# Technical Appendix C – Transportation Noise Assessment

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# Transportation Noise Assessment

## Forrestfield North Residential Precinct – Local Structure Plan

**Reference: 21046304-01**

**Prepared for:**
element

# Report: 21046304-01


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# 1 INTRODUCTION

The subject of this report is transportation noise impacts to the Forrestfield North Residential Precinct as shown in *Figure 1-1* and generally bound by Roe Highway, Sultana Road West, Milner Road and Poison Gully.

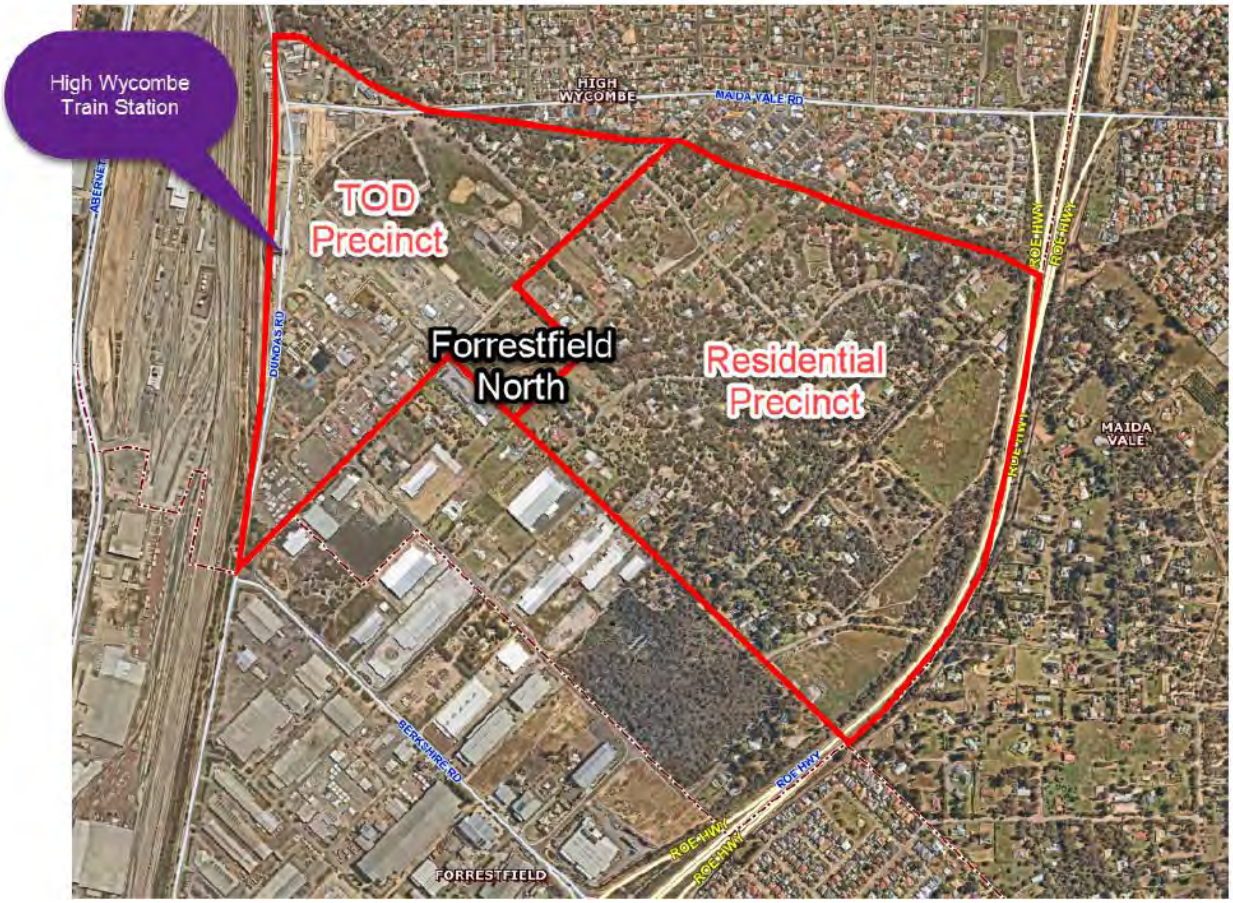


*Figure 1-1 Locality of Residential Precinct*

The Local Structure Plan is provided in *Figure 1-2*.

The most significant noise impact to the Residential Precinct is from Roe Highway road traffic. Aircraft noise is also discussed although is a lesser impact. Noise and vibration from the freight and passenger railway is also touched upon briefly, although determined to be of negligible impact to the Residential Precinct area.

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


*Figure 1-2 Local Structure Plan*

# 2 CRITERIA

## 2.1 Road and Rail Noise

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 reasonable 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.

[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.

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.

It is recognised that in some instances, it may not be reasonable and/or practicable to meet the outdoor noise targets. Where transport noise is above the noise targets, measures are expected to be implemented that balance reasonable and practicable considerations with the need to achieve acceptable noise protection outcomes.

### 2.2 Aircraft Noise

The relevant planning policy in Western Australia in relation to aircraft noise is *State Planning Policy 5.1: Land Use Planning in the Vicinity of Perth Airport*; July 2015, Western Australian Planning Commission (hereafter referred to as SPP 5.1). SPP 5.1 applies to any land within Aircraft Noise Exposure Forecast (ANEF) 20 and separates land into three zones:

- Areas below 20 ANEF;
- Areas between 20 ANEF and 25 ANEF; and
- Areas above 25 ANEF.

There is no restriction on zoning or development below 20 ANEF.

Separate to the ANEF contours, which are used as a planning tool, Perth Airport has also produced N65 contours which show the average expected number of times a day an aircraft event above 65 dB(A) will occur. A level of 65 dB(A) is considered to be the point at which aircraft noise may be considered intrusive.

# 3 METHODOLOGY

### 3.1 Road and Rail Noise

*State Planning Policy No. 5.4 Road and Rail Noise* provides the trigger distances shown in *Table 3-1*.

*Figure 3-1* shows these trigger distances across the subject site, with the image taken from the PlanWA Maps. On the western side are the trigger distances associated with the existing freight railway (grey) and the new passenger railway (green). On the eastern side is the trigger distance associated with Roe Highway (red).

