Transportation Noise Assessment

Lots 23, 24 & 336 Anstey Road and Lots 3, 5 & 61 Armadale Road

Reference: 18074510-01.docx

Prepared for:
Emerge Associates
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1 INTRODUCTION

This report has been prepared to assist with the Local Structure Plan (LSP) for Lots 23, 24 & 336 Anstey Road and Lots 3, 5 & 61 Armadale Road as shown in Figures 1-1 & 1-2. Armadale Road to the south is a major road and as such, this report considers the potential noise mitigation options to the newly proposed residences.
2 CRITERIA

The criteria relevant to this assessment is the *State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning* (hereafter referred to as SPP 5.4) produced by the Western Australian Planning Commission (WAPC). The objectives in SPP 5.4 are to:

- Protect people from unreasonable levels of transport noise by establishing a standardised set of criteria to be used in the assessment of proposals;
- Protect major transport corridors and freight operations from incompatible urban encroachment;
- Encourage best practice design and construction standards for new development proposals and new or redevelopment transport infrastructure proposals;
- Facilitate the development and operation of an efficient freight network; and
- Facilitate the strategic co-location of freight handling facilities.

SPP 5.4’s outdoor noise criteria are shown below in *Table 2-1*. These criteria apply at any point 1-metre from a habitable façade of a noise sensitive premises and in one outdoor living area.

<table>
<thead>
<tr>
<th>Period</th>
<th>Target</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day (6am to 10pm)</td>
<td>55 dB $L_{Aeq(Day)}$</td>
<td>60 dB $L_{Aeq(Day)}$</td>
</tr>
<tr>
<td>Night (10pm to 6am)</td>
<td>50 dB $L_{Aeq(Night)}$</td>
<td>55 dB $L_{Aeq(Night)}$</td>
</tr>
</tbody>
</table>

Note: The 5 dB difference between the target and limit is referred to as the margin.

In the application of these outdoor noise criteria to new noise sensitive developments, the objectives of SPP 5.4 is to achieve -

- acceptable indoor noise levels in noise-sensitive areas (e.g. bedrooms and living rooms of houses); and
- a ‘reasonable’ degree of acoustic amenity in at least one outdoor living area on each residential lot.

If a noise sensitive development takes place in an area where outdoor noise levels will meet the target, no further measures are required under SPP 5.4.

In areas where the target is exceeded, customised noise mitigation measures should be implemented with a view to achieving the target in at least one outdoor living area on each residential lot, or if this is not practicable, within the margin. Where indoor spaces are planned to be facing outdoor areas that are above the target, mitigation measures should be implemented to achieve acceptable indoor noise levels in those spaces.

For residential buildings, “acceptable indoor noise levels” are taken to be 40 dB $L_{Aeq(Day)}$ in living areas and 35 dB $L_{Aeq(Night)}$ in bedrooms.
3 METHODOLOGY

Lloyd George Acoustics worked with Main Roads WA on the Armadale Road Duplication Project, between Tapper Road and Anstey Road. Main Roads WA was contacted for permission to use the noise monitoring and road design information from that project for this proposed LSP and this was granted, with the information described below.

3.1 Site Measurements

For the Armadale Road Duplication Project, noise monitoring was undertaken at eight (8) locations, with the relevant location for this LSP being at 759 Armadale Road in Forrestdale (refer Figures 3-1 & 3-2). The purpose of the monitoring is 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 instrument used was an ARL Type 316 noise data logger, located approximately 40 metres from the edge of the existing Armadale Road, with the microphone 1.4 metres above ground level. The logger was programmed to record hourly $L_{A1}$, $L_{A10}$, $L_{A90}$, and $L_{Aeq}$ levels. This instrument complies with the instrumentation requirements of Australian Standard 2702-1984 Acoustics – Methods for the Measurement of Road Traffic Noise. The logger was 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.

The noise data collected was verified by inspection and professional judgement. Where hourly data was considered atypical, an estimated value was inserted.
3.2 Noise Modelling

The computer programme *SoundPLAN 7.4* 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 corrections are applied to the exhaust of –8.0 dB (based on Transportation Noise Reference Book, Paul Nelson, 1987) and to the engine source of –0.8 dB, so as to provide consistent results with the CoRTN algorithms for the no barrier scenario;

- An adjustment of –1.7 dB has been applied to the predicted levels 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 1982.

