Implementation Guidelines for State Planning Policy 5.4

Road and Rail Transport Noise and Freight Considerations in Land Use Planning

The information provided in these Guidelines is designed to be general in nature and does not take into account every possible scenario.

December 2014
About this document

These Guidelines are designed to assist with the implementation of the Western Australian Planning Commission's State Planning Policy 5.4, also referred to in this document as 'SPP5.4' or the 'Policy'.

Acknowledgements

These guidelines have been produced following a consultation process with various government and private organisations.

Specifically we thank the following organisations for their input:

- Department of Environment Regulation
- Western Australia Local Government Association (WALGA)
- Public Transport Authority
- Main Roads Western Australia
- Freight Logistics Council of Western Australia
- Chartered Institute of Logistics and Transport Australia
- Urban Development Institute of Australia
- Department of Transport (WA)
- Brookfield Rail
- Australian Acoustical Society
- Association of Australian Acoustical Consultants
- Royal Automobile Club of Western Australia
## Implementation Guidelines for State Planning Policy 5.4
Road and Rail Transport Noise and Freight Considerations in Land Use Planning

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1 Preamble

These Guidelines assist with the implementation of State Planning Policy 5.4 – Road and Rail Transport Noise and Freight Considerations in Land Use Planning, providing supporting information on identifying, assessing and managing transportation noise impacts.

It is intended for use by planners and proponents of future proposals where transport infrastructure and noise-sensitive development are in close proximity.

The current version of this Policy is available from the Planning WA website.

1.1 Aims of the Policy

The Policy aims to promote a system in which sustainable land use and transport are mutually compatible. It was first gazetted in September 2009.

The Policy’s objectives include protecting people from unreasonable noise impacts; protecting major transport corridors from urban encroachment; and encouraging best practice design and construction standards.

1.2 Limitations

It is important to note that the Policy was enacted under the Planning and Development Act 2005, which means that the Policy:

- does not have jurisdiction or power to control transport noise at its source; and
- does not have retrospective powers over existing transport infrastructure or existing urban development.

Despite this, the noise targets promoted by the Policy can be referenced in other jurisdictions and through goodwill shown by infrastructure operators and property developers.

Refer to Section 3.1 for further information on where it can be specifically applied.
2 Getting Started

2.1 How to use this document

This document is structured as follows:

Section 3 provides a summary of key concepts of the Policy and Guidelines.

Section 4 discusses options for mitigating road and rail noise outside an individual lot boundary during planning stages. Appendix A also includes a quick guide for planners.

Section 5 discusses aspects relevant to transport infrastructure developers.

Section 6 discusses individual lot and building design options. A quick guide for developers is provided in Appendix B.

Section 7 outlines specific requirements for detailed noise assessments. Appendix C provides technical information for field measurements.

Section 8 provides further information on design standards and other references.

2.2 Understanding noise

Sound may be simply described as what we hear. Noise is unwanted sound, and the literature shows it carries a variety of negative health effects.

Road vehicle noise sources typically include engine exhausts (and truck engine braking), vehicle aerodynamics (flow turbulence) and the interaction between wheel and road or track.

Rail noise generally includes these factors plus safety horns, interaction/shunting between cars and wheel squealing on tight curves.

The World Health Organisation (WHO) in the Night Noise Guidelines for Europe of 2009 considers that there is 'sufficient evidence' that road and rail transport noise can adversely affect community health and amenity. Research indicates noise increases the risk of adverse physiological and psychological outcomes, including:

- increased incidence of stroke;
- effects on pregnancy outcomes such as reduced birth weight and size in newborns;
- children’s learning in schools, such as retardation of reading age; and
- sleep patterns (direct health effects are still under research).

Environmental noise also affects the amenity of an area, including activities such as reading, watching TV, studying and enjoyment of outdoor areas.

Figure 1 shows a range of typical noise levels.

<table>
<thead>
<tr>
<th>LAeq (dB re 20μPa)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>120</td>
<td>Jet aircraft takeoff at runway edge</td>
</tr>
<tr>
<td>110</td>
<td>Rock concert</td>
</tr>
<tr>
<td>100</td>
<td>225mm angle grinder at 1 metre</td>
</tr>
<tr>
<td>90</td>
<td>Heavy industrial factory interior</td>
</tr>
<tr>
<td>80</td>
<td>Shouting at 1 metre</td>
</tr>
<tr>
<td>70</td>
<td>Freeway at 20 metres</td>
</tr>
<tr>
<td>60</td>
<td>Normal conversation at 1 metre</td>
</tr>
<tr>
<td>50</td>
<td>Night time Outdoor Noise Target</td>
</tr>
<tr>
<td>40</td>
<td>Office airconditioning</td>
</tr>
<tr>
<td>30</td>
<td>Typical bedroom design target</td>
</tr>
<tr>
<td>20</td>
<td>Whisper, rural bedroom at night</td>
</tr>
<tr>
<td>10</td>
<td>Human breathing at 3 metres</td>
</tr>
<tr>
<td>0</td>
<td>Threshold of typical hearing</td>
</tr>
</tbody>
</table>

Refer to Section 8.1 for further details regarding the units of noise used in the Policy.
3 Applying the Policy

This section broadly discusses key concepts of the Policy and Guidelines.

3.1 Where the Policy applies

The Policy applies to development of new noise-sensitive land uses and future major road and rail transport infrastructure projects in close proximity to each other.

**Urban primary distributors and freight roads**

For roads, this includes:

- interstate and national highways;
- urban primary distributors;
- roads forecasted in the next 20 years to carry more than
  - 5,000 vehicles per day in rural areas; or
  - 20,000 vehicles per day in metropolitan areas; and
- primary freight roads.

Proponents should refer to the Metropolitan Region Scheme, Peel Region Scheme and Greater Bunbury Region Scheme maps for the urban primary distributors’ network. This network is made up of roads called Primary Regional Roads and Other Regional Roads.

Outside the Region Schemes, the Policy applies to roads declared as a Main Road under the Main Roads Act.

The Policy also applies to major redevelopments of existing major roads (defined in Section 5.2.2 of the Policy).

The Department of Transport outlines the extent of Primary freight roads.

**Railways and intermodal facilities**

For railways, the Policy must be applied to new passenger and freight infrastructure projects; to major redevelopments of railways; and to “minor redevelopments that are likely to adversely affect a noise sensitive land use”. Section 5.1 provides a more detailed description of these aspects.

Section 5.2.4 of the Policy also applies to new freight handling facilities.

**Forecasting daily road traffic**

The Policy forecast design period is estimated between 15 and 20 years. The Policy is to be applied to development sites with currently low traffic volumes where it reasonable to expect that traffic volume above these thresholds may happen in the next 20 years (such as the metropolitan fringe areas).