It can be seen that the Residential Precinct is outside of the trigger distances for the trains and therefore this is no longer considered. With regard to road traffic noise, the site is within the trigger distance of Roe Highway and therefore warrants more detailed noise management.

*Table 3-1 Transport Corridor Classification and Trigger Distances*

| Transport Corridor Classification | Trigger Distance | Distance Measured From |
|---|---|---|
| **Strategic freight and major traffic routes**<br>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**<br>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 |

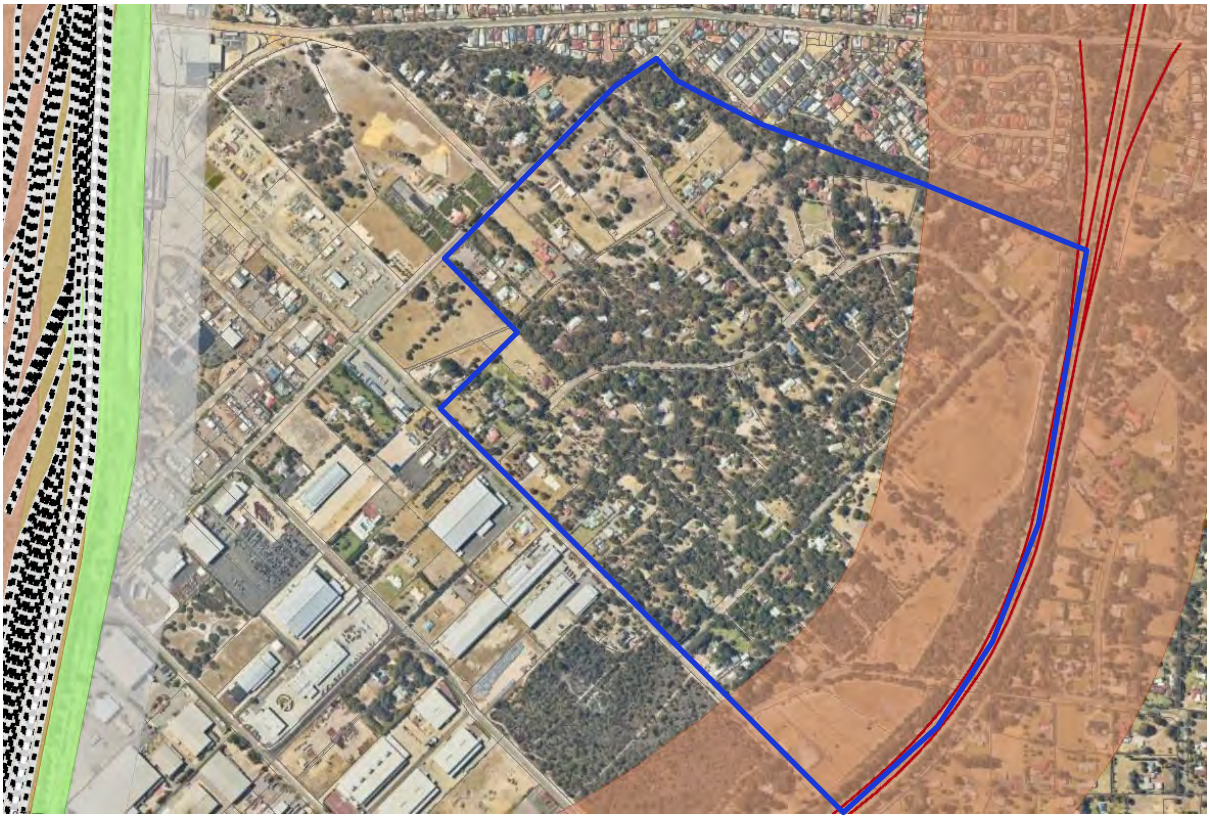

*Figure 3-1 Locality of Residential Precinct in Relation to Road and Rail Triggers*

### 3.1.1 Site Measurements

Noise monitoring was undertaken at two (2) locations in order to:

- Quantify the existing noise levels;
- Determine the differences between different acoustic parameters ($L_{A10,18hour}$, $L_{Aeq(Day)}$ and $L_{Aeq(Night)}$); and
- Calibrate the noise model for existing conditions.

The instruments used and their locations are provided in *Table 3-2*.

*Table 3-2 Noise Monitoring Information*

| On Site Photo and Description | General Locality |
|---|---|
|  |  |
| Alongside Maida Vale Northbound Off Ramp<br>Ngara Noise Logger (S/N: 8780F6) | |
|  | |
| South of Maida Vale Northbound Off Ramp<br>Ngara Noise Logger (S/N: 8780F5) | |

The microphones are 1.4 metres above ground level with the loggers programmed to record hourly $L_{A1}$, $L_{A10}$, $L_{A90}$, and $L_{Aeq}$ levels. The instruments comply with the requirements of *Australian Standard 2702-1984 Acoustics – Methods for the Measurement of Road Traffic Noise*. The loggers were field calibrated before and after the measurement session and found to be accurate to within +/- 1 dB. Lloyd George Acoustics also holds current laboratory calibration certificate for the loggers.

### 3.1.2 Noise Modelling

The computer programme *SoundPLAN 8.2* was utilised incorporating the *Calculation of Road Traffic Noise* (CoRTN) algorithms, modified to reflect Australian conditions. The modifications included the following:

- Vehicles were separated into heavy (Austroads Class 3 upwards) and non-heavy (Austroads Classes 1 & 2) with non-heavy vehicles having a source height of 0.5 metres above road level and heavy vehicles having two sources, at heights of 1.5 metres and 3.6 metres above road level, to represent the engine and exhaust respectively. By splitting the noise source into three, allows for less barrier attenuation for high level sources where barriers are to be considered;
- Note that a -8.0 dB correction is applied to the exhaust and -0.8 dB to the engine (based on Transportation Noise Reference Book, Paul Nelson, 1987), so as to provide consistent results with the CoRTN algorithms for the no barrier scenario;
- Adjustments of -0.8 dB and -1.7 dB have been applied to the predicted levels for the 'free-field' and 'at facade' cases respectively, based on the findings of *An Evaluation of the U.K. DoE Traffic Noise Prediction*; Australian Road Research Board, Report 122 ARRB – NAASRA Planning Group (March 1983).

Predictions are made at heights of 1.4 m above ground floor level for single storey houses and 4.2 m for double storey houses. The noise is predicted at 1.0 metre from an assumed building facade resulting in a + 2.5 dB correction due to reflected noise.

