Lloyd George Acoustics
PO Box 717
Hillarys WA 6923
T: 9401 7770
www.lgacoustics.com.au

Transportation Noise Assessment

Kelmscott Activity Centre

Reference: 20055531-01A

Prepared for:
TBB

Report: 20055531-01A

Lloyd George Acoustics Pty Ltd

ABN: 79 125 812 544

PO Box 717
Hillarys WA 6923

www.lgacoustics.com.au

Contacts	General	Daniel Lloyd	Terry George	Matt Moyle
E:	info@lgacoustics.com.au	daniel@lgacoustics.com.au	terry@lgacoustics.com.au	matt@lgacoustics.com.au
P:	9401 7770	0439 032 844	0400 414 197	0412 611 330
Contacts	**Accounts**	**Rob Connolly**	**Daryl Thompson**	**Hao Tran**
E:	lisa@lgacoustics.com.au	rob@lgacoustics.com.au	daryl@lgacoustics.com.au	hao@lgacoustics.com.au
P:	9401 7770	0410 107 440	0420 364 650	0438 481 207

Date:	Rev	Description	Prepared By	Verified
16-Feb-22	0	Issued to Client	Terry George	Matt Moyle
13-May-22	A	Updated with Comments	Terry George	-

Table of Contents

List of Tables

List of Figures

Appendices

1 INTRODUCTION

The City of Armadale has engaged TBB Planning to prepare a structure plan for the Kelmscott Activity Centre shown in *Figure 1-1*. The site is located in areas where road and rail traffic noise need to be considered for future development, being the subject of this report. The current concept structure plan is shown in *Figure 1-2*.