For this reason, significant structure plans and subdivision plans should have an accompanying traffic impact assessment report to forecast changes in traffic volumes. Alternatively, forecast daily traffic volumes may be obtained from Main Roads WA. The referral authority will assess the validity of forecast traffic volumes.

SPP5.4 can also be applied at the discretion of the Western Australian Planning Commission (WAPC) or local government to other roads which have the potential to significantly impact on people by exceeding a ‘critical’ level of noise referred to in Section 5.2.1 of the Policy. Determining if a noise-sensitive land use is likely to be adversely impacted is covered in Sections 3.2 and 4.2 of these Guidelines.

**Where it does not have jurisdiction**

The Policy does not apply:

- retrospectively to noise from existing railways or roads in the vicinity of existing noise sensitive land uses;
- to proposals involving an increase in traffic along an existing railway or road in the absence of a major land use redevelopment;
- to aircraft or watercraft noise impacts;
- to safety warning devices installed on road or rail vehicles and infrastructures;
- to fixed sources of noise; or
- to ground vibration.
3.2 Criteria

Outdoor noise criteria are presented in Section 5.3 of the Policy for day (6am to 10pm) and night (10pm to 6am) periods.

The criteria are defined in terms of a ‘noise target’ and a ‘noise limit’. They are considered differently depending on whether the proposal is for transport infrastructure or a noise sensitive development.

**Noise target**

The noise target is used to determine the level of further investigation required under the Policy.

- Any design proposal should first be assessed in terms for comparison against the target.
- If outdoor noise levels on all locations on a noise-sensitive development are equal to or less than the noise target, no further measures are necessary. Note that individual sensitivities vary and some people may still be affected to noise levels equal to or less than the target.
- Transport infrastructure providers and developers must consider implementing design measures to meet the target.
- A ‘critical’ level of noise referred to in Section 5.2.1 of the Policy may be considered equivalent to the target.

**Noise limit**

The noise limit is the value which should trigger a detailed assessment of a noise-sensitive development and infrastructure proposal.

- If the noise limit is likely to be exceeded at any outdoor location on a site where noise sensitive development is to occur, then a detailed assessment should be undertaken by the developer.
- If the limit is likely to be exceeded in relation to a noise-sensitive development proposal, mitigation measures should be implemented by the developer with a view to achieve the noise target in at least one outdoor area.
- Transport infrastructure providers should design mitigation measures to meet the limit or better if practicable.

The Policy describes the 5dB difference between the noise target and the noise limit as ‘an acceptable margin for compliance’.

In a general sense, where noise is likely to be in this acceptable margin (between the noise target and the noise limit), the proponent is expected to consider implementing mitigation measures that would achieve the noise target.

Where noise exceeds the limit, the proponent is required to consider and implement design measures to achieve the limit, and to also consider measures to meet the target and to implement these if practicable.

3.3 Implementing the Policy

3.3.1 Documentation

These Guidelines refer to several types of documents here broadly described as:

- a screening assessment to identify the likely extent of any noise issues at an early stage and if any, whether the acceptable treatment packages (Section 6.3) will alone suffice;
- a detailed assessment to determine what (if any) specific acoustic treatments are needed to control noise; and
- a specific noise management plan to outline what agreed actions and commitments will be made towards noise management.

**Screening assessment (Appendix A)**

A screening assessment is a useful first-look at the risks of noise impacts on sensitive areas in close proximity to road and / or rail infrastructure.

Its purpose is to identify or discount the need for a more detailed assessment which carries substantially more time and effort to produce.

**Detailed assessment / noise assessment report**

Usually undertaken on behalf of the proponent, detailed assessments are comprehensive studies that describe levels of forecast noise and recommend suitable acoustic treatments where the noise target may be exceeded.

Sections 4.3 and 7.1 outline the information that should be included in the noise assessment report.
Noise management plan

A noise management plan (Section 7.2) details the various commitments and actions to be taken to comply with the Policy.

3.3.2 When the noise criteria are exceeded

Section 5.8 of the Policy discusses the implementation of all ‘reasonable’ and ‘practicable’ noise mitigation measures to achieve acceptable outdoor and indoor noise levels.

About the term ‘reasonable’

An assessment of reasonableness should demonstrate that efforts have been made to resolve conflicts, without compromising on the need to protect noise-sensitive land use activities. For example, if residents are concerned about the height of a transport noise barrier, has reasonable effort been made to design, relocate or vegetate the barrier to address these concerns?

A noise mitigation measure might be ‘reasonable’ if the following is considered:

- the noise reduction benefit provided;
- the number of people protected;
- the cost of mitigation;
- existing and future noise levels, including changes in noise levels;
- community views and impacts;
- aesthetic and visual impacts;
- compatibility with other planning policies;
- differences between metropolitan and regional situations; and
- the benefits arising from the proposed development.

For this reason, effective community consultation is important and should be considered as a vital element in any reasonableness assessment.

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;
- safety issues (such as impact on crash zones or restrictions on road vision);
- topography and site constraints (such as space limitations);
- drainage requirements;
- access requirements (for example, driveways or pedestrian access);
- maintenance requirements; and
- suitability of the building for acoustic treatments.

Reasonable and practicable considerations must be justifiable and well-documented. A submission outlining the reasonable and practicable considerations should help to facilitate a determination on the matter and should assist in communicating that decision to the community in a transparent way.

3.4 Roles and responsibilities

Successful application of SPP5.4 requires early appreciation of its requirements and ongoing collaboration between stakeholders.

In general, to ensure early investigation of noise issues:

- where major transport corridors are located in a proposed structure plan, the proponent who wishes to develop or construct first would be expected to investigate noise mitigation measures in detail; and
- for redevelopments and revisions to greenfield structure plans or subdivisions, it is expected that that proponent would prepare a noise assessment report and a noise management plan.

This is not to say that whoever intends to build first pays the most.
Sharing responsibilities and costs associated with assessment, implementation and maintenance should be determined in advance by negotiation between the various stakeholders as noted in the following subsections.

3.4.1 Transport infrastructure providers

Section 6 of the Policy states that “transport infrastructure providers will have regard to the policy in the planning, design and implementation of new major road or rail infrastructure projects”. Transport infrastructure providers are therefore responsible for addressing the issue of noise mitigation through infrastructure design in detail.

For greenfield sites, it is expected that transport infrastructure providers in such locations should at least:

- implement controls (as far as is practicable within the transport corridor as outlined in Section 5.2) towards achieving the noise target when assessed at one metre from the façade at ground floor level of each noise sensitive building; and
- upon request from developers of land where the noise target is likely to be exceeded, provide details of such controls.

