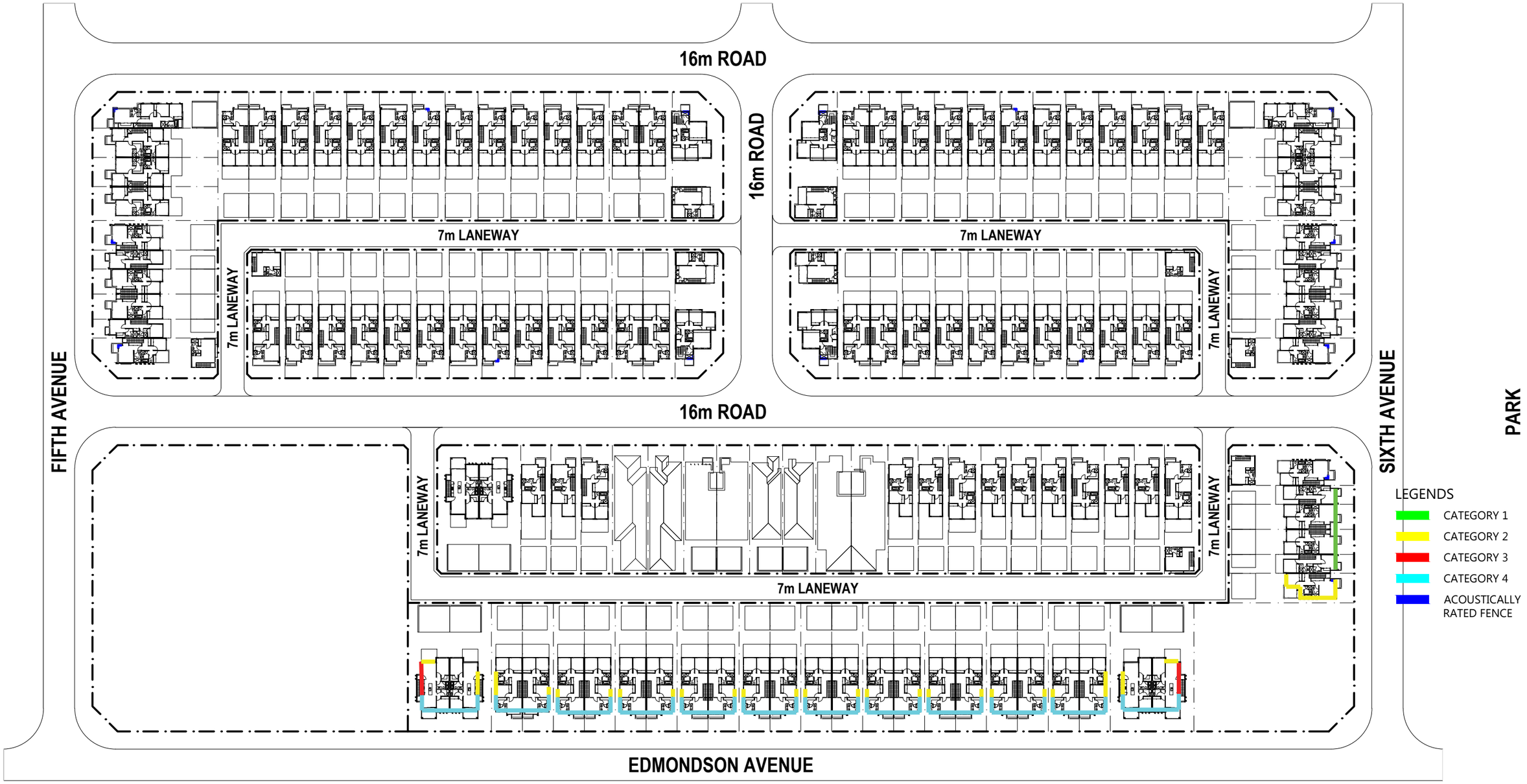

No.	Date	Revision Details	Drn	Dgn	App
	14.10.2016	Prepare Drawing	THW	DS	DS

Not drawn to scale. Use figured dimensions only. Check & verify levels and dimensions prior to the preparation of shop drawings, prior to the fabrication of components and prior to the commencement of any work on or off site.

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PROJECT

230 SIXTH AVENUE, 68 EDMONDSON AVENUE & 50 EDMONDSON AVENUE, AUSTRAL

DRAWING TITLE

ROAD TRAFFIC NOISE ASSESSMENT
(4.5m HIGH)

SCALE	SHEET SIZE	DATE
NTS	A3	14-10-2016
DRAWN	DESIGNED	APPROVED
THW	DS	DS

FILE NAME:

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PROJECT NO.	DRAWING NO.	REV
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