Various input data are included in the modelling such as ground topography, road design, traffic volumes etc. These model inputs are discussed in the following sections.

#### *3.1.2.1 Ground Topography*

Topographical and road design data for this project was taken from Landgate data on file. At this stage information on subdivision levels are unknown and therefore the modelling uses the existing topography. For the future scenario, it is assumed Roe Highway will increase to 3 lanes in each direction, with the widening assumed to occur outside the existing lanes (i.e. northbound lane added to the west, southbound carriageway added to the east).

Buildings have also been included as these can provide barrier attenuation when located between a source and receiver, in much the same way as a hill or wall provides noise shielding. For the future scenario with buildings, these have been incorporated as indicative blocks only, to be further refined as the subdivision design progresses. However, within the R30-R60, houses are assumed single storey at 3.5 metres high and within R60-R100 assumed to be double storey at 7.0 metres high.

#### *3.1.2.2 Traffic Data*

Traffic data includes:

- Road Surface – The noise relationship between different road surface types is shown in *Table 3-3*.

*Table 3-3 Noise Relationship Between Different Road Surfaces*

| Road Surfaces | | | | | | | |
|---|---|---|---|---|---|---|---|
| Chip Seal | | | | Asphalt | | | |
| 14mm | 10mm | 5mm | Slurry | Dense Graded | Novachip | Stone Mastic | Open Graded |
| +3.5 dB | +2.5 dB | +1.5 dB | +1.0 dB | 0.0 dB | -0.2 dB | -1.5 dB | -2.5 dB |

On/Off ramps are generally dense graded asphalt in the vicinity of the interchange, nominally 150 metres and as such this has also been assumed in this project. The ramps then change to match that of the main carriageway. Closer to the Berkshire interchange, the existing road surface is open graded asphalt with the rest mostly stone mastic asphalt although there is some areas incorporating slurry seal and chip seal. In the future scenario, it is assumed this will change to open graded asphalt throughout.

- Vehicle Speed – The existing and future posted speeds for Roe Highway is 100km/hr, with the on/off ramps modelled as 70km/hr and then increasing to or decreasing from 100 km/hr.

- Traffic Volumes – Existing (2016) and forecast (2041) traffic volumes were provided by Main Roads WA (Thomas Ng, Traffic Modelling Analyst, Reference: #41867). A validation plot was also provided allowing the Main Roads WA traffic volume model to be calibrated against actual counts. More recent existing volumes were obtained from the Main Roads WA Traffic Map and these have been used to calibrate the noise model to the noise loggers. Note that the existing counts for Maida Vale on/off ramps were relatively old (2015/16) so that these were increased by the percentage growth shown on Roe Highway between 2015/16 and 2019/20. *Table 3-4* provides the traffic volume input data in the model based on the information provided.

*Table 3-4 Traffic Information Used in the Modelling*

| Road / Parameter | Scenario | | | |
|---|---|---|---|---|
| | Existing – 2019/20 | | Future - 2041 | |
| | Northbound | Southbound | Northbound | Southbound |
| ***Berkshire Av On/Off Ramps*** | | | | |
| 24 Hour Volume | 2845 | 2896 | 6700 | 5300 |
| % Heavy | 14.7 | 14.1 | 15 | 6 |
| ***Maida Vale Road On/Off Ramps*** | | | | |
| 24 Hour Volume | 6416 | 6689 | 8347 | 10024 |
| % Heavy | 11.7 | 17.0 | 11 | 11 |
| ***Roe Highway, North of Berkshire*** | | | | |
| 24 Hour Volume | 27055 | 26523 | 53800 | 57000 |
| % Heavy | 16.3 | 17.8 | 13 | 12 |

#### *3.1.2.3 Ground Attenuation*

The ground attenuation has been assumed to be 0.0 (0%) for the road, 0.5 (50%) throughout the subdivision, except for the public open space, which was set to 1.00 (100%). Note 0.0 represents hard reflective surfaces such as water and 1.00 represents absorptive surfaces such as grass.

#### *3.1.2.4 Parameter Conversion*

The CoRTN algorithms used in the *SoundPlan* modelling package were originally developed to calculate the $L_{A10,18hour}$ noise level. SPP 5.4 however uses $L_{Aeq(Day)}$ and $L_{Aeq(Night)}$. The relationship between the parameters varies depending on the composition of traffic on the road (volumes in each period and percentage heavy vehicles).

As noise monitoring was undertaken, the relationship between the parameters is based on the results of the monitoring – refer *Section 4.1*.

## 3.2 Aircraft Noise

*Figure 3-2* shows the relationship of the site to the ANEF contours. It can be seen that the Residential Precinct is located outside the ANEF 20 zone and therefore there are no restrictions on residential development.

In addition to the ANEF Contours, Perth Airport also provide N65 Contours. These have been extracted from the Perth Airport 2020 Master Plan as shown in *Figure 3-3* showing that there are small areas of the site where there may be an average of 5 or more aircraft events above 65 dB(A).