Transport infrastructure providers also have a role in reviewing and considering changes to road and rail infrastructure within the corridor which could result in a change in noise emissions, such as noise walls or track surface arrangements.

See Section 5.2 for further guidance.

3.4.2 Land and property developers

Property values may be improved through effective noise control.

Planners and developers should regularly consult the Department of Transport, Main Roads Western Australia and the Public Transport Authority for input on a specific site development and determining long-term freight and transport corridor spatial requirements.

Where there is a likelihood of a major road or railway being constructed in the future, a noise management plan could be developed jointly between the developer and the infrastructure provider to outline the division of responsibilities between the parties.

Developers are expected to consider transportation noise issues in the urban design form as early as possible in planning stages, resorting to acceptable treatment packages and title notifications as secondary measures.

Development adjacent to proposed major roads and railways should assume that mitigating measures equivalent to the acceptable treatment packages will at least be required by default. This is particularly the case with multi-storey residential developments.

For greenfield sites\(^1\), it is expected that proponents of noise sensitive development should at least:

- cover costs involved with meeting the noise target in at least one outdoor area per lot; and
- implement mitigating measures within the development boundary to achieve acceptable internal noise criteria (Section 7.1.3) at all floor levels.

There may be instances in which developers provide contributions to noise attenuation works for which they are not primarily responsible, for example where their site is not located immediately adjacent to a noise source and / or greenfield sites.

In such cases, contributions for greenfield development sites should be undertaken in accordance with established WAPC policy and practices.

See Section 6.1 and Appendix B for further guidance relevant to land and property developers.

3.4.3 Consultants and specialist expertise

A basic screening assessment according to Appendix A below may be undertaken by anyone to get an approximate indication of potential transportation noise impact.

Measurement and prediction of transportation noise for a detailed assessment requires the competency of a suitably qualified and experienced professional acoustics engineer or consultant.

A competent professional is one who can clearly demonstrate that they meet the dual requirements of being both suitably qualified and suitably experienced in the area relevant to their work.

\(^1\) Non-urbanised (greenfield) land zoned for urban development.
Those accepted as being suitably qualified are:

- a person holding membership of the Australian Acoustical Society (AAS) in the grade of Member or Fellow (designated by the letters M.A.A.S. or F.A.A.S. respectively); and / or
- a company holding current corporate membership of the Australian Association of Acoustical Consultants (AAAC).

An acoustician, or an acoustic consultancy, must also be able to demonstrate that they have experience relevant to the field of work being undertaken.

An acoustics engineer is defined as being eligible for professional membership to the Institute of Engineers Australia (MIEAust) in addition to the above.

Note that being experienced in one of these areas of professional practice does not necessarily guarantee that the person is competent to work in the other areas of acoustic practice.

Both the AAS and AAAC require their members to meet and maintain standards of technical competency. The AAS and AAAC retain current lists of their members on their respective websites at acoustics.asn.au and aaac.org.au.

3.5 Vibration

Ground-borne vibration is most commonly associated with rail transport, and at close distances can lead to a loss of amenity in noise sensitive areas, but is not specifically addressed in the Policy. Refer to the Department of Environment Regulation (DER) for specific technical guidance.

Reference is also made to the following standards:

- ISO 2631-2:2003 Evaluation of human exposure to whole-body vibration Part 2: Continuous and shock-induced vibration in buildings (1 to 80 Hz);
- British Standard BS6472-2008: Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz).
4 Planning stages

The best outcomes arise from early consideration and administration of noise impacts, especially at a strategic planning level.

Indeed, planning presents the best opportunities to meet the aims of the Policy - decisions made at this stage carry the highest impact, and effective, practicable options quickly narrow with each following stage.

Planning controls can be very effective by increasing the distance to sensitive receivers, and encouraging buildings and structures that have a screening effect without resorting to highly visible walls or expensive acoustic treatments.

See Section 4.1 for further details.

As noted in Section 5.5 of the Policy, assessments for new noise-sensitive developments must be conducted as early as is practicable.

See Appendix A for a quick guide for planners and a screening assessment worksheet template.

The Planning and Development Act 2005 empowers the WAPC to make State Planning Policies, and SPP5.4 was developed and implemented under this Act in 2009. The Planning Act also sets out the Western Australian planning processes. These processes occur at different stages of planning and can address noise interface from high-level strategic documents such as regional and local planning strategies, through to statutory planning controls contained in local planning schemes. This flows into structure, subdivision and development plans.

Statutory applications must be consistent with strategic planning to ensure coordinated, holistic planning outcomes are achieved.
### Table 4.1: Noise management during planning stages

<table>
<thead>
<tr>
<th>Scale</th>
<th>Planning stage</th>
<th>Decision maker</th>
<th>Scope to address</th>
<th>Applicable policy measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affecting multiple local government areas – regional, sub-regional, district or local</td>
<td>Region schemes and amendments</td>
<td>• Minister for Planning</td>
<td>• Identify and designate major transport corridors.</td>
<td>• Screening assessment to identify potential noise-sensitive development areas that may be noise-affected by the proposal.</td>
</tr>
<tr>
<td></td>
<td>Sub-regional strategies / plans and other state-initiated documents</td>
<td>• WAPC</td>
<td>• Review compatible land usages.</td>
<td>• Screening assessment to review / determine likely setback distances.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Identify potential noise sensitive development areas near major roads, railways and freight handling facilities.</td>
<td></td>
</tr>
<tr>
<td>Single local government area</td>
<td>Local planning strategies</td>
<td>• WAPC</td>
<td>• Provide appropriate noise separation around transport areas of influence, appropriate segregation of noise-sensitive uses from major transport corridors and freight handling facilities</td>
<td>• Screening assessment to determine policy measures against claimed rights to development.</td>
</tr>
<tr>
<td></td>
<td>Local planning schemes and amendments</td>
<td>• Minister for Planning</td>
<td>• Identify suitable land use density options adjacent to major transport corridors and freight handling facilities.</td>
<td>• Preparation of detailed noise assessment (Section 7.1), and Noise management plan (Section 7.2) by proponent.</td>
</tr>
<tr>
<td></td>
<td>Structure plans</td>
<td>• WAPC</td>
<td>• Consider subdivision layouts that address transport noise impacts; for example, allotting non-sensitive land uses and open space to increase separation etc.</td>
<td>• Outcomes used to develop design guidelines or special control area (Section 4.6).</td>
</tr>
<tr>
<td>Several suburbs down to a single residential estate</td>
<td>Subdivision applications</td>
<td>• WAPC</td>
<td>• Quiet house design measures such as living areas furthest from noise source, continuous external noise walls.</td>
<td>• Screening assessment by developer, to inform and justify proposed layout of lots and roads, location of open space etc.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Local government</td>
<td></td>
<td>• Detailed noise assessment by proponent, where required. Noise management plan and works by proponent, to approval of relevant agencies, on advice of the state environment agency.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Cost-sharing and responsibilities for the installation and maintenance of any large scale noise walls or similar treatments negotiated and agreed between affected parties.</td>
</tr>
<tr>
<td>Hundreds of lots or less</td>
<td>Development applications</td>
<td>• WAPC</td>
<td>• Reference to acceptable treatment packages (Section 6.3) to determine whether the policy will be met.</td>
<td>• Approval agency may require one of these packages as a condition of development, as well as notification on title.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WAPC</td>
<td></td>
<td>• If a noise management plan has been provided at a previous planning stage, this will identify measures relevant to development approval.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DAPs</td>
<td></td>
<td>• Otherwise, noise assessment and noise management plans (Section 7) may now be required. They should be provided and implemented by the proponent, to approval of relevant agencies.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Others</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Identify extent of study area and all nearby existing and future road and rail transport infrastructure corridors.