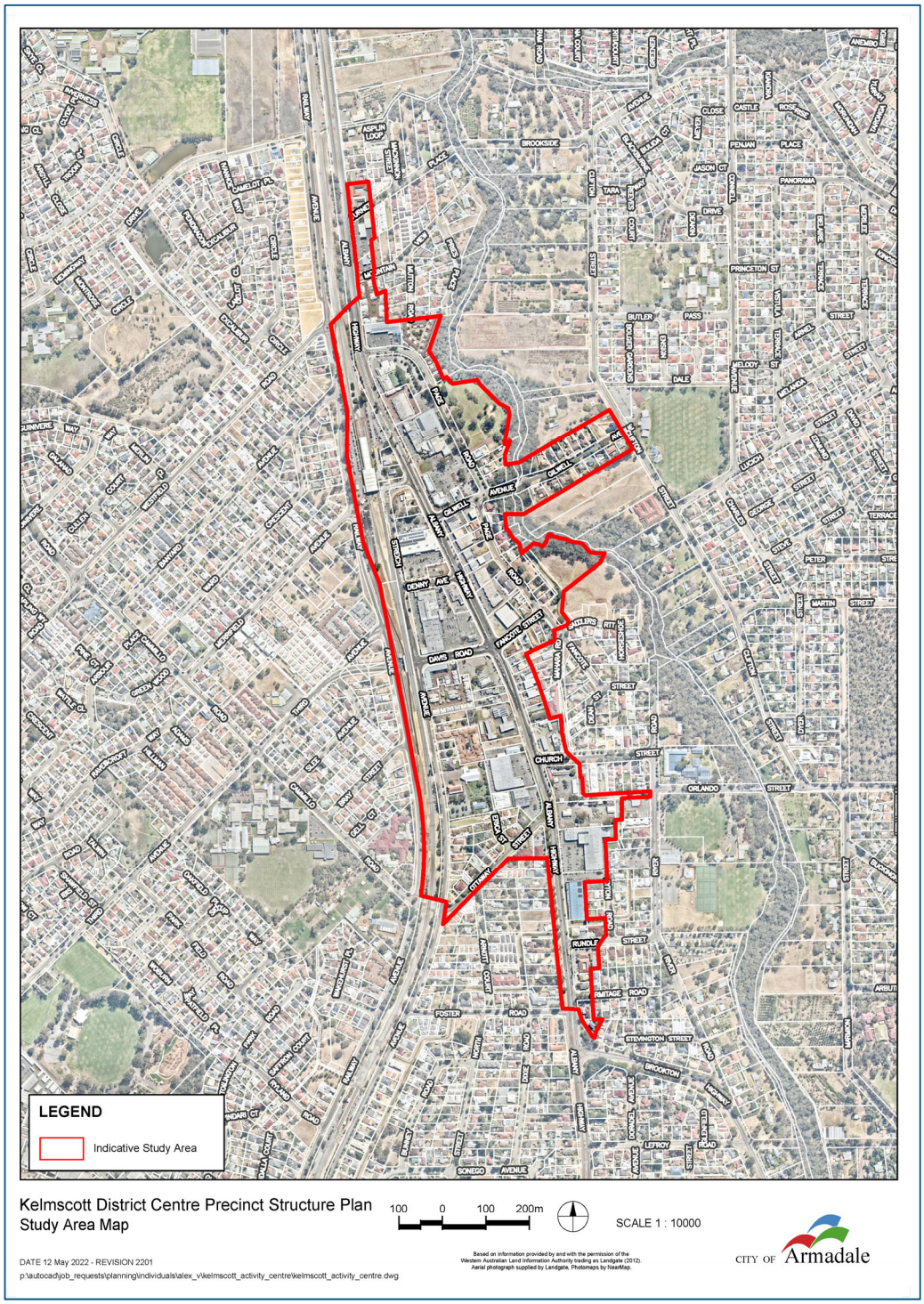


Figure 1-1 Site Locality

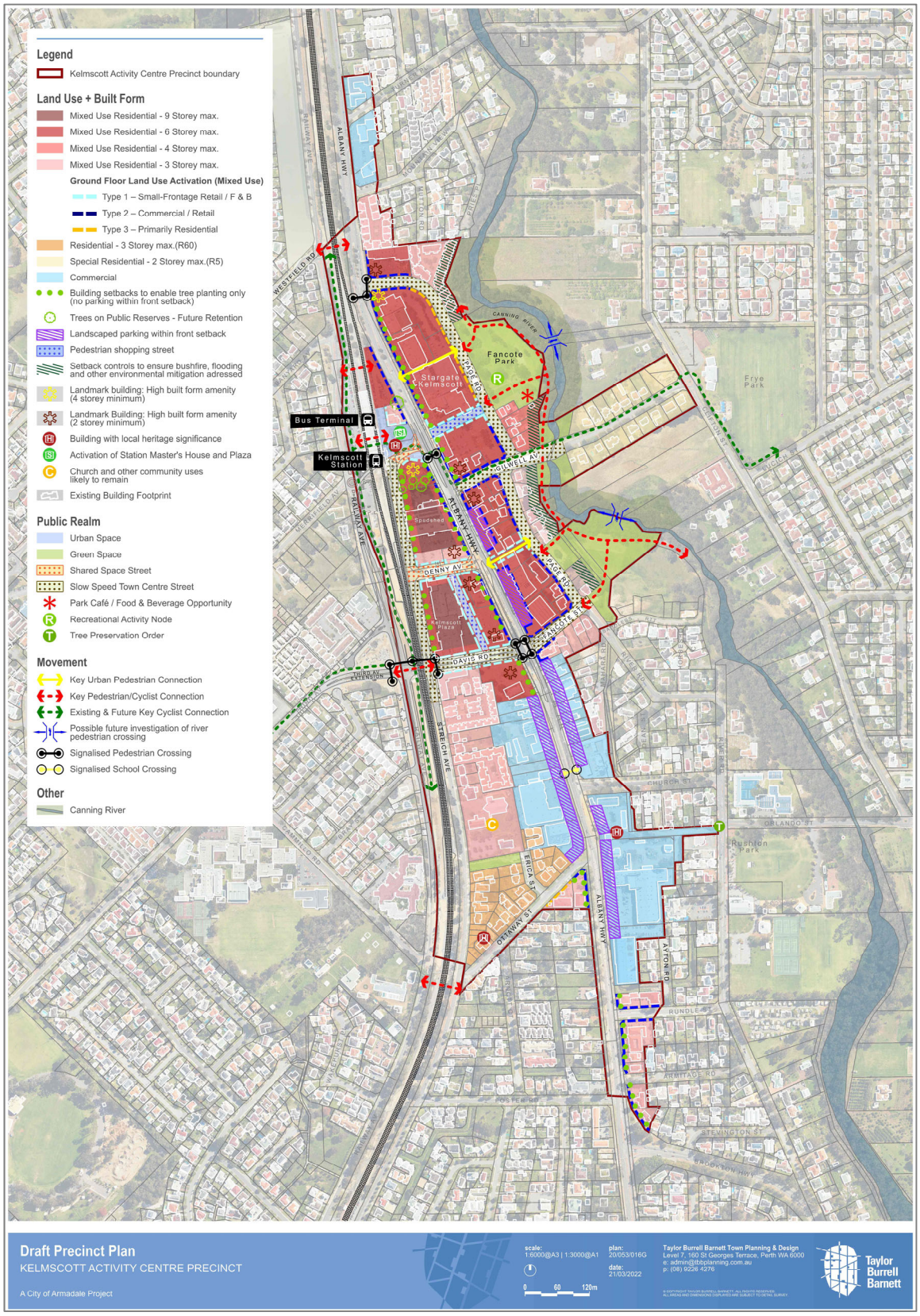


Figure 1-2 Concept Plan

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

2 STATE PLANNING POLICY No. 5.4

The criteria relevant to this assessment is provided in *State Planning Policy No. 5.4 Road and Rail Noise* (hereafter referred to as SPP 5.4) produced by the Western Australian Planning Commission (WAPC). The objectives of SPP 5.4 are to:

- Protect the community from unreasonable levels of transport noise;
- Protect strategic and other significant freight transport corridors from incompatible urban encroachment;
- Ensure transport infrastructure and land-use can mutually exist within urban corridors;
- Ensure that noise impacts are addressed as early as possible in the planning process; and
- Encourage best practice noise mitigation design and construction standards

Table 2-1 sets out noise targets that are to be achieved by proposals under which SPP 5.4 applies. Where the targets are exceeded, an assessment is required to determine the likely level of transport noise and management/mitigation required.

Table 2-1 Noise Targets for Noise-Sensitive Land-Use

Outdoor Noise Target		Indoor Noise Target	
55 dB $L_{Aeq(Day)}$	50 dB $L_{Aeq(Night)}$	40 dB $L_{Aeq(Day)}$ (Living and Work Areas)	35 dB $L_{Aeq(Night)}$ (Bedrooms)

Notes:

- Day period is from 6am to 10pm and night period from 10pm to 6am.
- The outdoor noise target is to be measured at 1-metre from the most exposed, habitable[1] facade of the noise sensitive building.
- For all noise-sensitive land-use and/or development, indoor noise targets for other room usages may be reasonably drawn from Table 1 of Australian Standard/New Zealand Standard AS/NZS 2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors (as amended) for each relevant time period.
- Outdoor targets are to be met at all outdoor areas as far as is reasonable and practicable to do so using the various noise mitigation measures outlined in the Guidelines.

The application of SPP 5.4 is to consider anticipated traffic volumes for the next 20 years from when the noise assessment is undertaken.

In the application of the noise targets, the objective is to achieve:

- indoor noise levels specified in *Table 2-1* in noise-sensitive areas (e.g. bedrooms and living rooms of houses and school classrooms); and
- a reasonable degree of acoustic amenity for outdoor living areas on each residential lot. For non-residential noise-sensitive developments, for example schools and childcare centres, the design of outdoor areas should take into consideration the noise target.

[1] A habitable room is defined in State Planning Policy 3.1 as a room used for normal domestic activities that includes a bedroom, living room, lounge room, music room, sitting room, television room, kitchen, dining room, sewing room, study, playroom, sunroom, gymnasium, fully enclosed swimming pool or patio.

SPP 5.4 provides the trigger distances shown in *Table 2-2* with *Figure 2-1* showing those relevant across the subject site being rail traffic from the Perth to Armadale Line and road traffic from Albany Highway. It must be noted however that the trigger distances are based on a worst-case scenario (e.g. 10 lanes).

Table 2-2 Transport Corridor Classification and Trigger Distances

Transport Corridor Classification	Trigger Distance	Distance Measured From
Strategic freight and major traffic routes Roads as defined by Perth and Peel Planning Frameworks and/or roads with either 500 or more Class 7 to 12 Austroads vehicles per day, and/or 50,000 per day traffic volume.	300 metres	Road carriageway edge
Other significant freight/traffic routes These are generally any State administered road and/or local government road identified as being a future State administered road (red road) and other roads that meets the criteria of either ≥ 100 Class 7 to 12 Austroads vehicles daily or ≥ 23,000 daily traffic count (averaged equivalent to 25,000 vehicles passenger car units under region schemes).	200 metres	Road carriageway edge
Passenger railways	100 metres	Centreline of the closest track
Freight railways	200 metres	Centreline of the closest track