*Figure 3-2 Locality of Residential Precinct in Relation to ANEF Contours*

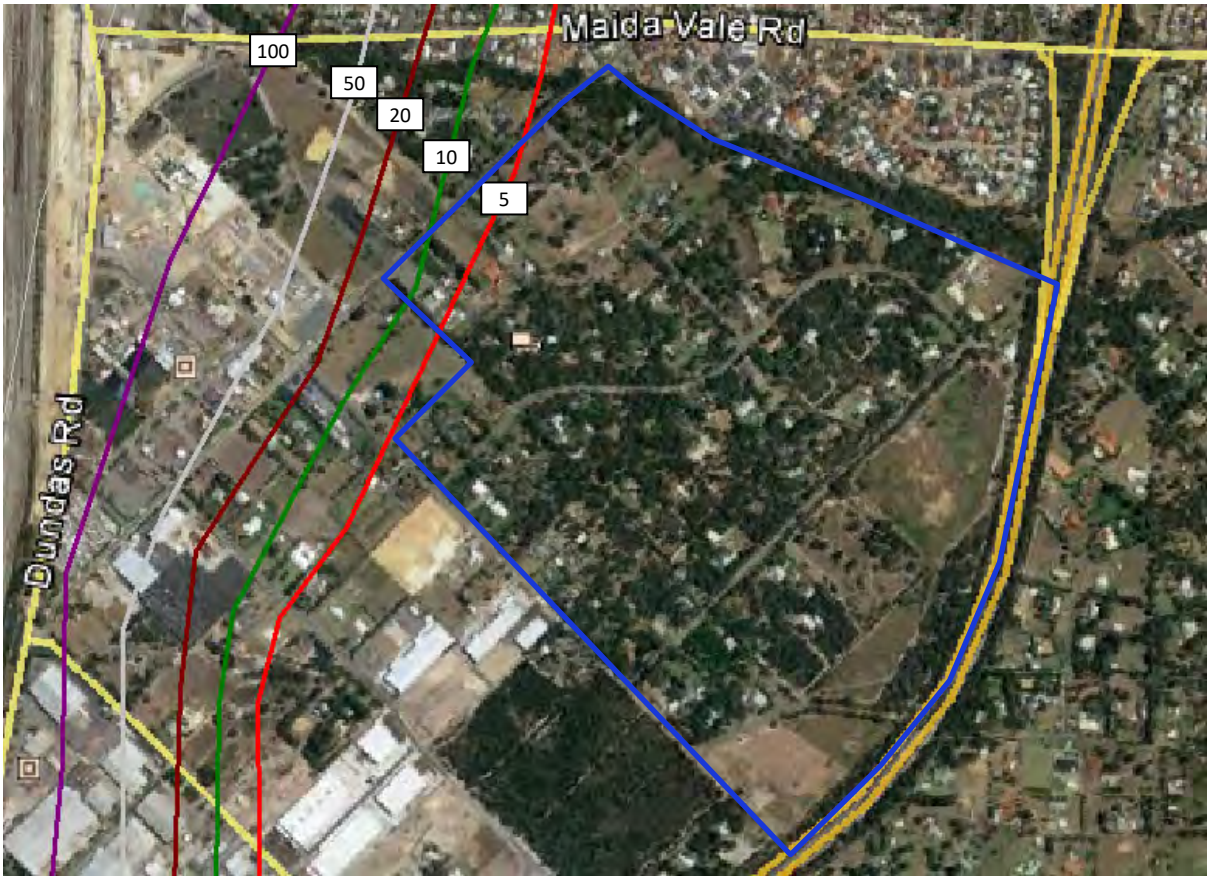


*Figure 3-3 Locality of Residential Precinct in Relation to N65 Contours*

# 4 RESULTS

## 4.1 Road Traffic

### 4.1.1 Road Traffic Measurements

The results of the noise monitoring at the two locations are provided in *Table 4-1* and *Table 4-2* and graphically in *Figure 4-1* and *Figure 4-2*.

*Table 4-1 Measured Average Noise Levels: Alongside Northbound Off Ramp*

| Date | Average Weekday Noise Level, dB | | | |
|---|---|---|---|---|
| | $L_{A10,18hour}$ | $L_{Aeq,24hour}$ | $L_{Aeq\ (Day)}$ | $L_{Aeq\ (Night)}$ |
| Monday 17-May-21 | 69.8 | 67.1 | 68.4 | 62.0 |
| Tuesday 18-May-21 | 70.2 | 67.2 | 68.5 | 62.2 |
| Wednesday 19-May-21 | 70.1 | 67.1 | 68.4 | 62.0 |
| Thursday 20-May-21 | 70.3 | 67.4 | 68.6 | 62.9 |
| Friday 21-May-21 | 70.3 | 67.3 | 68.5 | 62.8 |
| **Average** | **70.1** | **67.2** | **68.5** | **62.4** |