Will any part of the development be noise-sensitive in the next 20 years, and within (a) 300m of a major freeway, primary freight road, freight railway or terminal, within 100m of a passenger railway or secondary roads, or otherwise reasonably close to current or future road and rail infrastructure at the discretion of WAPC or local government?

NO

No further action at this stage required with respect to noise mitigation – proceed with assessment of other factors.

YES

Detailed assessment and determination of appropriate mitigation treatments. Noise Management Plan also required if the detailed assessment indicates potential for ongoing exceedance of noise targets.

Submit to stakeholders for review and agree any third party contributions or cost sharing for procurement and maintenance.

Amend documentation to reflect that agreed. Arrange for notification on title accordingly. Then proceed with assessment of other factors.

Are all determined noise levels in the Screening Assessment below the noise target for each time period?

YES

NO

Are any determined levels above the noise limit for any time period?

YES

“Acceptable treatment” packages (a.k.a. Quiet House Design) may be specified according to Section 6. At the option of the proponent, a detailed assessment may instead be prepared which certifies compliance with the noise targets via alternative means.
4.1 Noise-compatible land uses and zoning

Noise-compatible land use planning reduces the impact of transport noise by allocating and developing less sensitive land uses as a spatial buffer. It involves applying the following principles:

- identifying a suitable area of influence between major transport corridors and noise sensitive development;
- encouraging the use of less sensitive land uses adjacent to major transport corridors within that buffer distance, particularly businesses that benefit from close proximity to transport;
- prescribing, where practicable, the building form to shield noise sensitive development from transport noise; and
- using zoning mechanisms to permit only non-sensitive land uses within the area of influence of the transport corridor.

For example, transit-oriented development such as intensive retail, commercial, car parking and leisure facilities are particularly suited to areas immediately surrounding train and other transit stations. They benefit as a result of their proximity to and visibility from the road or railway while providing protection to the noise sensitive uses behind them.

In all cases, effective noise-compatible land use planning reduces the requirement for transport noise barriers, improving access and sight lines.

The WAPC Policy ‘Liveable Neighbourhoods’ specifies that subdivision layouts abutting arterial roads or railways should ensure lots created are capable of accommodating:

- non-residential uses that provide a shield to residential uses behind;
- home-business uses with the workplace providing the spatial separation;
- dwelling layouts that locate the more noise sensitive rooms away from the noise source; and
- other noise mitigation measures.

Land easements and buffers

There are other non-sensitive land use activities that could be considered to provide spatial separation between the transport infrastructure and sensitive areas, such as:

- local roads and road reserves (the width of the frontage road reserve should comply with Liveable Neighbourhoods, depending on traffic volumes and street type and function);
- defined easements or building setbacks in new estates along road/rail corridors (the vesting/management authority for such reserves on greenfield site subdivisions should be local government);
- dual use / cycling pathways;
- planting and landscaping; and
- open public spaces designed for high activity, including parks, playgrounds and natural bushland (there should however, be other communal parks in the area which offer a quieter option to residents).

4.2 Screening assessments

A basic screening assessment may be undertaken by anyone to get an approximate indication of potential transportation noise impact.

This involves a basic comparison of expected future road and passenger rail daytime traffic noise levels against the day period noise target (L_{Aeq,Day} 55dB) and noise limit (L_{Aeq,Day} 60dB). It can also be performed for freight rail traffic, but the comparison value must instead be the night period values (noise target L_{Aeq,Night} 50dB and noise limit L_{Aeq,Night} 55dB).

The screening assessment may be performed by:

- first determining the spatial distance between each noise-sensitive land use boundary and the edge of the nearest road carriageway or railway centreline; and
- looking up from Table A.1 in Appendix A of these Guidelines the L_{Aeq,Day} value for that distance.

Allowing for a forecast change in traffic volume over 20 years^2, the L_{Aeq,Day} value is compared against the noise target and noise limit to determine if and what actions are to be undertaken.

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^2 The +2dB as a default correction within the Screening Assessment is based upon 2.5% average traffic growth over 20 years, without any reduction in the average noise emissions from vehicles.
A new residential development is proposed near the intersection of Marmion Avenue and Burns Beach Road. Being residential it is noise-sensitive. Both roads are considered distributor roads at 80 kilometres per hour; Marmion Avenue is listed in SPP5.4 Schedule 1 as a primary road, and Burns Beach Road in its vicinity has similar traffic volume and posted speed.

The closest carriageway edges of Marmion Avenue and Burns Beach Road to the development site are approximately 40 and 80 metres, respectively.

According to most recent traffic volume data, Marmion Avenue carries 36,000 vehicles a day, and Burns Beach Road carries 21,000 vehicles a day.

From Table A.1 in Appendix A, the contribution from Burns Beach Road (20,000 vehicles, 80 metres distant) is estimated as $L_{Aeq,Day} 60\text{dB}$ (averaging between the values provided for 50 metres and 100 metres).

Also from Table A.1, the Marmion Avenue contribution (35,000 vehicles, 40 metres distant) is estimated as $L_{Aeq,Day} 64\text{dB}$. These two values are 4dB different, so a cumulative correction of +1dB is added. A default +2dB correction for forecast change in traffic volumes is also added.

Therefore the highest value of $64\text{dB} + 3\text{dB}$ in corrections is $L_{Aeq,Day} 67\text{dB}$, which is 7dB in excess of the noise limit of $L_{Aeq,Day} 60\text{dB}$.