Predictions are made at heights of 1.5 metres above ground floor level and at 1.0 metre from an assumed building façade (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 below.

### 3.2.1 Ground Topography & Road Design

Topographical data was provided by Main Roads WA, with the contours being in 0.5 metre intervals. The new road design has been integrated into the existing topography. The existing topography for the subject site was updated from survey information provided for this LSP.

Buildings have 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. All buildings are assumed to have a height of 4.0 metres.

Finished lot levels were not available at the time of this study, however the bulk earthworks design was provided by JDSi so that future houses and fences/walls are incorporated based on these ground levels. When the finished lot levels are designed, it is recommended this assessment be updated.

The above are combined to create a 3D noise model as shown in *Figure 3-3*. 
3.2.2 Traffic Data

Traffic data includes:

- Road Surface – The noise relationship between different road surface types is shown below in Table 3-1.

<table>
<thead>
<tr>
<th>Road Surfaces</th>
<th>Chip Seal</th>
<th>Asphalt</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>14mm</td>
<td>10mm</td>
</tr>
<tr>
<td></td>
<td>+3.5 dB</td>
<td>+2.5 dB</td>
</tr>
</tbody>
</table>

The existing road surface is assumed to be a worn chip seal. Main Roads WA advised the future road surface is to be stone mastic asphalt.

- Vehicle Speed – The existing and future posted speeds are 80km/hr.

- Traffic Volumes – Information used in the modelling for the project was provided by Main Roads WA and are shown in Figures 3-4 and 3-5. It is assumed that the percentage of heavy vehicles for future traffic volumes will be the same as those for the existing traffic volumes.
3.2.3 Ground Attenuation

The ground attenuation has been assumed to be 0.0 (0%) for the roads, 0.7 (70%) generally elsewhere and 0.5 (50%) throughout the proposed subdivision, except for the POS at 1.0 (100%). Note 0.0 represents hard reflective surfaces such as water and 1.00 represents absorptive surfaces such as grass. This is considered to be a reasonable approach for assessment.

3.2.4 Parameter Conversion

The CoRTN algorithms used in the SoundPlan modelling package were originally developed to calculate the $L_{A10,18\text{hour}}$ noise level. The WAPC Policy 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.
4 RESULTS

4.1 Noise Monitoring

The results of the noise monitoring are summarised below in Table 4-1 and shown graphically in Figure 4-1.

Table 4-1 Measured Average Noise Levels - 759 Armadale Road

<table>
<thead>
<tr>
<th>Date</th>
<th>Average Weekday Noise Level, dB</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( L_{A10,18 hour} )</td>
</tr>
<tr>
<td>21 February 2017</td>
<td>68.2</td>
</tr>
<tr>
<td>22 February 2017</td>
<td>67.1</td>
</tr>
<tr>
<td>23 February 2017</td>
<td>66.7</td>
</tr>
<tr>
<td>24 February 2017</td>
<td>66.6</td>
</tr>
<tr>
<td>27 February 2017</td>
<td>66.6</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>67.0</strong></td>
</tr>
</tbody>
</table>

Figure 4-1 Noise Monitoring Results: Pre-Construction Armadale Road Duplication Project at 759 Armadale Road
The average differences between the weekday $L_{10,18\text{hour}}$ and $L_{\text{eq}(\text{Day})}$ is 2.7 dB and this conversion has been used in the modelling. The average differences between the weekday $L_{\text{eq}(\text{Day})}$ and $L_{\text{eq}(\text{Night})}$ is 4.4 dB. As traffic volumes increase, the difference between the day and night noise levels is expected to approach 5 dB as most of the increase will occur during the day. This assumption is supported by the other monitoring for this duplication project, where the day to night differences tended to increase towards the western end of the project where existing traffic volumes are higher. As such, the daytime noise levels are used for assessment purposes throughout this report.

