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MINT, GLENMORE PARK

ROAD TRAFFIC NOISE ASSESSMENT REPORT

TG369-01F02 (REV 2) RTN REPORT

4 FEBRUARY 2014

Prepared for:

Mint Holdings Pty Ltd

c/- CCL Development

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1 INTRODUCTION

Renzo Tonin & Associates was engaged to conduct an environmental noise impact assessment of road traffic noise onto the proposed residential dwellings in the Mint Holdings Draft Concept Plan.

This report quantifies the noise impact from future road traffic along the road network surrounding the site and is to inform the Development Application (DA) for the Mint Holdings development. The assessment has been carried out in accordance with the requirements of the New South Wales (NSW) State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) and in-principle acoustic mitigation recommendations have been identified.

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.

2 PROJECT DESCRIPTION

2.1 Site Description

The Mint Holdings development site is situated on the southern side of Bradley Street, The Ponds to the west and approximately 250 m to 300 m west of The Northern Road. Bradley Street runs along the northern boundary of the site.

This assessment is based on a draft Concept Plan prepared by Development Planning Strategies (dated September 2013). The draft Concept Plan includes the development of 94 residential dwellings, made up of:

- 85 single dwelling lots;
- 3 triple lots (3 dwellings per lot); and
- 1 medium density super lot (30-65 dwellings).

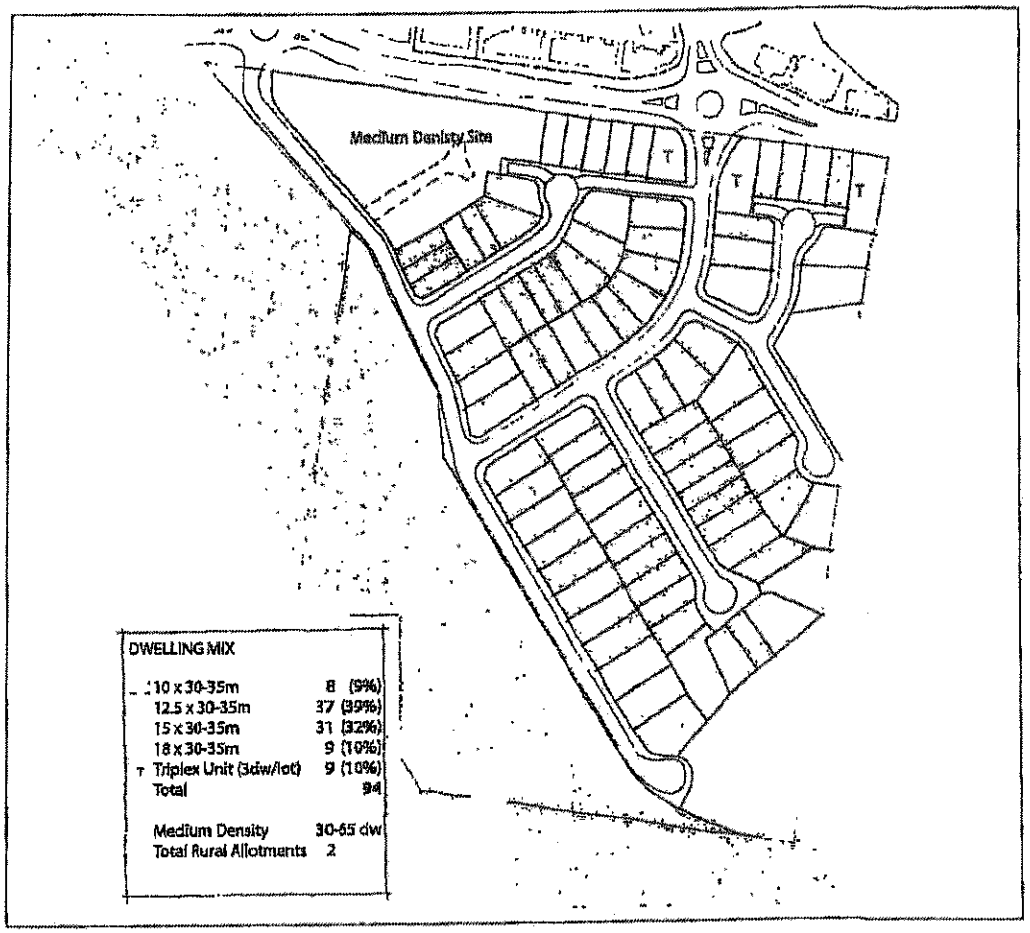
Further to the draft Concept Plan, a concept design for the integrated housing sites, which include the superlot, the 2 triple lots and 9 single lots, fronting onto Bradley Street has been developed by DKO. The concept design (dated 31.07.13) contains:

- 3 manor apartment homes, each containing 3 units;
- 9 double fronted homes;
- 6 terrace homes;
- 13 urban homes;
- 14 apartment buildings, which may contain 3 units in each block;
- 6 strata studios.

All the above dwellings will be two storeys, with the exception of the three-storey apartment buildings.

Figure 1 shows the draft concept plan.

Figure 1 – Schofields Terrace Indicative Lot Plan



2.2 Assessment Methodology

In order to assess the potential noise impact onto the residential development in the draft Concept Plan, the following methodology was used:

- Evaluate the site to determine the layout and site conditions with respect to its proximity to the roads, potential noise impact, topography, etc.;
- Using predictive noise modelling to determine the extent of noise impact from the surrounding road network onto the proposed residential lots;
- Identify where traffic noise exposure onto the site may exceed the relevant road traffic noise objectives; and
- Where external noise levels are predicted to exceed the relevant criteria, in-principle recommendations are provided for building envelope design in order to achieve the relevant internal noise criteria.

3 ROAD TRAFFIC NOISE CRITERIA

Since the replacement of the Environmental Criteria for Road Traffic Noise (ECRTN) with the Road Noise Policy (RNP) by the NSW Office of Environment & Heritage (OEH) on the 1st of July 2011, the only noise criteria for new residential developments impacted by road traffic noise is the State Environmental Planning Policy (Infrastructure) 2007 (ISEPP). The ISEPP sets out internal noise criteria for residential development adjacent to roads having Annual Average Daily Traffic (AADT) greater than 40,000 vehicles.

In regard to the RNP, the change in policy resulted in the removal of noise criteria for new housing developments. The effect of the criteria removal is that there is no requirement to assess noise for new housing developments unless they are exposed to noise from roads with AADT greater than 40,000 vehicles. Furthermore, there is no external noise requirement for new residential development.

Bradley Street has been identified as the greatest source of potential road traffic noise impact onto the Mint Holdings land. The Northern Road, to the west of the site may also potentially contribute to road traffic noise at the Mint Holdings site.

Based on the forecasted traffic volumes, The Northern Road has an AADT of approximately 40,000 vehicles, meaning compliance with the ISEPP is required. However, based on the forecasted traffic volumes, Bradley Street has AADTs less than 40,000 vehicles, meaning compliance with the ISEPP is not strictly required. However, the ISEPP guideline also recommends that it be used as a best practice approach for development along roads having volumes between 20,000 and 40,000 AADT. Given that Bradley Street's forecasted traffic volumes are close to this range, then it is included with The Northern Road in the ISEPP impact assessment for the Mint Holdings site.

3.1 ISEPP 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.

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--35dB(A) at any time between 10pm 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.*

3.1.1 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.

3.1.1.1 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 Table 1.

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 façades 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 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
Bedrooms*	Internal, windows closed	40	35
	Internal, windows open	50	45
	External Free-Field (allowing windows to remain open)^	60	55
Other Habitable Rooms*	Internal, windows closed	40	40
	Internal, windows open	50	50
	External Free-Field (allowing windows to remain open)^	60	60

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 requirements.

4 ROAD TRAFFIC NOISE PREDICTION

4.1 Road Design and Traffic Flow

Consultation was carried out with the traffic engineers J Wyndham Prince (JWP) and review of the traffic assessment prepared by JWP in November 2008 to determine likely future traffic volumes on Bradley Street and The Northern Road. The traffic volumes used for this assessment are set out in Table 3. It is noted that variations in the actual traffic volumes will affect the noise level impact at receiver locations in particular heavy vehicle percentages. A sensitivity assessment could be undertaken during the detail design phase of the development.