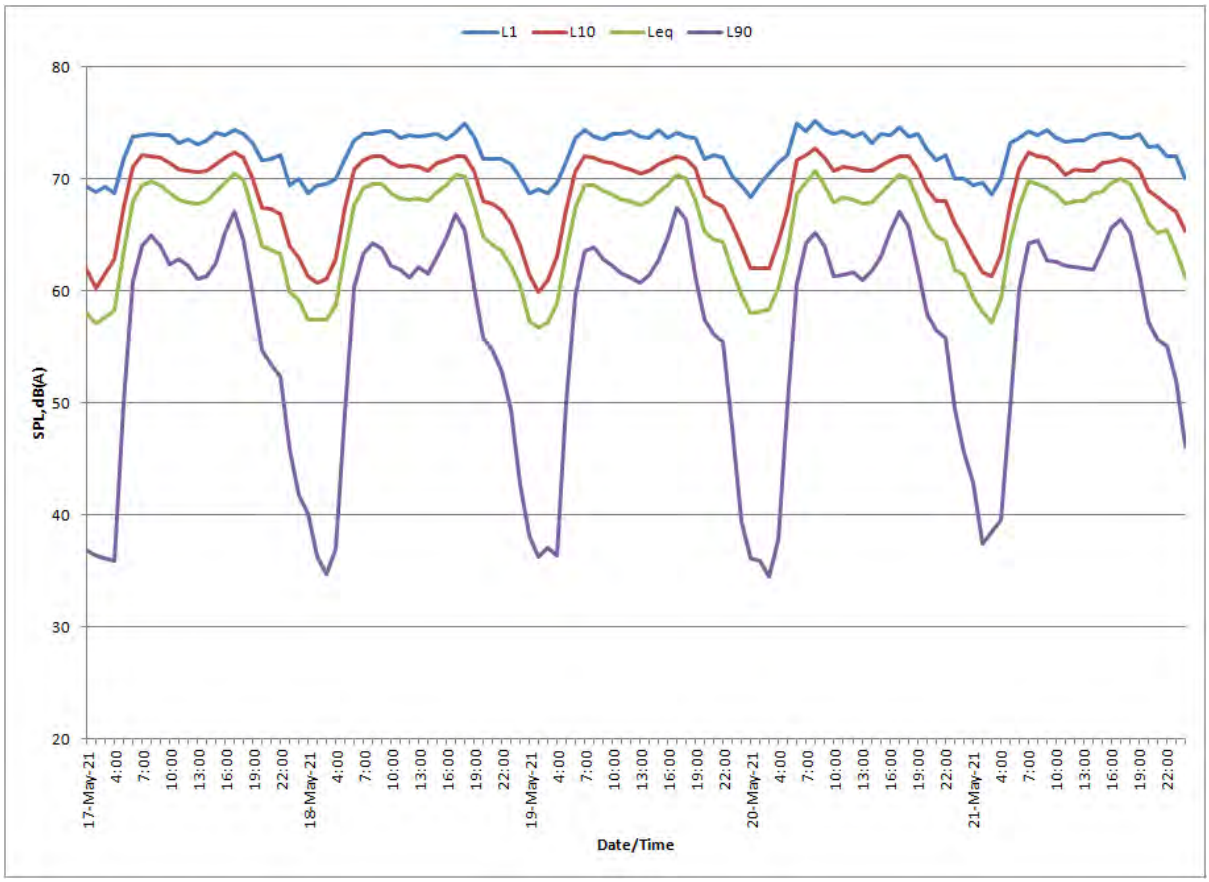


*Figure 4-1 Noise Monitoring Results: Alongside Northbound Off Ramp*

*Table 4-2 Measured Average Noise Levels: Alongside Roe Highway*

| Date | Average Weekday Noise Level, dB | | | |
|---|---|---|---|---|
| | $L_{A10,18hour}$ | $L_{Aeq,24hour}$ | $L_{Aeq\ (Day)}$ | $L_{Aeq\ (Night)}$ |
| Monday 17-May-21 | 67.9 | 65.1 | 66.4 | 60.0 |
| Tuesday 18-May-21 | 68.3 | 65.4 | 66.6 | 60.5 |
| Wednesday 19-May-21 | 68.2 | 65.3 | 66.6 | 60.0 |
| Thursday 20-May-21 | 68.3 | 65.4 | 66.6 | 60.8 |
| Friday 21-May-21 | 68.4 | 65.6 | 66.8 | 60.7 |
| **Average** | **68.2** | **65.3** | **66.6** | **60.4** |

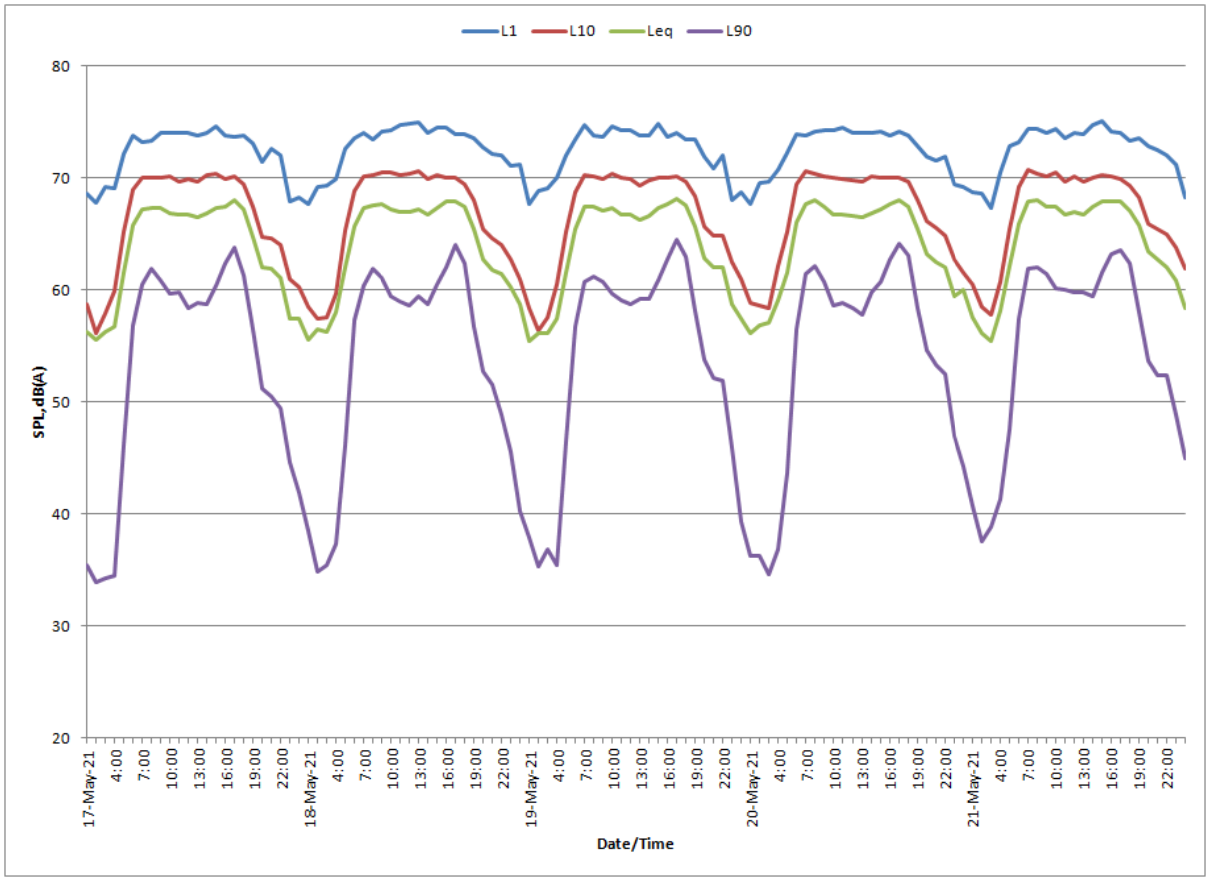


*Figure 4-2 Noise Monitoring Results: Alongside Roe Highway*

The difference between the weekday $L_{Aeq(Day)}$ and $L_{Aeq(Night)}$ at both sites is around 6 dB, such that it is the daytime noise levels that will dictate compliance since these are at least 5 dB more than night-time levels.

### 4.1.2 Road Traffic Modelling

The noise model is initially set-up for existing conditions and calibrated against the results of the noise logging. The model is then modified for future conditions (increased traffic volumes and proposed development) using the same calibration. The results of this modelling are provided in *Figure 4-3*.