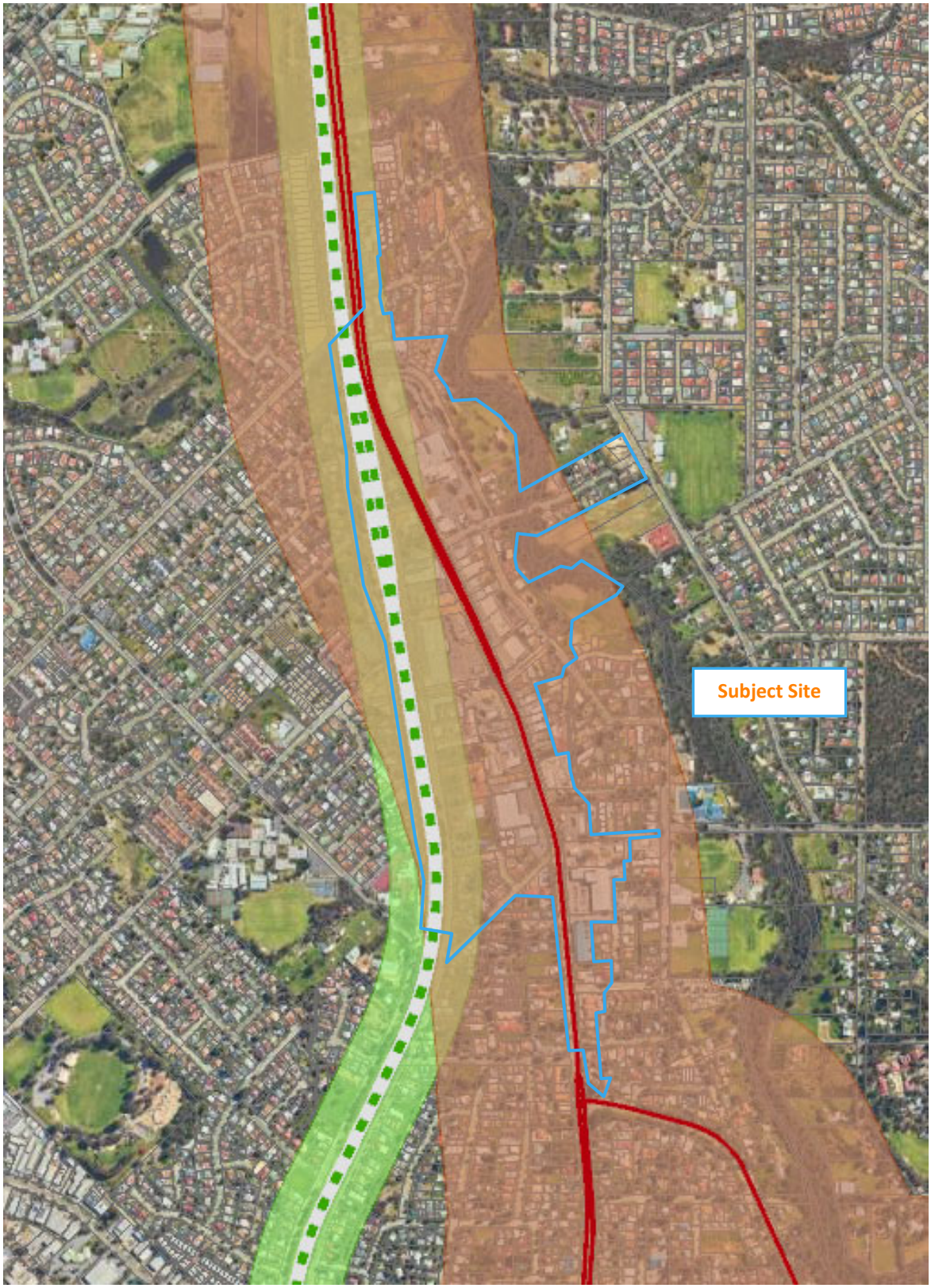
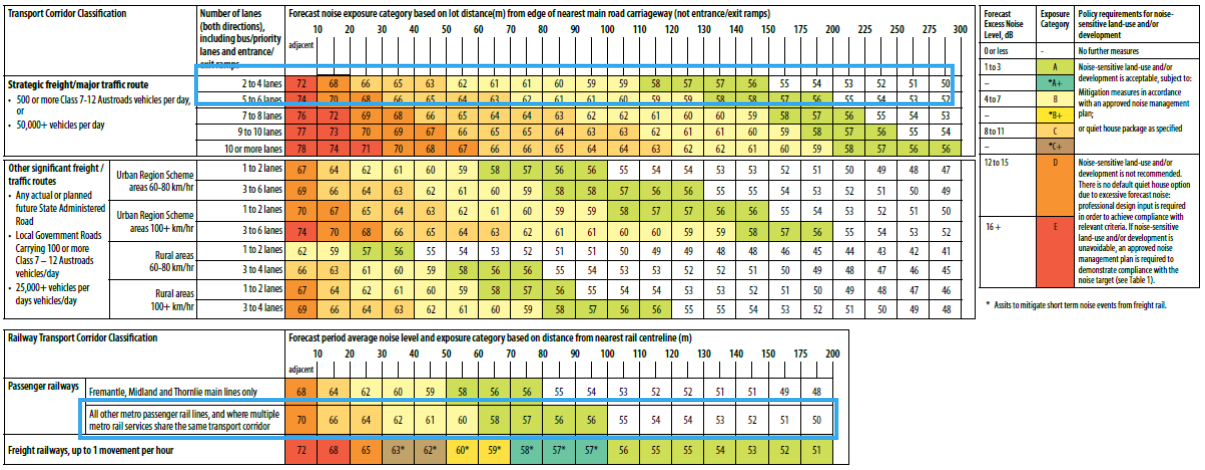


Figure 2-1 Site Locality in Relation to Road & Rail (DPLH PlanWA Maps)

Figure 2-2 shows the noise levels from various transport corridors and the associated exposure level with the relevant rows highlighted. The exposure zones have been overlaid onto the *Figure 2-3* concept for the structure plan.



Transport Corridor Classification		Number of lanes (both directions), including bus/priority lanes and entrance/exit ramps	Forecast noise exposure category based on lot distance(m) from edge of nearest main road carriageway (not entrance/exit ramps)																						
			adjacent	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	175	200	225	250	275	300
Strategic freight/major traffic route • 500 or more Class 7-12 Austroads vehicles per day, or • 50,000+ vehicles per day		2 to 4 lanes	72	68	66	65	63	62	61	61	60	59	59	58	57	57	56	55	54	53	52	51	50
		5 to 6 lanes	74	70	68	66	65	64	63	62	61	61	60	59	59	58	58	57	56	55	54	53	52
		7 to 8 lanes	76	72	69	68	66	65	64	64	63	62	62	61	60	60	59	58	57	56	55	54	53
		9 to 10 lanes	77	73	70	69	67	66	65	65	64	63	63	62	61	61	60	59	58	57	56	55	54
		10 or more lanes	78	74	71	70	68	67	66	66	65	64	64	63	62	62	61	60	59	58	57	56	56
Other significant freight / traffic routes • Any actual or planned future State Administered Road • Local Government Roads Carrying 100 or more Class 7 – 12 Austroads vehicles/day • 25,000+ vehicles per days vehicles/day	Urban Region Scheme areas 60-80 km/hr	1 to 2 lanes	67	64	62	61	60	59	58	57	56	56	55	54	54	53	53	52	51	50	49	48	47
		3 to 6 lanes	69	66	64	63	62	61	60	59	58	58	57	56	56	55	55	54	53	52	51	50	49
	Urban Region Scheme areas 100+ km/hr	1 to 2 lanes	70	67	65	64	63	62	61	60	59	59	58	57	57	56	56	55	54	53	52	51	50
		3 to 6 lanes	74	70	68	66	65	64	63	62	61	61	60	60	59	59	58	57	56	55	54	53	52
	Rural areas 60-80 km/hr	1 to 2 lanes	62	59	57	56	55	54	53	52	51	51	50	49	49	48	48	46	45	44	43	42	41
		3 to 4 lanes	66	63	61	60	59	58	56	56	55	54	53	53	52	52	51	50	49	48	47	46	45
	Rural areas 100+ km/hr	1 to 2 lanes	67	64	62	61	60	59	58	57	56	55	54	54	53	53	52	51	50	49	48	47	46
		3 to 4 lanes	69	66	64	63	62	61	60	59	58	57	56	56	55	55	54	53	52	51	50	49	48

Forecast Excess Noise Level, dB	Exposure Category	Policy requirements for noise-sensitive land-use and/or development
0 or less	-	No further measures
1 to 3	A	Noise-sensitive land-use and/or development is acceptable, subject to: Mitigation measures in accordance with an approved noise management plan; or quiet house package as specified
–	*A+	
4 to 7	B	
–	*B+	
8 to 11	C	
–	*C+	
12 to 15	D	Noise-sensitive land-use and/or development is not recommended. There is no default quiet house option due to excessive forecast noise: professional design input is required in order to achieve compliance with relevant criteria. If noise-sensitive land-use and/or development is unavoidable, an approved noise management plan is required to demonstrate compliance with the noise target (see Table 1).
16 +	E	

* Assits to mitigate short term noise events from freight rail.

Railway Transport Corridor Classification		Forecast period average noise level and exposure category based on distance from nearest rail centreline (m)																	
		adjacent	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	175	200
Passenger railways	Fremantle, Midland and Thornlie main lines only	68	64	62	60	59	58	56	56	55	54	53	52	52	51	51	49	48	
	All other metro passenger rail lines, and where multiple metro rail services share the same transport corridor	70	66	64	62	61	60	58	57	56	56	55	54	54	53	52	51	50	
Freight railways, up to 1 movement per hour		72	68	65	63*	62*	60*	59*	58*	57*	57*	56	55	55	54	53	52	51	

Figure 2-2 Noise Exposure Forecast from Guidelines

Figure 2-3 is conservative for noise sensitive developments located behind another development, since the closer development will provide screening and therefore noise attenuation for the development behind. As discussed in *Section 3*, there is potential for PTA to provide barriers as part of the rail upgrade occurring in the area. Such barriers would reduce noise levels to the ground floor and first floor of future developments. Higher floors may still have line-of-sight to the rail and therefore not obtain the noise reduction. The Guidelines permit a 4 dB reduction where such barriers exist. As this is unknown at this stage and would not be of benefit to higher floors, this has not been considered in *Figure 2-3*.