### 4.2 Noise Modelling

The noise modelling for the Armadale Road Duplication Project applied a -1.2 dB calibration factor, which results in an accuracy in the area of the LSP of 0.2 dB.

The future noise contours across the site, assuming no new development, are provided in Figure 4-2. As houses are constructed, the extent of the noise contours will not be as significant due to the barrier attenuation provided by these future dwellings. Figure 4-3 shows the noise contours with the future dwellings in place and a standard residential boundary fence. These results are also provided for the nearest residences in tabular format in Table 4-2.

<table>
<thead>
<tr>
<th>Receiver No.</th>
<th>$L_{\text{eq}(\text{Day})}$, dB</th>
<th>Receiver No.</th>
<th>$L_{\text{eq}(\text{Day})}$, dB</th>
<th>Receiver No.</th>
<th>$L_{\text{eq}(\text{Day})}$, dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>56</td>
<td>09</td>
<td>67</td>
<td>17</td>
<td>67</td>
</tr>
<tr>
<td>02</td>
<td>57</td>
<td>10</td>
<td>67</td>
<td>18</td>
<td>66</td>
</tr>
<tr>
<td>03</td>
<td>58</td>
<td>11</td>
<td>68</td>
<td>19</td>
<td>63</td>
</tr>
<tr>
<td>04</td>
<td>59</td>
<td>12</td>
<td>67</td>
<td>20</td>
<td>62</td>
</tr>
<tr>
<td>05</td>
<td>67</td>
<td>13</td>
<td>67</td>
<td>21</td>
<td>60</td>
</tr>
<tr>
<td>06</td>
<td>67</td>
<td>14</td>
<td>67</td>
<td>22</td>
<td>59</td>
</tr>
<tr>
<td>07</td>
<td>67</td>
<td>15</td>
<td>67</td>
<td>23</td>
<td>58</td>
</tr>
<tr>
<td>08</td>
<td>67</td>
<td>16</td>
<td>67</td>
<td>24</td>
<td>57</td>
</tr>
</tbody>
</table>

|                |                               | 25           | 56                            |

It can be seen that predicted noise levels will be above the target at some residences and therefore noise control is required to comply with SPP 5.4.
Local Structure Plan
Lots 23, 24 & 336 Anstey Road and Lots 3, 5 & 61 Armadale Road

LAeq(Day) Noise Level Contours Based on Future Traffic Volumes
Stone Mastic Asphalt Road Surface / 80km/hr

SoundPlan v7.4
CoRTN Algorithms

Figure 4-2
Local Structure Plan
Lots 23, 24 & 336 Anstey Road and Lots 3, 5 & 61 Armadale Road

LAeq(Day) Noise Level Contours Based on Future Traffic Volumes
Stone Mastic Asphalt Road Surface / 80km/hr
Includes Proposed Structure Plan Houses and Standard Fence

SoundPlan v7.4
CoRTN Algorithms

14 September 2018

Figure 4-3

Scales and symbols
- Study Area
- Future House
- Standard Fence

Noise levels
LAeq, Day dB

- = 55
- = 56
- = 57
- = 58
- = 59
- = 60
- = 61
- = 62
- = 63
- = 64
- = 65
5 ASSESSMENT

The objectives of the criteria are for noise at all houses to be no more than the limit and preferably no more than the target. Where the target is achieved, no further controls are required. Where the target is exceeded, further controls are necessary.

Achieving the target at all proposed residences is not considered practicable. Where residences will be backing onto Armadale Road, their outdoor living space will likely be on the side of the house facing Armadale Road. As such, a noise wall will be required so that noise levels in the rear yard will be within the margin and compliant with SPP 5.4 objectives.

Figure 5-1 shows the indicative noise wall requirements, as well as the noise contours with such a wall in place. Figure 5-2 then shows the indicative noise mitigation requirements for the project. Note that these are considered indicative only at this stage, since the finished lot levels and subdivision design are required to define more accurately.

Where a proposed residence is shown to require “Package A”, this is the architectural treatment package provided in Appendix A, taken from SPP 5.4 Guidelines. As well as the architectural upgrades, these lots will also require a notification on title as per SPP 5.4 and again provided in Appendix A.