## 4.2 Aircraft Noise

The Residential Precinct is outside the ANEF 20 zone and therefore there are no restrictions on residential development. Aircraft noise will be audible at times with parts of the site exposed to an average of 5 or more events per day above 65 dB(A). This is considered a relatively minor impact, only warranting notifications on title for any noise sensitive premises to the west of the 5 events N65 contour line shown in *Figure 3-3*. Suggested wording from SPP No. 5.1 is:

*This property is situated in the vicinity of Perth Airport and is currently affected, or may be affected in the future by aircraft noise. Noise exposure levels are likely to increase in the future as a result of an increase in aircraft using the airport, changes in aircraft type or other operational changes. Further information regarding noise insulation requirements for noise-affected property is available on request from the relevant local government offices.*

# Figure 4-3

Noise levels
$L_{Aeq(Day)}$ dB

| | |
|---|---|
| <= 55 | |
| <= 56 | Exposure A |
| <= 57 | |
| <= 58 | |
| <= 59 | Exposure B |
| <= 60 | |
| <= 61 | |
| <= 62 | |
| <= 63 | Exposure C |
| <= 64 | |
| <= 65 | |
| <= 66 | |
| > 66 | Exposure D |

SPP 5.4 (Sep 2019)

Signs and symbols
- Road
- Block of Buildings
- Residential Precinct

Length Scale 1:10000

0 50 100 200 300 400 m

Forrestdale North Residential Precinct -
Future (2041) $L_{Aeq(Day)}$ Noise Level Contours: Ground Level

**Road Traffic Noise: Roe Highway Widened to 6 Lanes / 100 km/hr and Open Graded Asphalt**

**SoundPLAN v8.2**
**CoRTN Algorithms**

1 July 2021

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# 5 ASSESSMENT

## 5.1 Road Traffic

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.

With reference to the predicted noise levels in *Figure 4-3*, it is evident the outdoor noise target will be exceeded. As such, the following is recommended:

- Noise wall to be constructed. Such a wall may be constructed by Main Roads WA or the developer as part of subdivision approval process and can be negotiated between the two parties. At this stage, the outcome of an indicative 5-metre high wall has been provided on *Figure 5-1*. Any noise wall is to be solid, free of gaps and of minimum surface mass 15 kg/$m^2$ (or approved equivalent).
- Where lots are still above the outdoor noise target (refer *Figure 5-1*), the following Packages (refer *Appendix A*) are required:
    - Package A where noise levels are between 56 dB and 58 dB $L_{Aeq(Day)}$;
    - Package B where noise levels are between 59 dB and 62 dB $L_{Aeq(Day)}$;
    - Package C where noise levels are between 63 dB and 66 dB $L_{Aeq(Day)}$;

      Alternative constructions from the deemed to satisfy packages may be acceptable if supported by a report 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 houses are to be double storey, the noise impacts extend further into the development due to less ground absorption and barrier attenuation. Noise contours for the first floor are provided in *Figure 5-2*. Where a double storey residence is constructed, the same packages described above are applicable.
- All affected lots are to have notifications on lot titles as per SPP 5.4 requirements – refer *Appendix A*.

As the project progresses through to subdivision the findings and recommendations will need to be reviewed in more detail.

## 5.2 Aircraft Noise

Noise from aircraft to the Residential Precinct is considered to be of minimal impact. Any noise sensitive premises located west of the 5 events N65 contour line shown on *Figure 3-3* are to incorporate notifications on lot title.

# Figure 5-1

Noise levels
$L_{Aeq(Day)}$ dB

| | |
|---|---|
| <= 55 | |
| <= 56 | Exposure A |
| <= 57 | |
| <= 58 | |
| <= 59 | Exposure B |
| <= 60 | |
| <= 61 | |
| <= 62 | |
| <= 63 | Exposure C |
| <= 64 | |
| <= 65 | |
| <= 66 | |
| > 66 | Exposure D |

SPP 5.4 (Sep 2019)

Signs and symbols

- Road
- Block of Buildings
- 5m High Wall
- Residential Precinct

Length Scale 1:10000

0 50 100 200 300 400 m

Forrestdale North Residential Precinct -
Future (2041) $L_{Aeq(Day)}$ Noise Level Contours: Ground Level
Includes 5m High Noise Walls

**Road Traffic Noise: Roe Highway Widened to 6 Lanes / 100 km/hr and Open Graded Asphalt**

**SoundPLAN v8.2**
**CoRTN Algorithms**

1 July 2021

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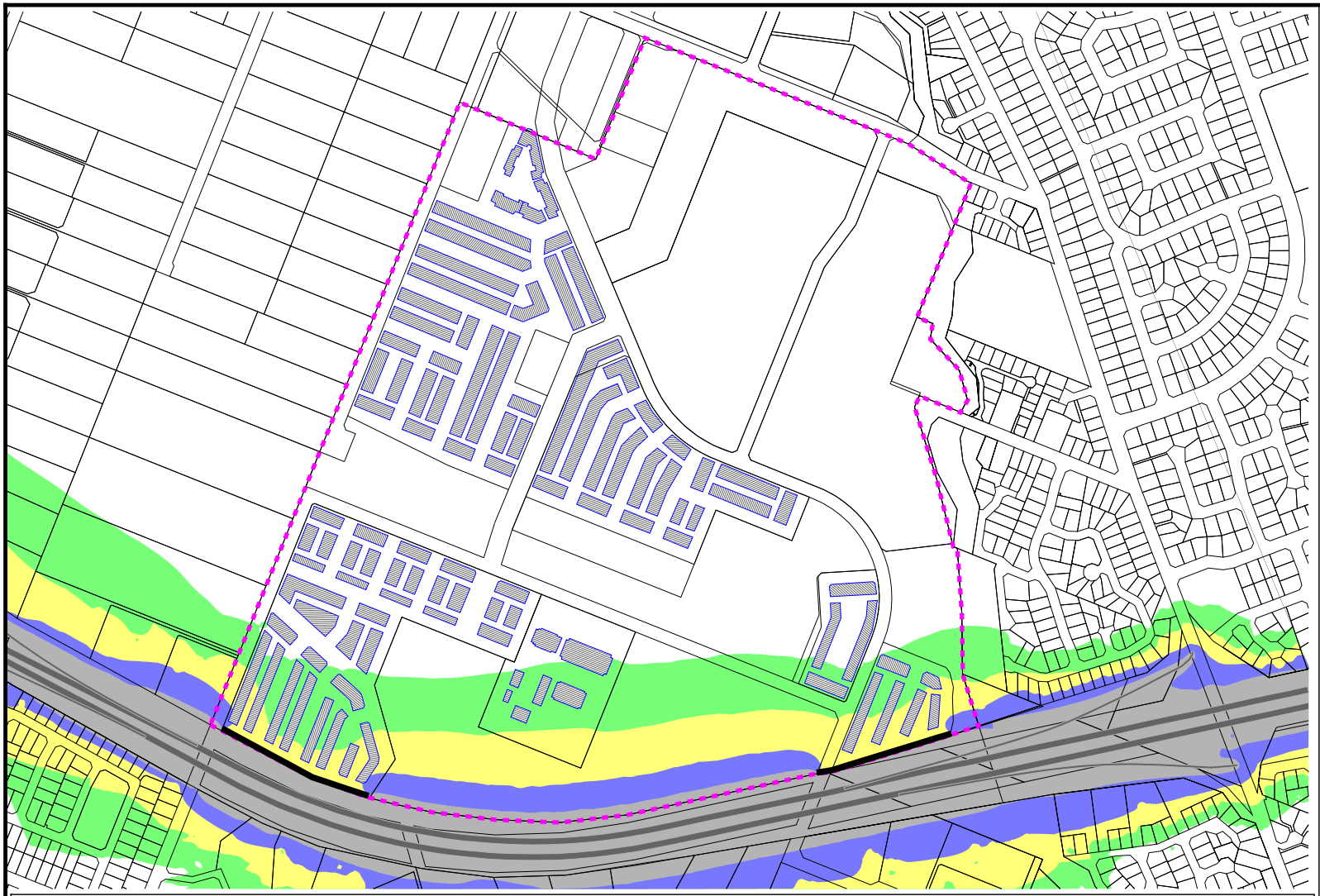
# Figure 5-2