Areas shown as commercial are at the north end, either side of Turner Place and generally south of Davis Road, either side of Albany Highway. Whilst commercial uses can still be affected by transport noise, SPP 5.4 is not applicable. Similarly the areas shown as landscaped parking have not been included.

Other areas are indicated as predominantly having some noise sensitive component, albeit mixed use with possible commercial on lower floors.

Noise from Albany Highway has a greater impact generally with the outdoor target not achieved until 150 metres, as opposed to 100 metres for the passenger railway.

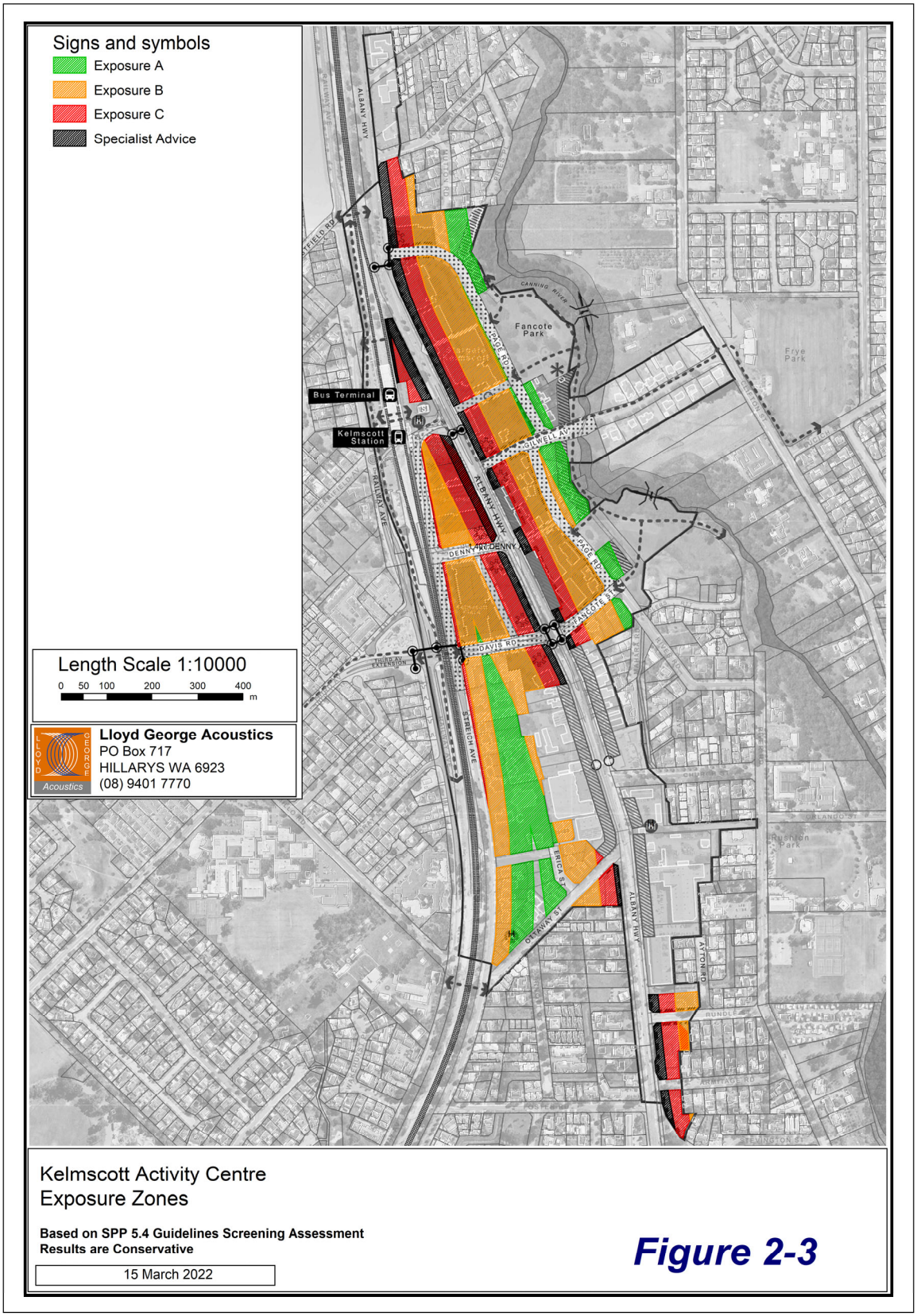


Figure 2-3 Concept Structure Plan with Exposure Zones

3 PROJECTS IN THE AREA

To improve safety in the area, Public Transport Authority (PTA) is proposing to remove the Denny Avenue level crossing. Doing so requires the railway to be elevated by some 3 metres, allowing for the construction of Davis Road underpass. SLR Consulting (SLR) was engaged by PTA to undertake a rail noise and vibration assessment[2] of the project and findings of this study are discussed, noting that this study focused on existing surrounding premises rather than considering potential changes associated with this structure plan. Some road traffic noise modelling was also undertaken but related to only Railway Avenue, Streich Avenue and Davis Road so this SLR report does not provide information for Albany Highway road traffic noise.

The key findings from the SLR report are:

- Mitigation options are suggested including noise walls, close fitting noise walls and rail web dampers. The noise wall design put forward is shown in *Figure 3-1*. This has not been considered in the screening approach of *Figure 2-3* given this may/may not be installed and would only benefit ground and first floors. In any case, the PTA noise controls consider only the residences south of Davis Road within this study area;
- Vibration is expected to be controlled at the track to compliant levels.

[2] *Denny Avenue Level Crossing Removal, Operational Noise and Vibration Assessment*; SLR Ref: 675.11244-R01, October 2019