Alternatives to the Appendix A constructions are acceptable if supported by a report undertaken by a suitably qualified acoustical consultant, being a member firm of the Association of Australasian Acoustical Consultants (AAAC). Where an affected residence is proposed to be of multi-storey construction, this residence must be supported by such a report as the upper floor may require higher levels of acoustic performance and construction.
Local Structure Plan
Lots 23, 24 & 336 Anstey Road and Lots 3, 5 & 61 Armadale Road

LAeq(Day) Noise Level Contours Based on Future Traffic Volumes
Stone Mastic Asphalt Road Surface / 80km/hr
Includes Proposed Structure Plan Houses and Noise Wall (Heights Read from Left to Right)

SoundPlan v7.4
CoRTN Algorithms

14 September 2018

Figure 5-1
Local Structure Plan
Lots 23, 24 & 336 Anstey Road and Lots 3, 5 & 61 Armadale Road

Indicative Noise Mitigation - Wall heights (read from left to right) are relative to finished lot level.

SoundPlan v7.4
CoRTN Algorithms

Figure 5-2
6 CONCLUSION

This report shows that it will be practicable for the proposed Local Structure Plan to satisfy the requirements of the State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning. The indicative noise control requirements consist of:

- Indicative noise wall height to be as shown in Figure 5-2. The wall is to be solid, free of gaps and of a material having a minimum surface mass of 15kg/m²;

- Dwellings indicated on Figure 5-2 to incorporate Package A architectural treatments and notifications on lot title. Alternative treatment to the deemed to satisfy can be accepted if supported by a report by a suitably qualified acoustical engineer (member firm of the Association of Australasian Acoustical Consultants);

- Where an affected lot is to be of double storey construction, specialist advice must be sought since the upper level will not receive the same level of attenuation provided by walls or other dwellings.

The noise mitigation requirements are to be finalised once the subdivision design is complete along with finished lot levels.
Appendix A

ACCEPTABLE TREATMENT PACKAGES
The packages and information provided on the following pages are taken from *Implementation Guidelines for State Planning Policy 5.4 Road and Rail Transport Noise and freight Considerations in Land Use Planning*; December 2014.

Where outdoor noise levels are above the *target* level, excluding the effect of any boundary fences, the Guidelines propose acceptable treatment packages that may be implemented without requiring detailed review. The packages are also intended for residential development only. At higher noise levels or for other building usages, specialist acoustic advice will be needed.

The acceptable treatment packages are intended to simplify compliance with the noise criteria, and the relevant package should be required as a condition of development in lieu of a detailed assessment.

Transition between each package should be made on the basis of the highest incident $L_{Aeq}(Day)$ or $L_{Aeq}(Night)$ value to the nearest whole number determined for the building development under assessment.

Any departures from the acceptable treatment specifications need to be supported by professional advice from a competent person that the proposal will achieve the requirements of the Policy.

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

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

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

- **Opposite** to transport corridor: Neither ‘side on’ nor ‘facing’, as defined above.
### Lloyd George Acoustics

#### Package A

<table>
<thead>
<tr>
<th>Area</th>
<th>Orientation to Road or Rail Corridor</th>
<th>Package A (up to 60 dB $L_{Aeq(Day)}$ and 55 dB $L_{Aeq(Night)}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bedrooms</td>
<td>Facing</td>
<td>• Windows systems: Glazing up to 40% of floor area (minimum $R_w + C_{tr}$ 28) – 6mm thick glass (monolithic, toughened or laminated) in fixed sash, awning or casement opening with seals to openings.</td>
</tr>
<tr>
<td></td>
<td>Side</td>
<td>• Windows systems: As above.</td>
</tr>
<tr>
<td></td>
<td>Opposite</td>
<td>No requirements</td>
</tr>
<tr>
<td>Other Habitable Rooms Including Kitchens</td>
<td>Facing</td>
<td>• Windows and external door systems: Glazing up to 60% of floor area (minimum $R_w + C_{tr}$ 28) – 6mm thick glass (monolithic, toughened or laminated) in fixed sash, awning or casement opening with seals to openings. Doors to be either 35mm thick solid timber core door with full perimeter acoustic seals. Glazed inserts to match the above. Sliding glass doors to be same performance including brush seals.</td>
</tr>
<tr>
<td></td>
<td>Side</td>
<td>• Windows and external door systems: As above.</td>
</tr>
<tr>
<td></td>
<td>Opposite</td>
<td>No requirements</td>
</tr>
<tr>
<td>General</td>
<td>Any</td>
<td>• Walls (minimum $R_w + C_{tr}$ 45) – Two leaves of 90mm thick brick with minimum 50mm cavity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Roof and ceiling (minimum $R_w + C_{tr}$ 35) – Standard roof construction with 10mm plasterboard ceiling and minimum R2.5 insulation between ceiling joists.</td>
</tr>
<tr>
<td>Outdoor Living Area</td>
<td></td>
<td>• Eaves to be closed using 4mm compressed fibre cement sheet.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Mechanical ventilation – Refer following pages.</td>
</tr>
</tbody>
</table>