Noise levels
$L_{Aeq(Day)}$ dB

| | |
|---|---|
| <= 55 | |
| <= 56 | Exposure A |
| <= 57 | |
| <= 58 | |
| <= 59 | Exposure B |
| <= 60 | |
| <= 61 | |
| <= 62 | |
| <= 63 | Exposure C |
| <= 64 | |
| <= 65 | |
| <= 66 | |
| > 66 | Exposure D |

SPP 5.4 (Sep 2019)

Signs and symbols
- Road
- Block of Buildings
- 5m High Wall
- Residential Precinct

Length Scale 1:10000

0 50 100 200 300 400 m

Forrestdale North Residential Precinct -
Future (2041) $L_{Aeq(Day)}$ Noise Level Contours: First Floor Level
Includes 5m High Noise Walls

**Road Traffic Noise: Roe Highway Widened to 6 Lanes / 100 km/hr and Open Graded Asphalt**

**SoundPLAN v8.2**
**CoRTN Algorithms**

1 July 2021

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**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.

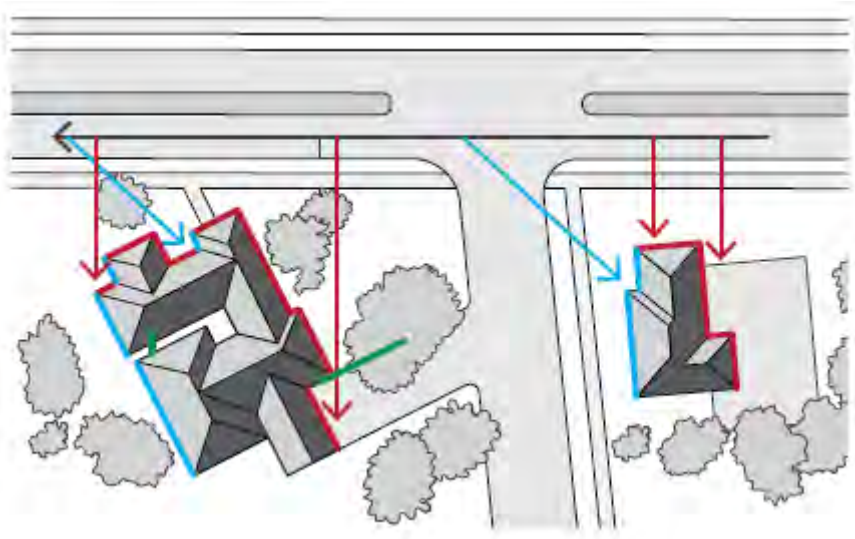
The quiet house packages are not the only solution to achieving acceptable internal transport noise levels. A suitably qualified acoustical engineer or consultant may also determine more tailored acoustic design requirements for buildings in a transport noise corridor by carrying out acoustic design 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 ($R_w + C_{tr} \geq 28$):<br>o Sliding or double hung with minimum 10mm single or 6mm-12mm-10mm double insulated glazing;<br>o Sealed awning or casement windows with minimum 6mm glass.<br>• Up to 60% floor area ($R_w + C_{tr} \geq 31$):<br>o Sealed awning or casement windows with minimum 6mm glass. | • Up to 40% floor area ($R_w + C_{tr} \geq 25$):<br>o Sliding or double hung with minimum 6mm single or 6mm-12mm-6mm double insulated glazing;<br>• Up to 60% floor area ($R_w + C_{tr} \geq 28$);<br>• 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 $R_w + C_{tr} \geq 25$:<br>o 35mm Solid timber core hinged door and frame system certified to $R_w$ 28 including seals;<br>o 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 | • $R_w + C_{tr} \geq 45$:<br>o Two leaves of 90mm thick clay brick masonry with minimum 20mm cavity; or<br>o Single leaf of 150mm brick masonry with 13mm cement render on each face; or<br>o One row of 92mm studs at 600mm centres with:<br>▪ Resilient steel channels fixed to the outside of the studs; and<br>▪ 9.5mm hardboard or fibre cement sheeting or 11mm fibre cement weatherboards fixed to the outside;<br>▪ 75mm thick mineral wool insulation with a density of at least 11kgkg/$m^3$; and<br>▪ 2 x 16mm fire-rated plasterboard to inside. | |
| Roofs and Ceilings | All | • $R_w + C_{tr} \geq 35$:<br>o 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 ($R_w + C_{tr} \geq 31$):<br>o Fixed sash, awning or casement with minimum 6mm glass or 6mm-12mm-6mm double insulated glazing.<br>• Up to 60% floor area ($R_w + C_{tr} \geq 34$):<br>o Fixed sash, awning or casement with minimum 10mm glass or 6mm-12mm-10mm double insulated glazing. | • Up to 40% floor area ($R_w + C_{tr} \geq 28$):<br>o Sliding or double hung with 6mm-12mm-10mm double insulated glazing;<br>o Sealed awning or casement windows with minimum 6mm glass.<br>• Up to 60% floor area ($R_w + C_{tr} \geq 31$);<br>• 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 $R_w + C_{tr} \geq 28$:<br>o 40mm Solid timber core hinged door and frame system certified to $R_w$ 32 including seals;<br>o 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 | • $R_w + C_{tr} \geq 50$:<br>o 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.<br>o Two leaves of 110mm clay brick masonry with minimum 50mm cavity between leaves and 25mm glasswool or polyester insulation (24kg/$m^3$).<br>o Single leaf of 220mm brick masonry with 13mm cement render on each face.<br>o 150mm thick unlined concrete panel or 200mm thick concrete panel with one layer of 13mm plasterboard or 13mm cement render on each face.<br>o Single leaf of 90mm clay brick masonry with:<br>▪ A row of 70mm x 35mm timber studs or 64mm steel studs at 600mm centres;<br>▪ A cavity of 25mm between leaves;<br>▪ 50mm glasswool or polyester insulation (11kg/$m^3$) between studs; and<br>▪ One layer of 10mm plasterboard fixed to the inside face. | |
| Roofs and Ceilings | All | • $R_w + C_{tr} \geq 35$:<br>o 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 ($R_w + C_{tr} \geq 31$):<br>o Fixed sash, awning or casement with minimum 6mm glass or 6mm-12mm-6mm double insulated glazing.<br>• Up to 40% floor area ($R_w + C_{tr} \geq 34$):<br>o Fixed sash, awning or casement with minimum 10mm glass or 6mm-12mm-10mm double insulated glazing. | • Up to 40% floor area ($R_w + C_{tr} \geq 31$):<br>o Fixed sash, awning or casement with minimum 6mm glass or 6mm-12mm-6mm double insulated glazing.<br>• Up to 60% floor area ($R_w + C_{tr} \geq 34$):<br>o 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 $R_w + C_{tr} \geq 30$:<br>o Fully glazed hinged door with certified $R_w + C_{tr} \geq 31$ rated door and frame including seals and 10mm glass;<br>o 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 | • $R_w + C_{tr} \geq 50$:<br>o 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.<br>o Two leaves of 110mm clay brick masonry with minimum 50mm cavity between leaves and 25mm glasswool or polyester insulation (24kg/$m^3$).<br>o Single leaf of 220mm brick masonry with 13mm cement render on each face.<br>o 150mm thick unlined concrete panel or 200mm thick concrete panel with one layer of 13mm plasterboard or 13mm cement render on each face.<br>o Single leaf of 90mm clay brick masonry with:<br>▪ A row of 70mm x 35mm timber studs or 64mm steel studs at 600mm centres;<br>▪ A cavity of 25mm between leaves;<br>▪ 50mm glasswool or polyester insulation (11kg/$m^3$) between studs; and<br>▪ One layer of 10mm plasterboard fixed to the inside face. | |
| Roofs and Ceilings | All | • $R_w + C_{tr} \geq 40$:<br>o Concrete or terracotta tile roof with sarking, or metal sheet roof with foil backed R2.0+ fibrous insulation between steel sheeting and roof battens;<br>o R3.0+ insulation batts above ceiling;<br>o 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.