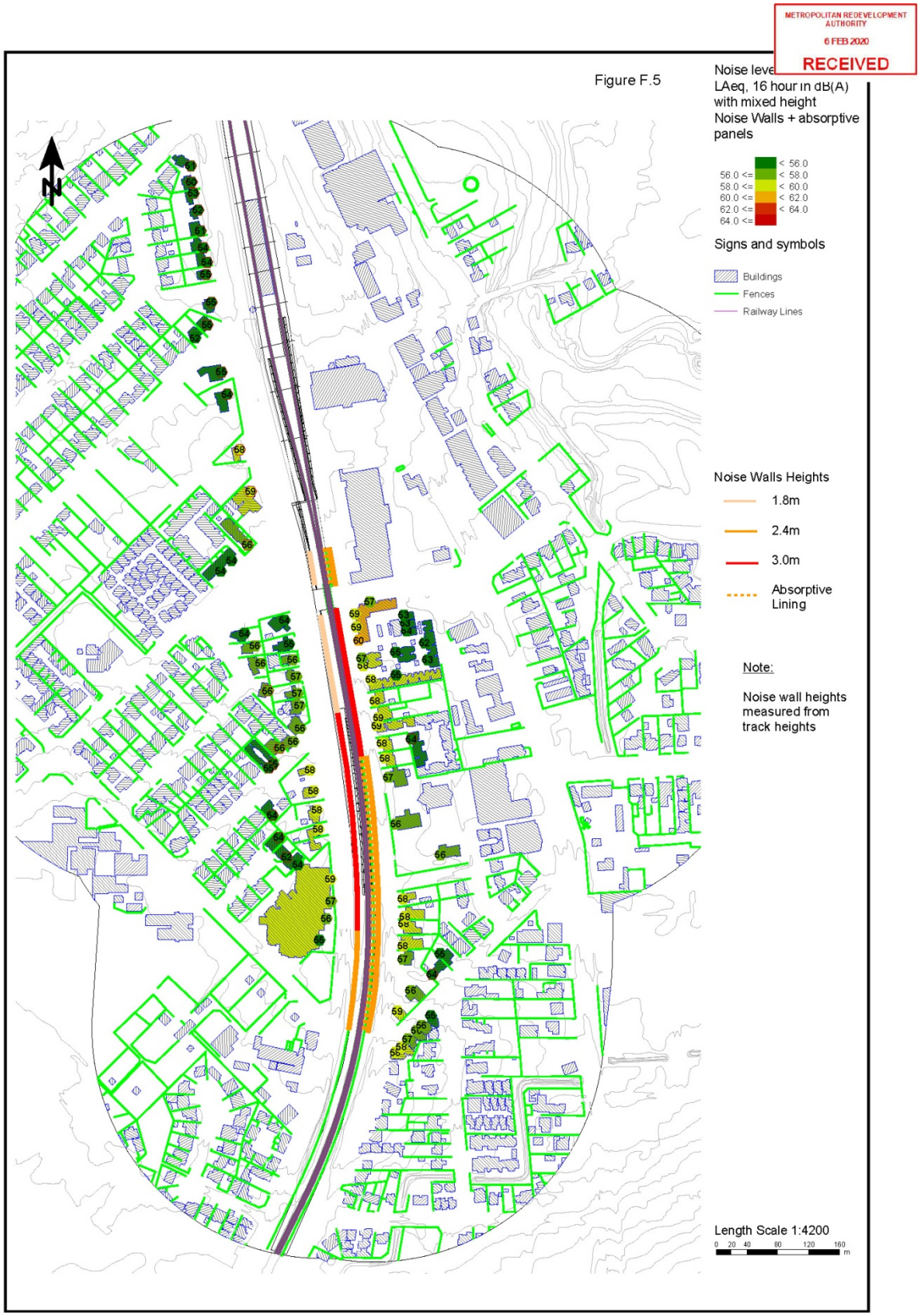


Figure 3-1 Concept Noise Mitigation (SLR)

4 CONCLUSION

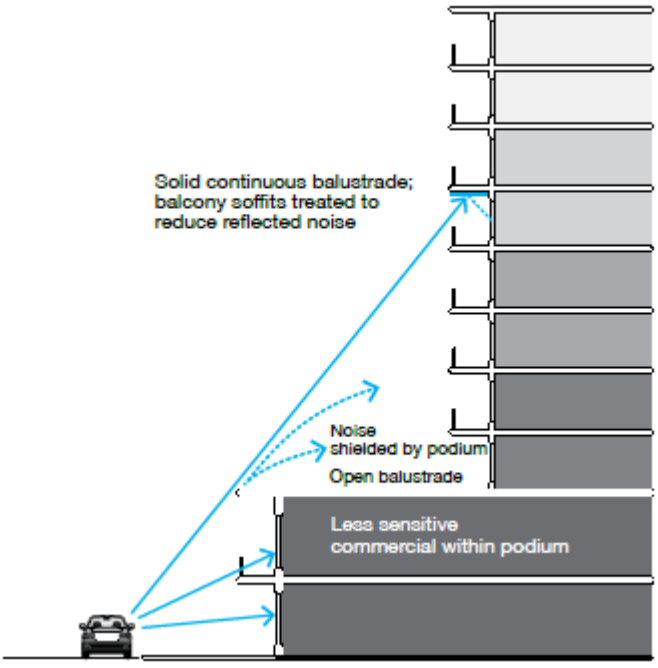
The objectives of SPP 5.4 are to achieve:

- indoor noise levels specified in *Table 2-1* in noise-sensitive areas (e.g. bedrooms and living rooms of houses and school classrooms); and
- a reasonable degree of acoustic amenity for outdoor living areas on each residential lot.

Where the outdoor noise targets of *Table 2-1* are achieved, no further controls are necessary. A conservative assessment of these areas is shown on *Figure 2-3*, being those areas outside the green zone (Exposure A).

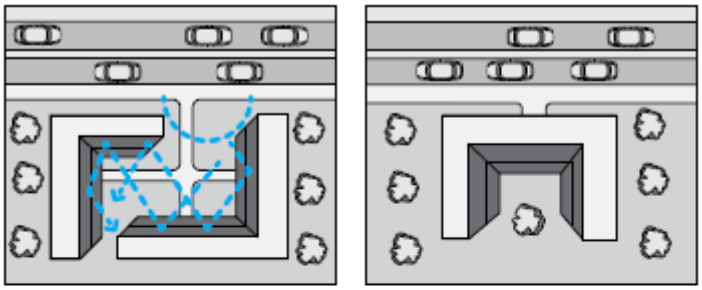
As a general guide, development within this area should consider:

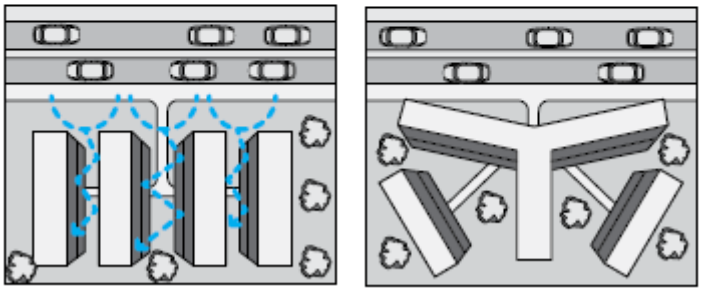
- Where practicable, the **separation distance** from Albany Highway to a noise sensitive part of a development, and similarly the railway, should be maximised. Methods to increase separation may be using non-sensitive parts (commercial) of a building closer to the transport corridor and/or car parking, public open space or the like. Ideally, at least 10 metres from the centre of the nearest railway track and 20 metres from the edge of the nearest Albany Highway lane, being the distances to no longer be Exposure D. For mixed use developments, it may be possible to set-back the noise sensitive parts of the development, providing some screening to some of the lower floors as shown below:



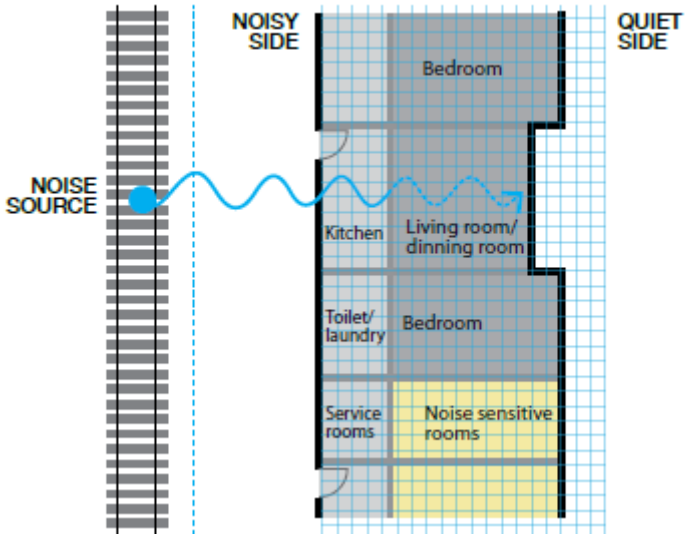
- Physical barriers such as **noise walls** can be considered. However, there is some practicality with the height of noise walls that will limit their effectiveness to ground and first floors only. The urban design of such walls would also need to be considered if proposed.