Table 3 – Year 2017 Road Traffic Volumes

Road	Calculated Traffic Volumes			% Heavy Vehicles
	AADT	15hr Day	9hr Night	
Bradley Street	14,000	12,000	2,000	1
The Northern Road	40,000	34,000	6,000	14

Although there are both 'day' and 'night' traffic noise goals to be satisfied, based on the difference in traffic volumes between day and night, daytime was established as the worst case period for road traffic noise impacts.

4.2 Residential Dwelling Design

The preliminary Concept Plan provides building footprints only. Where only building footprints are available, recommendations have been provided and are defined by categories to allow adaptation to different room types, building constructions and glazing sizes, etc.

4.3 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. This method has been adapted to Australian conditions and extensively tested by the Australian Road Research Board and as a result it is recognised and accepted by the Environment Protection Authority. The model predicts noise levels for steady flowing traffic and noise from high truck exhausts is taken into account.

The CoRTN algorithms are contained within the 'Cadna-A' noise model. Cadna-A noise level calculations consist of a source model and a propagation calculation. Cadna-A generates noise contours by performing point receiver calculations on a grid of points 5m apart.

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	The Northern Road – 70km/h; Bradley Street – 50km/h
Gradient of roadways	From 3D data provided by LPI
Source height	0.5m for car exhaust, 1.5m for car and truck engines and 3.6m for truck exhaust and detailed within CoRTN
Ground topography at receiver and road	From 3D data provided by LPI
Angles of view from receiver	Calculated within Cadna-A
Reflections from existing barriers, structures and cuttings on opposite side of road	Calculated within Cadna-A
Air and ground absorption - Values vary between 0 (hard surface) to 1 (100% absorptive)	0.5 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
Australian conditions correction	-1.7dB(A) facade, -0.7dB(A) free field (day only)
Acoustic properties of road surfaces	Assumed dense graded asphalt (DGA)
Roadside mounds / barriers	Barriers considered reflective on both sides
Free field noise levels	Free field noise levels were used in this assessment as it is directly relevant to the assessment against the ISEPP criteria

4.4 Road Traffic Noise Assessment Results

The noise prediction results for ground and first floor levels of the development are presented in the figures in Appendix B of this report. The results revealed that the 16 buildings facing onto Bradley Street on all levels will be exposed to noise levels that exceed the ISEPP criteria of $L_{Aeq\ (15hour)}$ 60 dB (A) and will require architectural acoustic treatment of the building envelope so as to comply with the internal ISEPP noise criteria with windows and doors closed.

This first row of buildings on Bradley Street will provide adequate noise shielding such that noise levels at all dwellings to the south of this first row will be below the ISEPP criteria of $L_{Aeq,(15hour)}$ 60 dB (A).

Traffic noise from The Northern Road is below the ISEPP criteria of $L_{Aeq\ (15hour)}$ 60 dB (A).

The noise modelling presented in Appendix B shows areas where the ISEPP equivalent external noise goals have not been met. Therefore the recommended internal noise criteria should be achieved through the building envelope design.

The following recommendations provide in-principle noise control solutions to reduce noise impacts inside residential premises and 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. Best practice elements for good acoustic design of development around road transport corridors include:

- Designing the layout of residential buildings to have bedrooms on the opposite side of the building to the road transport corridor. Less sensitive rooms can be placed on the road side of the building. It is noted that these recommendations are not requisites for development within the Mint Holdings site.
- Provide adequate acoustic windows and doors with good quality acoustic seals (where applicable) on the residential building facades exposed to traffic noise.
- Whilst not required by the ISEPP, external amenity can be improved through use of solid boundary fences to appropriate height or use of the building envelope to provide acoustic shielding from the road traffic noise.

5.2 Indicative Building Construction Requirements

On the basis of our noise modelling and in accordance with the internal noise goals set out in Table 1, recommendations for building element constructions are presented for the affected rooms. Table 5 presents indicative room parameters for three room types which have been assumed for all residential subdivision lots for which specific floor plans are not available. It is assumed that non-habitable rooms are separated from habitable spaces by doors (i.e. doors to laundries and ensuites/bathrooms, etc.).