Therefore a detailed assessment needs to be prepared and a notification on title arranged in addition to any other treatments that may be determined to be required from the assessment.

A simple template for undertaking a screening assessment is provided in Appendix A.
4.3 Detailed assessments

Under the Policy, detailed assessments should be requested where:

- the noise limit is likely to be exceeded;
- the proposal involves new road or rail infrastructure; and / or
- an alternative to the “Acceptable treatment” packages are sought.

The detailed assessments need to be available as part of the Local Planning Strategy and Local Structure Plan stages or otherwise as early as possible in the planning process.

Detailed assessments identify noise impacts and may recommend noise mitigation measures or preparation of a further noise management plan (NMP).

Structure plan provisions may refer to the need for a NMP. An example of a suitable structure plan provisions for a noise sensitive development requiring a NMP is given below:

A detailed Noise Management Plan must be submitted to and approved by the <Approval Authority> which demonstrates that the development has been designed to meet the relevant requirements of State Planning Policy 5.4 ‘Road and Rail Transport Noise and Freight Considerations in Land Use Planning (SPP5.4). The report must be prepared by a suitably qualified and competent person in accordance with the SPP5.4 Guidelines.

The proponent should be tasked with ensuring that what is designed and constructed remains consistent with the detailed assessment.
4.4 Noise Management Plan

Where noise levels are determined to be in excess of the Noise Target, a NMP is required. A NMP specifies the specific undertaking of mitigating measures such as landscaped easements, noise bunds or noise walls, and their ongoing maintenance. The NMP and any updated detailed assessment should be available at the subdivision or development stage of planning, whichever is earlier.

The NMP will recommend specific subdivision and development conditions to ensure noise mitigation measures are put in place.

State environment agencies such as the Department of Environment Regulation are available to provide advice and expertise within government, as well as other stakeholders potentially affected such as the Department of Transport, Main Roads Western Australia, and the Public Transport Authority. Local Government may play a role in the clearance of certain conditions.

The NMP typically outline:

- what noise mitigation measures are proposed to be used;
- how these noise mitigation measures will bring noise levels within the limit;
- what subdivision conditions should be imposed to achieve mitigation;
- notifications on title advising of noise impact;
- the recommended extent of noise walls/bunds;
- comments on detailed area plans for quiet house design; and
- consideration of amenity impacts of noise walls.

4.5 Notification on certificates of title

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 basic 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.

For more information, refer to WAPC Planning Bulletin No. 3: Record of Information on Titles (Memorials) and Section 3.4.3(a) of the Development Assessment Panel Training Notes ‘Making Good Planning Decisions’ (2011).

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3 WAPC Planning Bulletin No. 3: Record of Information on titles (Memorials) requires that notifications are limited to situations where the hazard or other factor is relatively permanent; significant in its effect on the use or enjoyment of the land; may not be apparent on inspection of the land; and not indicated by other documentation relating to the land. Notifications on certificates of title may be consistent with this Bulletin where noise from transport infrastructure may not be readily apparent.
4.6 Special control areas

Some measures rely on the building licence stage of approvals which are beyond the Planning and Development Act 2005, and hence State Planning Policy 5.4.

A special control area, (SCA) could be used to indicate an area within which a local government intends to apply this Policy before deciding on development proposals, where this may not otherwise be the case.

The extent of an SCA could be identified from undertaking screening assessments of existing transport infrastructure.

Use of an SCA introduces the requirement for development approval to be sought (see also WAPC Local Planning Manual).

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**Example of applying SCAs**

A mixed use commercial/residential precinct is planned adjacent to an urban railway station and major road.

A screening assessment based on the forecast traffic volumes indicates $L_{eq,day}$ values to be more than the Target (55dB) for most of the precinct.

Following the principles in Sections 4.1 and 6.2 of these Guidelines, a structure plan is developed with medium-rise commercial/residential buildings facing the railway and the major road, as a screen for the lower-rise residential areas, church site and private school site behind.

A detailed assessment of noise is conducted to determine design guidelines for the residential areas in the buildings fronting the railway and major road, and for parts of the school.

The detailed assessment also identifies the need for any unique acceptable treatment measures in some of the residential areas screened by the larger buildings, particularly where some focusing or reflections of noise off buildings may occur.

A special control area is designated to ensure that the design guidelines are implemented through the various development approvals in the precinct and that appropriate notifications are placed on titles where so identified in the detailed assessment.
5 Transport infrastructure planning

5.1 Application

As noted in Section 3.1, a detailed assessment is required under the Policy for:

- any new major road or rail infrastructure; or
- a major redevelopment of existing road or rail infrastructure.

The following types of proposals may also require a detailed assessment if likely to affect a noise-sensitive land use:

- a freight handling facility within 300 metres of a noise sensitive area;
- road or rail services underground / beneath existing or future noise sensitive areas;
- roads that have significant gradients or may become a possible future freight route;
- rail segments that have newly introduced elements that could create additional annoyance, such as track switchpoints, crossings, or track curve radii less than 600 metres; or
- where there may be a substantial change in noise from that currently, such as metropolitan fringe greenfield sites or rural areas.

Major redevelopment of existing major roads

Major roads are those defined in Section 3.1 of these Guidelines and Section 5.2 of the Policy. Typically this means works designed to facilitate an increase in traffic carrying capacity (such as carriageway duplication or the addition of a traffic lane), or a major change in the alignment.

5.1.1 Major and minor redevelopment of a railway

A major redevelopment of a railway means a substantial realignment, either inside or outside the existing corridor, a duplication or works that significantly increase capacity.

Minor works are those such as crossovers, sidings, turnouts, yards, loops, refuges, relief lines, realignment of track, re-sleepering or the installation of signalling devices.
Under Section 5.2.3 of the Policy, minor redevelopments of railways may trigger policy measures where they are “likely to adversely affect a noise-sensitive land use”.

This could trigger policy measures where:

- it is located in the vicinity of a noise-sensitive land use;
- it does not involve an increase in traffic along an existing railway in the absence of a major redevelopment (as exempted under Section 5.1 of the Policy);
- the nature of the noise emissions likely to emanate as a result of the minor redevelopment will probably increase in level or duration, e.g. a new crossing where there was none previously or tighter track curvature leading to new or additional wheel squeal;
- projected cumulative noise levels exceed the noise target; and
- past consultations with State environmental agencies indicated a need to apply policy measures on similar minor redevelopments.

If the screening assessment demonstrates that the proposed minor redevelopment is of a type that is not considered significant by the State environment agency, and that noise emissions from those assets to be redeveloped will be maintained or reduced, no further measures are required under the Policy.