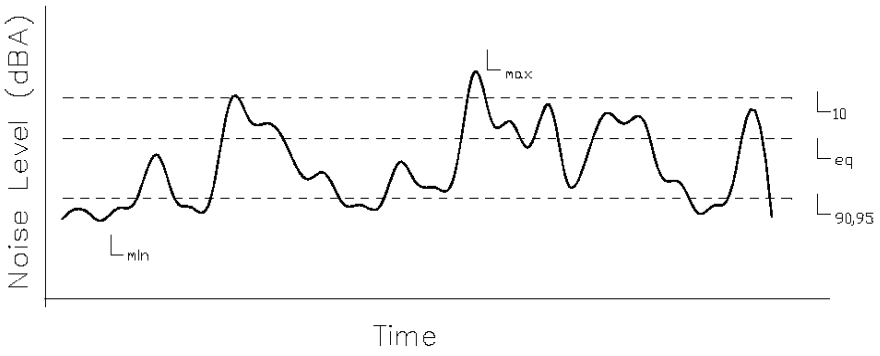
$R_w$

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.

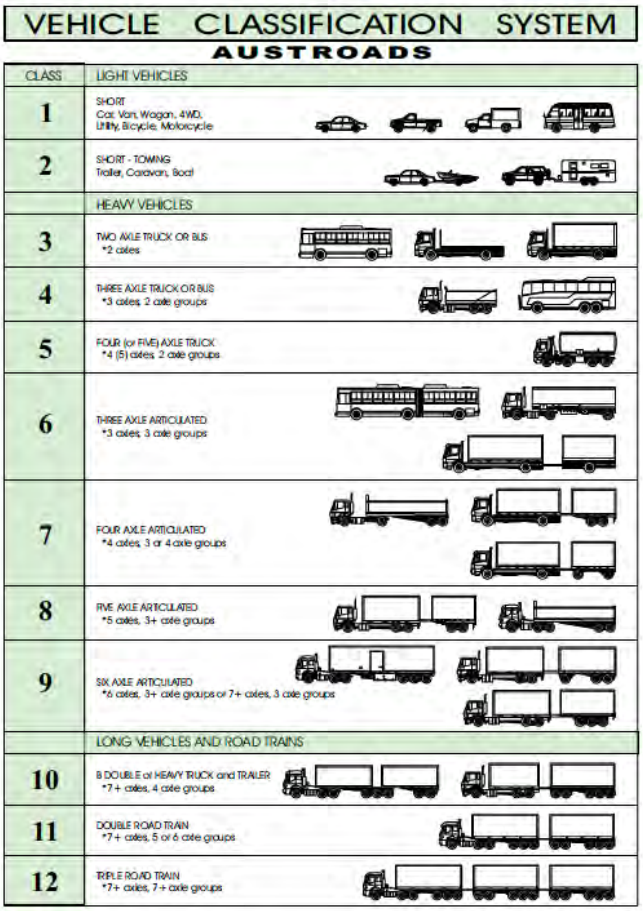
$C_{tr}$

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***