Table 5 – Assumed Room Parameters

Room	Item	Description
Bedroom/Study	Dimensions (L x W x H)	4.00m x 4.00m x 2.44m
	Surface Finishes	Carpeted floors with underlay, plasterboard walls, plasterboard ceiling and bed
Family/ Living/Dining	Dimensions (L x W x H)	7.00m x 5.00m x 2.44m
	Surface Finishes	Timber or tiled floors, plasterboard walls and plasterboard ceiling
Lounge/Retreat	Dimensions (L x W x H)	6.00m x 4.00m x 2.44m
	Surface Finishes	Carpeted floors with underlay, plasterboard walls and plasterboard ceiling

Table 6 below presents the 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.

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.

Unless otherwise recommended, the overall 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, R2.5 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.

Table 6 - Acoustic Constructions for Treatment Categories

Treatment Category	Room	Construction Element	Recommended Acoustic Performance	Indicative Construction
Category 1 (Alternative Ventilation Not 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
	Family/Living/Dining Lounge/Retreat	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
		Walls/Roof/Ceiling		Standard Constructions
Category 2 (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
		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, external metal or FC cladding with R1.5 wall batts
	Family/Living/Dining Lounge/Retreat	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
		Roof/Ceiling		Standard Constructions

Treatment Category	Room	Construction Element	Recommended Acoustic Performance	Indicative Construction
		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, external metal or FC cladding with R1.5 wall batts
Category 3 (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	
		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, external metal or FC cladding with R1.5 wall batts
	Family/Living/Dining Lounge/Retreat	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
		Roof/Ceiling	Tiled or metal pitched roof / 2 x 13mm plasterboard ceiling / bulk insulation in cavity	

Treatment Category	Room	Construction Element	Recommended Acoustic Performance	Indicative Construction
		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, external metal or FC cladding with R1.5 wall batts
Category 4 (Alternative Ventilation Required)	Bedrooms and adjoining Ensuites	Windows/Glazed Doors*	Less than $2m^2$ = R_w 33	10.38mm laminated glass with acoustic seals
			$2m^2$ – $4m^2$ = R_w 36	12.38mm laminated glass with acoustic seals
			$4m^2$ – $8m^2$ = R_w 39	Heavy laminated glass or double glazing with acoustic seals
		Roof/Ceiling	Tiled or metal pitched roof / 2 x 13mm fire-rated plasterboard ceiling / bulk insulation in cavity	
		Walls	R_w 52	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 Staggered metal studs with 2 layers of 16mm fire-rated plasterboard inside, external metal or FC cladding with R1.5 wall batts
	Family/Living/Dining Lounge/Retreat	Windows/Glazed Doors*	Less than $4m^2$ = R_w 38	Heavy laminated glass or double glazing with acoustic seals
			$4m^2$ – $8m^2$ = R_w 41	Double glazed with acoustic seals
			$8m^2$ – $16m^2$ = R_w 44	Double glazed with acoustic seals
		Roof/Ceiling	Tiled or metal pitched roof / 2 x 13mm fire-rated plasterboard ceiling / bulk insulation in cavity	

Treatment Category	Room	Construction Element	Recommended Acoustic Performance	Indicative Construction
		Walls	R_w 52	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 Staggered metal studs with 2 layers of 16mm fire-rated plasterboard inside, external metal or FC cladding with R1.5 wall batts

Note: [illegible] the total of all glazing for the given room.

6 CONCLUSION

Renzo Tonin & Associates has completed a road traffic noise impact assessment based on the preliminary Schofields Terrace Concept Plan prepared by SJB Urban. The assessment has been undertaken in accordance with the State Environmental Planning Policy (Infrastructure) 2007 (ISEPP).

The results of the noise modelling indicate that;

- 16 buildings facing onto Bradley Street on all levels require specific architectural acoustic treatment and provision of appropriate alternative ventilation (where applicable) in order to satisfy the requirements of the ISEPP.
- 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.

For dwellings where specific floor plans have not been determined, it is recommended that a review of the 'Construction' drawings be carried out for each affected lots identified in Section 4.4 to ensure that the recommendations have been appropriately incorporated into the design.