- It is inevitable that noise sensitive parts of the building will be located within noise affected areas. However, there are preferred **building shapes** to at least minimise some of the noise impacts as shown below where the left side shows a poor layout and the right side a better acoustic layout. Such approaches enable shared common outdoor areas to be shielded from the corridor as well as parts of the building/development.





- Even in the two images on the right that are shown above, the facade immediately adjoining the transport corridor will be significantly affected, even though this is considered a better acoustic layout because of the shielding provided to other parts of the development. In these cases, the room layouts should be given consideration with non-habitable rooms located closest to the corridor, followed by living areas followed by bedrooms (refer image below). By doing so will minimise the facade upgrades required. In higher noise level areas, providing balconies that can be enclosed (winter gardens) can be considered.



The requirements for land redeveloped within the study area are:

- Where the development has no noise sensitive uses (i.e. commercial only), a noise and/or vibration study is not mandatory, since it is not assessed against SPP 5.4. It should be noted however that some commercial uses can be sensitive to noise and vibration or may require such an assessment for Green Star for instance. As such, a study will be up to the developer of that site depending on their specific circumstances.
- Where noise sensitive uses exist within the Green, Orange or Red zones (Exposure A, B and C respectively), Quiet House Packages of SPP 5.4 (provided in *Appendix A*) can be adopted. As *Figure 2-3* is likely to be conservative, a developer could alternatively engage a suitably qualified acoustical consultant (member firm of the Association of Australasian Acoustical Consultants (AAAC)), once the lots specific building plans are available to conduct a site specific study. Where a noise sensitive development is within 40 metres of the railway, a vibration assessment should also be undertaken.
- Where noise sensitive uses exist within the Black zone (Exposure D), a site specific assessment would be mandatory, again to be undertaken by a suitably qualified acoustical consultant (member firm of the Association of Australasian Acoustical Consultants (AAAC)), once the lots specific building plans are available. Where a noise sensitive development is within 40 metres of the railway, a vibration assessment should also be undertaken.

The outcomes determined within this assessment are considered somewhat conservative given they do not include noise walls that may be constructed as part of the PTA project (Denny Avenue Level Crossing Removal) or screening provided by the buildings adjoining the transport corridors.

Appendix A

Quiet House Packages

The packages and information provided on the following pages are taken from *Road and Rail Noise Guidelines* (September 2019).

Where outdoor and indoor noise levels received by a noise-sensitive land-use and/or development exceed the policy's noise target, implementation of quiet house requirements is an acceptable solution.

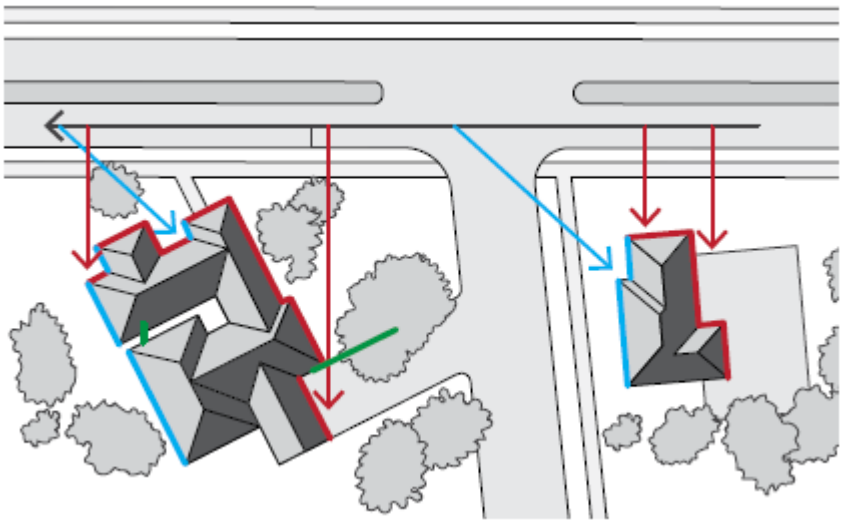
The quiet house packages are not the only solution to achieving acceptable internal transport noise levels. A suitably qualified acoustical engineer or consultant may also determine more tailored acoustic design requirements for buildings in a transport noise corridor by carrying out acoustic design in accordance with relevant industry standards. This includes the need to meet the relevant design targets specified in AS/NZS 2107:2016 for road traffic noise.

With regards to the packages, the following definitions are provided:

- **Facing** the transport corridor (red): Any part of a building façade is 'facing' the transport corridor if any straight line drawn perpendicular (at a 90 degree angle) to its nearest road lane or railway line intersects that part of the façade without obstruction (ignoring any fence).

- **Side-on** to transport corridor (blue): Any part of a building façade that is not 'facing' is 'side-on' to the transport corridor if any straight line, at any angle, can be drawn from it to intersect the nearest road lane or railway line without obstruction (ignoring any fence).

- **Opposite** to transport corridor (green): Neither 'side on' nor 'facing', as defined above.



Quiet House Package A

56-58 dB $L_{Aeq(Day)}$ & 51-53 dB $L_{Aeq(Night)}$

Element	Orientation	Room	
		Bedroom	Indoor Living and Work Areas

External Windows	Facing	• Up to 40% floor area ($R_w + C_{tr} \geq 28$):
		  ○ Sliding or double hung with minimum 10mm single or 6mm-12mm-10mm double insulated glazing;
		  ○ Sealed awning or casement windows with minimum 6mm glass.
		• Up to 60% floor area ($R_w + C_{tr} \geq 31$):
		  ○ Sealed awning or casement windows with minimum 6mm glass.
			• Up to 40% floor area ($R_w + C_{tr} \geq 25$):
			  ○ Sliding or double hung with minimum 6mm single or 6mm-12mm-6mm double insulated glazing;
			• Up to 60% floor area ($R_w + C_{tr} \geq 28$);
			• Up to 80% floor area ($R_w + C_{tr} \geq 31$).

	Side On	As above, except $R_w + C_{tr}$ values may be 3 dB less or max % area increased by 20%.	
	Opposite	No specific requirements	

External Doors	Facing	• Fully glazed hinged door with certified $R_w + C_{tr} \geq 28$ rated door and frame including seals and 6mm glass.	• Doors to achieve $R_w + C_{tr} \geq 25$:
			  ○ 35mm Solid timber core hinged door and frame system certified to R_w 28 including seals;
			  ○ Glazed sliding door with 10mm glass and weather seals.

	Side On	As above, except $R_w + C_{tr}$ values may be 3 dB less.	
	Opposite	No specific requirements	

External Walls	All	• $R_w + C_{tr} \geq 45$:
		  ○ Two leaves of 90mm thick clay brick masonry with minimum 20mm cavity; or
		  ○ Single leaf of 150mm brick masonry with 13mm cement render on each face; or
		  ○ One row of 92mm studs at 600mm centres with:
		  ▪ Resilient steel channels fixed to the outside of the studs; and
		  ▪ 9.5mm hardboard or fibre cement sheeting or 11mm fibre cement weatherboards fixed to the outside;
		  ▪ 75mm thick mineral wool insulation with a density of at least 11kgkg/m^3; and
		  ▪ 2 x 16mm fire-rated plasterboard to inside.	

Roofs and Ceilings	All	• $R_w + C_{tr} \geq 35$: ○ Concrete or terracotta tile or metal sheet roof with sarking and at least 10mm plasterboard.	
Outdoor Living Areas		At least one outdoor living area located on the opposite side of the building from the transport corridor and/or at least one ground level outdoor living area screened using a solid continuous fence or other structure of minimum 2 metres height above ground level.	