Figure 5.4: Planning level approaches for road and rail infrastructure in proximity to noise sensitive land uses
5.1.2 Minor roads

Minor roads are defined as those which:

- are local roads;
- carry less than 5,000 vehicles per day in rural areas or 20,000 vehicles per day in metropolitan areas; or
- are unlikely to create significant impact within a 20-year timeframe.

Minor roads are generally not covered under the Policy, however Section 5.2.2 gives authorities discretion to apply the Policy where there is a potential to significantly impact people, such as metropolitan fringe and rural areas where background noise levels are very low.

5.2 Reducing transport infrastructure noise emissions

The key noise mitigation options available to transport infrastructure providers at the transport infrastructure design stage are briefly summarised as follows:

- **Route selection.** Selecting a route alignment for a new road or railway that maximises separation distances from existing or future noise sensitive land uses is critical to achieving overall noise management outcomes.

  Note that historically quiet areas can be more sensitive to new road and rail infrastructure. Consider also the likely hours of operation of those routes, e.g. whether they will carry increased numbers of freight vehicles during night periods.

- **Vertical alignment.** Natural ground topography can be used to better shield the transport corridor. Cuttings, with a finished surface below natural ground level, can be significantly quieter and improve the effective height of nearby noise screening walls.

- **Reserve width.** Acquiring or preserving adequate space in the corridor reserve is important to ensure that suitable set-back distances to receivers can be achieved and that, if necessary, bunds and barriers can be constructed close to either the source or receiver, but preferably closer to the source.

- **Low-noise surfaces.** Low-noise road surfaces can be an effective noise mitigation tool. For roads, open graded asphalt can be up to 3dB quieter than standard asphalt pavement types. Chip seal surfaces are noisier. For rail vehicles, noise generated by the wheel/rail interaction is strongly influenced by the design and roughness of the track. Routine maintenance is crucial.

- **Appropriate speeds.** Vehicle noise increases with speed and acceleration rates. In noise-sensitive areas, controls which limit speeds and/or heavy acceleration can be an effective form of noise mitigation. For example, traffic noise levels near roundabouts, where vehicles do not need to stop fully are quieter in comparison to stop-controlled intersections. On the other hand, speed humps may increase noise if they are likely to be heavily trafficked or used by commercial vehicles (e.g. noise from loose items).

- **Minimising gradients.** Reducing gradients reduces noise from freight vehicles. This can be an effective noise mitigation tool. Because engines work harder and produced more noise to go up gradients, while on steep down gradients, trucks may use engine braking.

- **Eliminating tight rail curves.** Rail squeal can be a significant source of noise annoyance and can be eliminated in design by avoiding tight curves (generally defined as less than 600 metres in radius). A less effective option post-construction may be the use of specific trackside lubrication systems.
5.3 External noise mitigation techniques

Transportation noise controls can be effective through increasing the distance to sensitive receivers, and encouraging buildings and placing structures which have a screening effect.

5.3.1 Distancing

Increasing the distance between transport infrastructure and noise-sensitive areas is effective, but not a total solution as it carries potential cost impacts in lower land utilisation.

As a basic guide, noise in close proximity to freeways and rail lines decreases at a steady rate per doubling of distance. The following table provides an example of this effect.

<table>
<thead>
<tr>
<th>Example</th>
<th>Distance from edge of carriageway, metres</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Urban) 80-100 km/hr and 7.5% Heavy Vehicles, 20,000 vehicles per day</td>
<td>10  20  30  40  50  100</td>
</tr>
<tr>
<td></td>
<td>70  67  64  63  62  58</td>
</tr>
</tbody>
</table>

Soft/irregular ground terrain such as grassy or landscaped plantings can provide some further minor reduction through treatment absorption of noise reflected from the ground surface.

5.3.2 Screening

‘Screening’ means to insert something into the line of sight between the noise sources and the sensitive land use.

‘Noise walls’, ‘noise screens’, ‘noise barriers’ and the like all refer to the same thing - a solid wall or fence designed to provide a certain amount of airborne noise reduction. In this context, ‘walls’ usually refer to heavy or primary walls immediately adjacent to transport infrastructure. Fences usually refer to lighter and shorter arrangements located on residential lot boundaries.

Noise walls used near Perth freeways generally reduce transport noise (L(eq)) levels by between five and 10dB, depending on the design of the barrier and the topography of the site.

As a basic rule, a reduction of 5dB can be readily achieved by eliminating the ‘line of sight’ between the noise receiver and the traffic source. Beyond that, an additional noise reduction of about 1.5dB can be achieved for every one metre of added barrier height. Up to 9dB of noise reduction is generally attainable with heights that have been historically acceptable to residents.

Achieving substantially more than this (e.g. 15dB) with a wall is usually very difficult in practice.
Low transport noise barriers, e.g. those around two metres high, should be used with high caution when used in close proximity to transport infrastructure. While low barriers may be effective at reducing noise from sources close to the ground, such as noise from the wheels of passenger cars or freight wagons, they are likely to have no effect on elevated noise sources such as exhaust discharges from trucks or locomotives.

**Positioning walls**

The most effective place to position a transport noise barrier is generally as close as possible to the road or railway, as this will tend to reduce the overall height of the barrier required to attenuate traffic noise. However, construction of such barrier is usually limited to transport infrastructure providers who operate within the province of the road or railway reserve.

To minimise the transmission of noise around the ends of a transport noise barrier, it should generally be long enough to subtend an angle of 160 degrees from the receiver to the road or railway (Figure 5.7). This results in a barrier with a total length of about eight times the distance from receiver to barrier.

The length of the barrier can be effectively reduced by moving the barrier closer to the receiver or by bending the ends of the barrier away from the road or railway (Figure 5.7).

Overlapping barriers can be used to suit pedestrian walkways, egress points or service roads (Figure 5.8).
Wall materials

Barriers can be made from a range of materials including precast concrete panels, brickwork, limestone blocks, concrete blockwork, timber, transparent acrylic, fibre cement, recycled plastic, and metal sheeting. In all cases they must be continuously airtight or without gaps.

It is generally recommended that walls in close proximity to transport noise have a minimum surface density of at least 15 kilograms per square metre to effectively reduce the noise passing through the barrier. This surface density is readily achieved with masonry or timber walls which meet relevant structural/wind-loading requirements. Heavier walls do not necessarily perform better since at this point the dominant noise path is probably over the top of the wall.

For fences, where heights are limited to around 2.4 metres and only a modest noise reduction of around five decibels is required, lighter weight materials may be acceptable. Lightweight materials may be sheeted on both sides of supports to form a double layer construction for comparable performance, but care must be taken such that noise passing through the barrier is sufficiently controlled.