Note: Any penetrations in a part of the building envelope must be acoustically treated so as to not downgrade the performance of the building elements affected. Most penetrations in external walls such as pipes, cables or ducts can be sealed through caulking gaps with non-hardening mastic or suitable mortar.
Mechanical Ventilation requirements

It is noted that natural ventilation must be provided in accordance with F4.6 and F4.7 of Volume One and 3.8.5.2 of Volume Two of the National Construction Code. Where the noise limit is likely to be exceeded, a mechanical ventilation system is usually required. Mechanical ventilation systems will need to comply with AS 1668.2 – The use of mechanical ventilation and air-conditioning in buildings.

In implementing the acceptable treatment packages, the following must be observed:

- Evaporative air conditioning systems will meet the requirements for Packages A and B provided attenuated air vents are provided in the ceiling space and designed so that windows do not need to be opened.
- Refrigerant based air conditioning systems need to be designed to achieve fresh air ventilation requirements.
- External openings (e.g. air inlets, vents) need to be positioned facing away from the transport corridor where practicable.
- Ductwork needs to be provided with adequate silencing to prevent noise intrusion.

Notification

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

The area of land for which notification is required should be identified in the noise management plan and contain a description of major noise sources nearby (e.g. 24-hour freight rail).

Notification should be provided to prospective purchasers, and required as a condition of subdivision (including strata subdivision) for the purposes of noise sensitive development or planning approval involving noise sensitive development, where external noise levels are forecast or estimated to exceed the ‘target’ criteria as defined by the Policy.

In the case of subdivision and development, conditions of approval should include a requirement for registration of a notice on title, which is provided for under Section 165 of the Planning and Development Act 2005 and Section 70A of the Transfer of Land Act 1893. An example of a suitable notice is:

Notice: This lot is situated in the vicinity of a transport corridor and is currently affected, or may in the future be affected, by transport noise. Transportation noise controls and Quiet House design strategies at potential cost to the owner may be required to achieve an acceptable level of noise reduction. Further information is available on request from the relevant local government offices.
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.

$L_{A10,18}^{10,18 hour}$
The $L_{A10,18}^{10,18 hour}$ 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.

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

$L_{Aeq,8}^{8 hour} / L_{Aeq}^{(Night)}$
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.

$L_{Aeq,16}^{16 hour} / L_{Aeq}^{(Day)}$
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 $L_{A10,18}^{10,18 hour}$.

$R_w$
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.
**Csr**
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.

**Satisfactory Design Sound Level**
The level of noise that has been found to be acceptable by most people for the environment in question and also to be not intrusive.

**Maximum Design Sound Level**
The level of noise above which most people occupying the space start to become dissatisfied with the level of noise.

**Chart of Noise Level Descriptors**

![Noise Level Chart](chart.png)

**Austroads Vehicle Class**

![Austroads Vehicle Classification System](classification.png)
Typical Noise Levels

- **Threshold of Hearing**
- **Forest Background**
- **Open-Plan Office**
- **Normal Conversation**
- **Busy Road**
- **Factory Floor**
- **Rock Band**

Sound Pressure Levels (dBA)