Quiet House Package B

59-62 dB $L_{Aeq(Day)}$ & 54-57 dB $L_{Aeq(Night)}$

Element	Orientation	Room	
		Bedroom	Indoor Living and Work Areas
External Windows	Facing	• Up to 40% floor area ($R_w + C_{tr} \geq 31$): ○ Fixed sash, awning or casement with minimum 6mm glass or 6mm-12mm-6mm double insulated glazing. • Up to 60% floor area ($R_w + C_{tr} \geq 34$): ○ Fixed sash, awning or casement with minimum 10mm glass or 6mm-12mm-10mm double insulated glazing.	• Up to 40% floor area ($R_w + C_{tr} \geq 28$): ○ Sliding or double hung with 6mm-12mm-10mm double insulated glazing; ○ Sealed awning or casement windows with minimum 6mm glass. • Up to 60% floor area ($R_w + C_{tr} \geq 31$); • Up to 80% floor area ($R_w + C_{tr} \geq 34$).
	Side On	As above, except $R_w + C_{tr}$ values may be 3 dB less or max % area increased by 20%.	
	Opposite	As above, except $R_w + C_{tr}$ values may be 6 dB less or max % area increased by 20%.	
External Doors	Facing	• Fully glazed hinged door with certified $R_w + C_{tr} \geq 31$ rated door and frame including seals and 10mm glass.	• Doors to achieve $R_w + C_{tr} \geq 28$: ○ 40mm Solid timber core hinged door and frame system certified to R_w 32 including seals; ○ Fully glazed hinged door with certified $R_w + C_{tr} \geq 28$ rated door and frame including seals and 6mm glass.
	Side On	As above, except $R_w + C_{tr}$ values may be 3 dB less or max % area increased by 20%.	
	Opposite	As above, except $R_w + C_{tr}$ values may be 6 dB less or max % area increased by 20%.	
External Walls	All	• $R_w + C_{tr} \geq 50$: ○ Two leaves of 90mm thick clay brick masonry with minimum 50mm cavity between leaves and 25mm glasswool or polyester (24kg/m^3). Resilient ties used where required to connect leaves. ○ Two leaves of 110mm clay brick masonry with minimum 50mm cavity between leaves and 25mm glasswool or polyester insulation (24kg/m^3). ○ Single leaf of 220mm brick masonry with 13mm cement render on each face. ○ 150mm thick unlined concrete panel or 200mm thick concrete panel with one layer of 13mm plasterboard or 13mm cement render on each face. ○ Single leaf of 90mm clay brick masonry with: ▪ A row of 70mm x 35mm timber studs or 64mm steel studs at 600mm centres; ▪ A cavity of 25mm between leaves; ▪ 50mm glasswool or polyester insulation (11kg/m^3) between studs; and ▪ One layer of 10mm plasterboard fixed to the inside face.	
Roofs and Ceilings	All	• $R_w + C_{tr} \geq 35$: ○ Concrete or terracotta tile or metal sheet roof with sarking and at least 10mm plasterboard ceiling with R3.0+ fibrous insulation.	
Outdoor Living Areas		At least one outdoor living area located on the opposite side of the building from the transport corridor and/or at least one ground level outdoor living area screened using a solid continuous fence or other structure of minimum 2.4 metres height above ground level.	

Quiet House Package C

63-66 dB $L_{Aeq(Day)}$ & 58-61 dB $L_{Aeq(Night)}$

Element	Orientation	Room	
		Bedroom	Indoor Living and Work Areas
External Windows	Facing	• Up to 20% floor area ($R_w + C_{tr} \geq 31$): ○ Fixed sash, awning or casement with minimum 6mm glass or 6mm-12mm-6mm double insulated glazing. • Up to 40% floor area ($R_w + C_{tr} \geq 34$): ○ Fixed sash, awning or casement with minimum 10mm glass or 6mm-12mm-10mm double insulated glazing.	• Up to 40% floor area ($R_w + C_{tr} \geq 31$): ○ Fixed sash, awning or casement with minimum 6mm glass or 6mm-12mm-6mm double insulated glazing. • Up to 60% floor area ($R_w + C_{tr} \geq 34$): ○ Fixed sash, awning or casement with minimum 10mm glass or 6mm-12mm-10mm double insulated glazing.
	Side On	As above, except $R_w + C_{tr}$ values may be 3 dB less or max % area increased by 20%.	
	Opposite	As above, except $R_w + C_{tr}$ values may be 6 dB less or max % area increased by 20%.	
External Doors	Facing	• Not recommended.	• Doors to achieve $R_w + C_{tr} \geq 30$: ○ Fully glazed hinged door with certified $R_w + C_{tr} \geq 31$ rated door and frame including seals and 10mm glass; ○ 40mm Solid timber core side hinged door, frame and seal system certified to R_w 32 including seals. Any glass inserts to be minimum 6mm.
	Side On	As above, except $R_w + C_{tr}$ values may be 3 dB less or max % area increased by 20%.	
	Opposite	As above, except $R_w + C_{tr}$ values may be 6 dB less or max % area increased by 20%.	
External Walls	All	• $R_w + C_{tr} \geq 50$: ○ Two leaves of 90mm thick clay brick masonry with minimum 50mm cavity between leaves and 25mm glasswool or polyester insulation (24kg/m^3). Resilient ties used where required to connect leaves. ○ Two leaves of 110mm clay brick masonry with minimum 50mm cavity between leaves and 25mm glasswool or polyester insulation (24kg/m^3). ○ Single leaf of 220mm brick masonry with 13mm cement render on each face. ○ 150mm thick unlined concrete panel or 200mm thick concrete panel with one layer of 13mm plasterboard or 13mm cement render on each face. ○ Single leaf of 90mm clay brick masonry with: ▪ A row of 70mm x 35mm timber studs or 64mm steel studs at 600mm centres; ▪ A cavity of 25mm between leaves; ▪ 50mm glasswool or polyester insulation (11kg/m^3) between studs; and ▪ One layer of 10mm plasterboard fixed to the inside face.	
Roofs and Ceilings	All	• $R_w + C_{tr} \geq 40$: ○ Concrete or terracotta tile roof with sarking, or metal sheet roof with foil backed R2.0+ fibrous insulation between steel sheeting and roof battens; ○ R3.0+ insulation batts above ceiling; ○ 2 x 10mm plasterboard ceiling or 1 x 13mm sound-rated plasterboard affixed using steel furring channel to ceiling rafters.	
Outdoor Living Areas		At least one outdoor living area located on the opposite side of the building from the transport corridor and/or at least one ground level outdoor living area screened using a solid continuous fence or other structure of minimum 2.4 metres height above ground level.	

Mechanical Ventilation requirements

In implementing the acceptable treatment packages, the following mechanical ventilation / air-conditioning considerations are required:

- Acoustically rated openings and ductwork to provide a minimum sound reduction performance of R_w 40 dB into sensitive spaces;
- Evaporative systems require attenuated ceiling air vents to allow closed windows;
- Refrigerant based systems need to be designed to achieve National Construction Code fresh air ventilation requirements;
- Openings such as eaves, vents and air inlets must be acoustically treated, closed or relocated to building sides facing away from the corridor where practicable.

Notification

Notifications on title advise prospective purchasers of the potential for noise impacts from major transport corridors and help with managing expectations.

The Notification is to state as follows:

This lot is in the vicinity of a transport corridor and is affected, or may in the future be affected, by road and rail transport noise. Road and rail transport noise levels may rise or fall over time depending on the type and volume of traffic.

Appendix B

Terminology

The following is an explanation of the terminology used throughout this report.