Sound absorptive and diffusive (rough feature/angled) surface treatments should be considered for walls parallel to and facing the traffic. These may be appropriate where the corridor carries a number of long and high-sided vehicles, such as freight rail, because noise reflections can be generated between the vehicle and a reflective barrier.

Vegetation alone is not effective as a noise barrier.

Reducing visual impacts of noise walls

Often the strongest resistance to implementing noise screening walls is in relation to their appearance to nearby residents.

Transport noise barriers can contribute significantly to overall urban design qualities. Where barrier aesthetics are important, consideration should be given to engaging the services of a design professional.

Planting can also break down the scale of a barrier by reducing its visual dominance, which is more critical on the receiver side of the transport noise barrier.

Effective vegetation and planting may require the engagement of a landscape designer to ensure that the planting selection appropriately screened the barrier, that the landscaping integrated seamlessly with the barrier design, and that the planting complemented the local landscape setting. Long-term maintenance is particularly important to ensure a tidy appearance and protect against overgrowth, risk of fire spread and vandalism.

Note that any proposals for landscaping within buffers need to be prepared to local government requirements as illustrated by a landscape plan.

To maintain a good amenity, breaking up noise walls is encouraged where possible.

Example of reducing visual impacts of noise walls
Where planting cannot be used to screen the barrier, then the aesthetics of the barrier should be of a high standard and create visual interest.

Visual interest can be created through the deliberate use and / or variation of:

- colour
- pattern
- height
- non-linear forms
- texture
- transparency
- materials
- lighting.

Note that aesthetic requirements differ depending on which side of the barrier is being considered.

On the transportation side, the barrier will be viewed at speed and drivers’ peripheral vision will be narrow.

By contrast, on the receiver side, the barrier will be viewed in terms of a much smaller section and as a static object with more scrutiny.

Lighting can be used to create interest and improve security in the vicinity of the wall; however some forms can be overly distracting to drivers. Transport authorities should be contacted to ensure any lighting proposals are compliant with network safety requirements.

Where practical, the barrier should make reference to the local environment, taking account of the urban fabric, the natural, historic and cultural context, and local materials, colours and textural patterns. In some cases it may also be appropriate to integrate the barrier design with an entrance statement or public art.

Visual connections to the landscape can be accommodated through transparent viewing panels inserted at strategic locations. Transparent materials can also be used across the top section of barriers to reduce their apparent height. This will also help to reduce the potential impact of overshadowing for barriers placed near the property boundary.

Figure 5.9: An example of various multiple techniques in visually and acoustically screening of residential areas near a rail line (not shown)
Strategies to improve surveillance and reduce crime are often at odds with requirements for acoustic protection. Careful positioning and selection of vegetation and barriers, particularly in relation to pedestrian pathways, access roads or houses, is also important to ensure that they do not provide a means of visual protection to would-be criminals.

Graffiti can be discouraged by using vegetation to cover or screen the barrier, or by using textured barrier surfaces and coatings that are difficult to use for graffiti. It is recommended that anti-graffiti coatings be applied to all transport noise barriers and that any graffiti is removed as quickly as possible to discourage further acts of vandalism.

Earth mounds / berms

Landscaped earth mounds or bunds can provide benefits in terms of natural landscape values and good visual screening. The main downsides to bunds are that they require large footprints and attract ongoing maintenance costs for weeding, erosion, litter and fire prevention.

For example, a two-metre high unreinforced earth bund requires approximately 17 metres of horizontal space; for every metre of additional height, approximately six metres of additional horizontal space is needed.

Such large footprints also encroach on usages suited to relatively flat ground, such as parks, native vegetation unsuited to slopes and dual use pathways.

Although it is often overlooked, bunds will often need to be built slightly higher than an equivalent vertical wall because the effective barrier edge, the top of the bund, cannot be placed as close to the noise source.

Structural retaining of the soil may also be needed to enable steeper vertical slopes to be constructed to bring the bund closer to the transport corridor, or enable the retention of mature trees on lower slopes.

Despite all above, where there is fill and space available, bunds may still be appropriate for the noise screening purpose.

5.4 Freight handling facilities

Areas for freight handling facilities generally correspond with (or are already part of) industrial zones under the relevant regional and local planning schemes.

The operation of freight handling facilities do result in substantial levels of noise and vibration emission, especially during night periods when nearby residents are most sensitive.

Although screening assessments are useful initial indicators, it is recommended that:

- all proposals for new freight handling facilities which trigger clauses 5.2.2 and 5.2.3 of the Policy; or
- proposals for noise-sensitive development located in the immediate vicinity

are required to include a detailed assessment. This is largely because:

(a) some common major noise emissions from such freight handling facilities are required to comply with statutory noise policy which would trigger a need for a detailed noise assessment anyway; and
(b) the screening assessment tool is not intended for the type and frequency of vehicle movements which are markedly different to surrounding infrastructure, e.g. shunting of trains and reversing of vehicles.

Detailed assessments for freight handling facilities may be undertaken on the following basis:

- The basis for assessment including future hours of operation, traffic growth and key activities is nominated by the proponent and reviewed by the state environment agency prior to development approval.
- The forecasted level of noise impact for each time period is presented in terms which allow comparison against the noise targets in the Policy and any other applicable statutory requirements or other criteria agreed with the state environmental agency in advance.
- The agreed basis / assumptions used in the noise assessment are reflected in any associated noise management plan.

\*4 WA Environmental Protection (Noise) Regulations 1997
6 Development approval stages and individual dwelling design and construction

6.1 Information for developers and builders

Through achieving the environmental noise standard prescribed in SPP5.4, new property development may benefit from the close proximity to transportation infrastructure while minimising adverse impacts on property values, community health and amenity. Public expectations of new high-quality developments on new subdivisions would include expectations for high standards of acoustic amenity.

The following subsections discuss various approaches of addressing transportation noise control requirements within the lot boundary for development approval stages and schematic design.

6.2 Building noise mitigation techniques
   – Quiet House design

Where all practicable steps to avoid or minimise transport noise have been taken but the external noise levels are predicted or measured to exceed the target level criteria, specific noise amelioration measures should be considered.

The Quiet House acoustic design aims are:

- to provide for at least one protected outdoor area; and
- to minimise the extent of noise insulation needed to meet the indoor noise level standards.

Aspects that should be considered include:

- boundary fences;
- building and interior arrangement;
- screening of outdoor living areas and balconies; and
- windows and openings.
6.2.1 Boundary fences and screening walls

Where development backs onto a major transport corridor and from which access is not permitted, it is normal practice to provide a continuous wall along the property boundary in conjunction with the original subdivision of the land.

It is critical that the walls are of suitable height, material and are continuous, i.e. extend to ground level without any gaps.