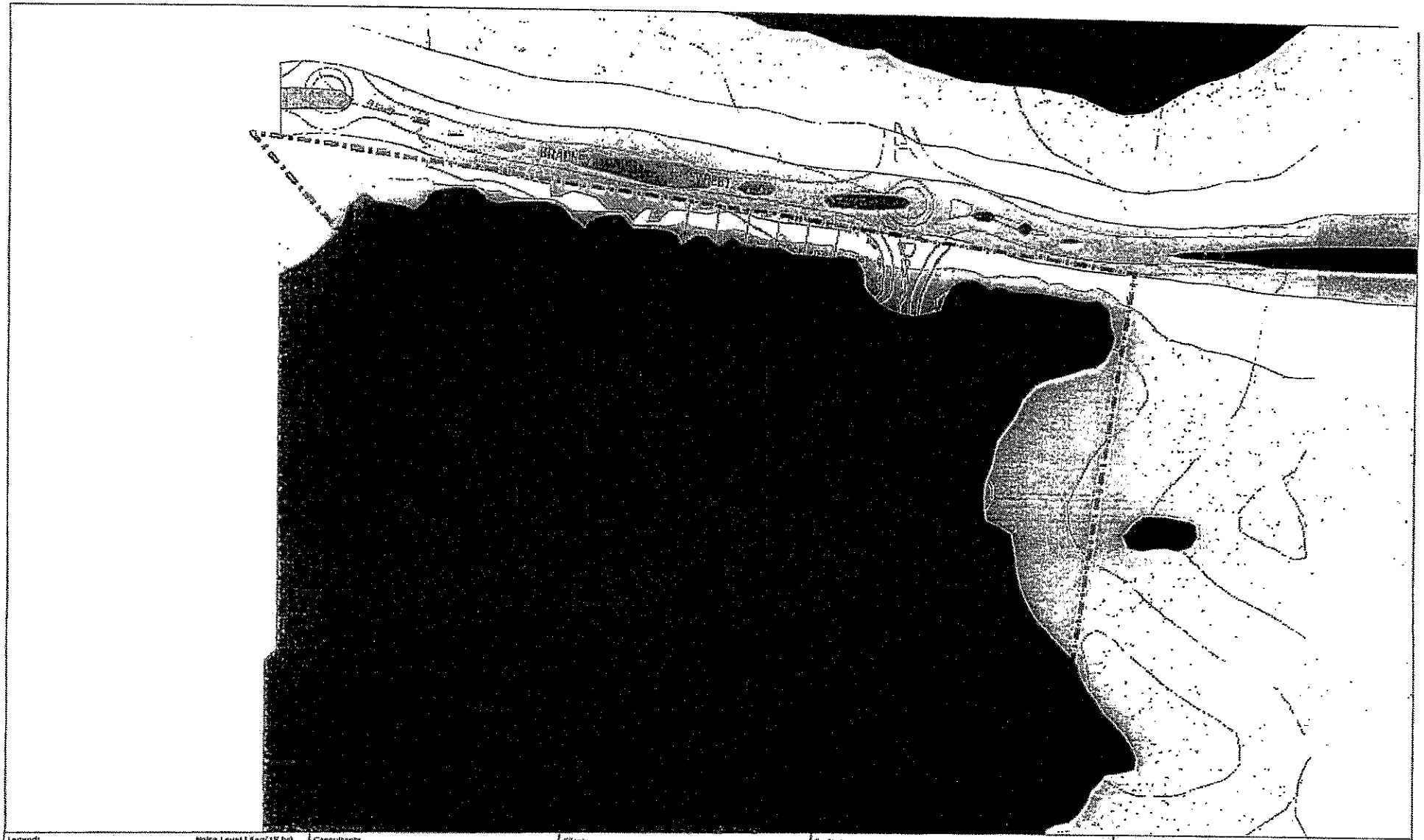
APPENDIX A - GLOSSARY OF ACOUSTIC TERMS

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 L90 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.
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.
Lmax	The maximum sound pressure level measured over a given period.
Lmin	The minimum sound pressure level measured over a given period.
L1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L10	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.

L90	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
Leq	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 Leq 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



APPENDIX C - ACOUSTIC TREATMENT CATEGORIES