Decibel (dB)
The decibel is the unit that describes the sound pressure and sound power levels of a noise source. It is a logarithmic scale referenced to the threshold of hearing.

A-Weighting
An A-weighted noise level has been filtered in such a way as to represent the way in which the human ear perceives sound. This weighting reflects the fact that the human ear is not as sensitive to lower frequencies as it is to higher frequencies. An A-weighted sound level is described as L_A dB.

L_1
An L_1 level is the noise level which is exceeded for 1 per cent of the measurement period and is considered to represent the average of the maximum noise levels measured.

L_{10}
An L_{10} level is the noise level which is exceeded for 10 per cent of the measurement period and is considered to represent the "*intrusive*" noise level.

L_{90}
An L_{90} level is the noise level which is exceeded for 90 per cent of the measurement period and is considered to represent the "*background*" noise level.

L_{eq}
The L_{eq} level represents the average noise energy during a measurement period.

$L_{A10,18hour}$
The $L_{A10,18\ hour}$ level is the arithmetic average of the hourly L_{A10} levels between 6.00 am and midnight. The *CoRTN* algorithms were developed to calculate this parameter.

$L_{Aeq,24hour}$
The $L_{Aeq,24\ hour}$ level is the logarithmic average of the hourly L_{Aeq} levels for a full day (from midnight to midnight).

$L_{Aeq,8hour}$ / $L_{Aeq\ (Night)}$
The $L_{Aeq\ (Night)}$ level is the logarithmic average of the hourly L_{Aeq} levels from 10.00 pm to 6.00 am on the same day.

$L_{Aeq,16hour}$ / $L_{Aeq\ (Day)}$
The $L_{Aeq\ (Day)}$ level is the logarithmic average of the hourly L_{Aeq} levels from 6.00 am to 10.00 pm on the same day. This value is typically 1-3 dB less than the $L_{A10,18hour}$.

Noise-sensitive land use and/or development
Land-uses or development occupied or designed for occupation or use for residential purposes (including dwellings, residential buildings or short-stay accommodation), caravan park, camping ground, educational establishment, child care premises, hospital, nursing home, corrective institution or place of worship.

About the Term 'Reasonable'

An assessment of reasonableness should demonstrate that efforts have been made to resolve conflicts without comprising on the need to protect noise-sensitive land-use activities. For example, have reasonable efforts been made to design, relocate or vegetate a proposed noise barrier to address community concerns about the noise barrier height? Whether a noise mitigation measure is reasonable might include consideration of:

- The noise reduction benefit provided;
- The number of people protected;
- The relative cost vs benefit of mitigation;
- Road conditions (speed and road surface) significantly differ from noise forecast table assumptions;
- Existing and future noise levels, including changes in noise levels;
- Aesthetic amenity and visual impacts;
- Compatibility with other planning policies;
- Differences between metropolitan and regional situations and whether noise modelling requirements reflect the true nature of transport movements;
- Ability and cost for mobilisation and retrieval of noise monitoring equipment in regional areas;
- Differences between Greenfield and infill development;
- Differences between freight routes and public transport routes and urban corridors;
- The impact on the operational capacity of freight routes;
- The benefits arising from the proposed development;
- Existing or planned strategies to mitigate the noise at source.

About the Term 'Practicable'

'Practicable' considerations for the purposes of the policy normally relate to the engineering aspects of the noise mitigation measures under evaluation. It is defined as "reasonably practicable having regard to, among other things, local conditions and circumstances (including costs) and to the current state of technical knowledge" (*Environmental Protection Act 1986*). These may include:

- Limitations of the different mitigation measures to reduce transport noise;
- Competing planning policies and strategies;
- Safety issues (such as impact on crash zones or restrictions on road vision);
- Topography and site constraints (such as space limitations);
- Engineering and drainage requirements;
- Access requirements (for driveways, pedestrian access and the like);
- Maintenance requirements;
- Bushfire resistance or BAL ratings;
- Suitability of the building for acoustic treatments.

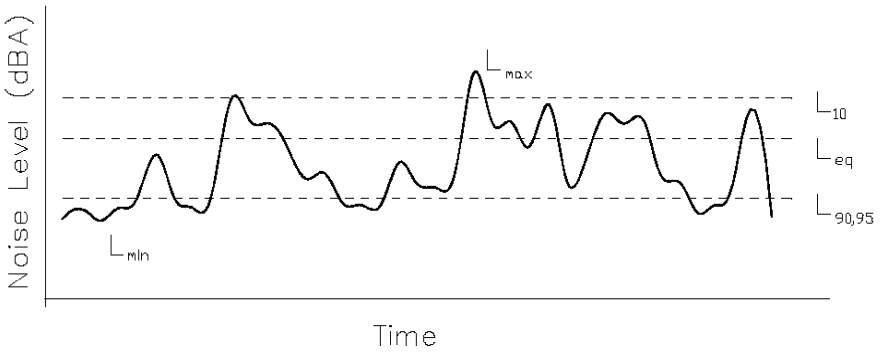
R_w

This is the weighted sound reduction index and is similar to the previously used STC (Sound Transmission Class) value. It is a single number rating determined by moving a grading curve in integral steps against the laboratory measured transmission loss until the sum of the deficiencies at each one-third-octave band, between 100 Hz and 3.15 kHz, does not exceed 32 dB. The higher the R_w value, the better the acoustic performance.

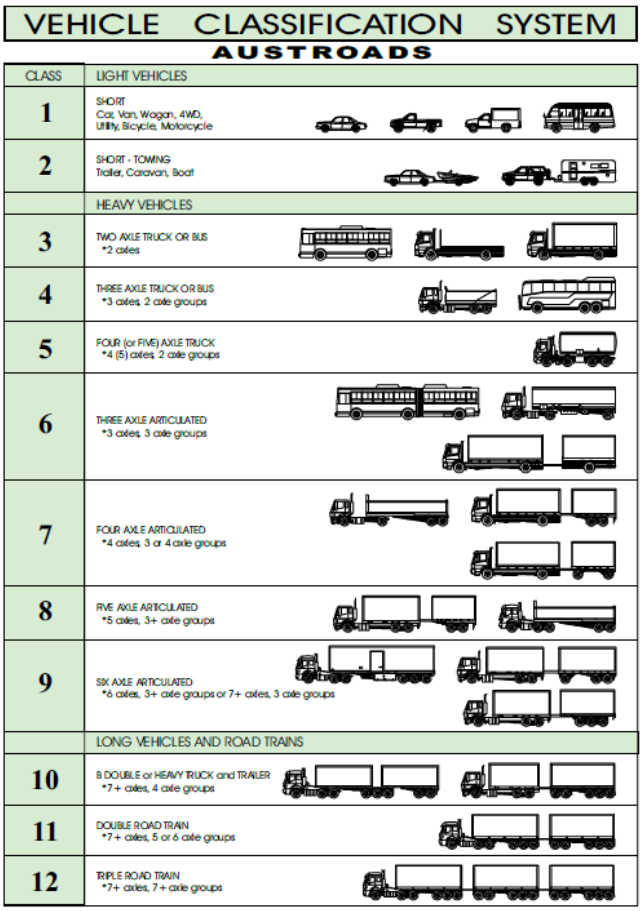
C_{tr}

This is a spectrum adaptation term for airborne noise and provides a correction to the R_w value to suit source sounds with significant low frequency content such as road traffic or home theatre systems. A wall that provides a relatively high level of low frequency attenuation (i.e. masonry) may have a value in the order of –4 dB, whilst a wall with relatively poor attenuation at low frequencies (i.e. stud wall) may have a value in the order of -14 dB.

Chart of Noise Level Descriptors



Austroads Vehicle Class



Typical Noise Levels