Lightweight fences (e.g. post and rail sheet steel) are not substitutes for noise walls as described in Section 5.3.2 but provide some benefit for heights up to 2.4 metres and locations immediately adjacent to outdoor living areas and ground-floor openings to habitable rooms. Some recommended construction tips are noted below.

- To avoid gaps emerging in timber fences over time, use seasoned and treated timber. Place the posts close together (2.4m centres or less) for rigidity and with three horizontal support rails. Use galvanised bolts and nails.

- Performance of a sheet steel fence can be improved by using two sheets such that an air space is formed of similar depth to the supporting posts.

- Planks or sheeting must be tight fitting and overlaid by a minimum of 30 millimetres, with no gaps between materials or between the base of the fence and the ground.

- Ensure the barrier is of adequate length to provide at least 160 degrees of protection (when viewed from a noise sensitive location towards the transport corridor), or extend down side boundaries.

6.2.2 Building arrangement

Acoustic design guidelines for single and multi-storey buildings generally recommend:

- the building bedroom and living areas are set back from the transport corridor as far as possible;
- the building to shield courtyards and open space areas from the corridor and avoid;
- shapes which ‘collect’ and ‘focus’ noise (Figure 6.1);
- noise sensitive spaces, such as bedrooms, to be shielded from noise by positioning less sensitive spaces, such as the garage, bathrooms and laundry, closer to the corridor;
- screen walls to be used to protect small outdoor areas or to shield windows.

Figure 6.1: Acoustic design for the effective orientation and shape of buildings in transport noise-affected zones (Adapted from US Department of Housing and Urban Design, Noise Guidebook)
• podiums and extended façade elements that can be used to provide useful shielding of floors above and provide distance offset;
• designing balustrades to be continuous without gaps to shield noise sources below;
• fully enclosing the balcony with operable windows to create winter gardens (Figure 6.2); and
• applying sound-absorptive / diffusive elements to the underside of balcony ceilings (soffit) above to reduce reflected sound into the dwelling (Figure 6.3).

Higher-density development also tends to provide an opportunity for quiet house design principles to be applied in a more cost-effective manner.

As a guide, where a noise-sensitive lot is located within an area that exceeds the noise limit, it will be preferable for the building to back onto the major transport corridor and to engage with the neighbourhood on the other side of the building.

Noise-sensitive spaces such as bedrooms, dedicated entertainment rooms and living areas should be situated away from the source of noise where possible with service areas in between, such as garages, store rooms, bathrooms and laundries.

![Figure 6.2: Semi-enclosed balconies and fully enclosed “winter gardens”](image)

![Figure 6.3: Shielding effects of commercial podium developments](image)
6.2.3 Outdoor living areas and balconies

The Policy requires that at least one outdoor living area be reasonably protected from transport noise. This protected area should have at least the minimum space requirements for outdoor living areas as defined in the Residential Design Codes of Western Australia.

In many ways, outdoor living areas are the most susceptible to noise from adjacent transport corridors as they are open and therefore difficult to protect, particularly where they are elevated with a direct line of sight to the traffic.

Outdoor areas should always be located furthest away from the noise source, so screened by the building itself.

In cases where a development cannot comply with the acceptable treatment requirements listed in Section 6.3 for upper level locations and balconies, and there are no screened ground-level locations, a best ‘reasonable and practicable’ design approach should be demonstrated in accordance with these Guidelines (Section 6.2).

6.2.4 Air conditioning and ventilation

Where noise levels are above the target, it is usually presumed that suitable indoor noise targets cannot be met without fixed, closed windows. This is not always the case, and should not prevent the effective application of natural cross-ventilation and energy-efficient air conditioning, particularly given the Western Australian climate.

For traffic noise levels well above noise limit values, energy efficient natural ventilation arrangements that are acoustically compliant are possible, but usually require specialist input prior to schematic design. The usual implications are that the external vents are located on sides not facing the transport corridor, and / or are acoustically treated.

In implementing the acceptable treatment packages (Section 6.3), 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. Without such vents, these systems require windows to remain open, with the result that indoor noise targets may not be achieved.
- Refrigerant-based air conditioning systems need to be designed to achieve 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.
- Ductwork needs to be provided with adequate silencing, particularly in higher noise areas, to prevent noise intrusion.

6.2.5 Doors, windows and openings

Windows and openings are typically the weakest points in a building façade.

The most common approaches to acoustic treatment of the building envelope are:

- providing mechanical ventilation or air conditioning so windows can remain closed;
- upgrading glazing thicknesses;
- improving doors that open from habitable rooms to outdoors; and
- improving insulation to the roof and above-ceiling space.

6.3 Acceptable treatment packages

Where outdoor noise levels are above the target level, excluding the effect of any boundary fences, these 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 in Table 6.3 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 ‘LAeq,Day’ or ‘LAeq,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.
Example of determining acceptable treatment glazing

A screening assessment is undertaken for a proposed new residential development in the vicinity of a primary road. The screening assessment determines an external incident level of $L_{Aeq,Day}^{60dB}$ at the lot boundary.

$L_{Aeq,Day}^{60dB}$ is above the external noise target of $L_{Aeq,Day}^{55dB}$, therefore mitigating measures need to be undertaken.

The approval agency advises that the development proponent can elect to implement Package A treatments according to Table 6.3 of the Guidelines, or undertake a detailed assessment which demonstrates to the satisfaction of the approval agency how the requirements will be otherwise be met. The proponent elects to implement the first option, which for $L_{Aeq,Day}^{60dB}$ corresponds to Package A according to Table 6.3.

One corner of the proposed dwelling has a bedroom of 20 square metres with attached ensuite, in which one wall is facing the road corridor and another is facing ‘side-on’. The wall facing the road corridor has window glazing with a combined area of eight square metres, and the wall facing side on has eight square metres of window and a glass balcony door of three square metres.

The glazing area facing the road is eight square metres per 20 square metres equating to 40 per cent of the floor area, so must have a minimum $R_w + C_r$ value of 28dB. From Table 6.4, this can be achieved with any fixed glazing more than six millimetres thick, or a sliding type window with 10 millimetres laminated glass and acoustic seals according to Section 6.3.3.

If for example, the window facing the road were increased to 60 per cent (or 12m² in this example), then the acoustic rating must be increased to $R_w + C_r$ 31dB, requiring 10 millimetres fixed pane glass or same six millimetres glass but with a sealed awning type frame according to Table 6.4.

Side on to the corridor, the glass door is included in the area calculation (11m² total/20m² = 55%), however the allowance for $R_w + C_r$ 28dB glazing is increased to 60 per cent, meaning the same window system facing the road can be used. The glass door needs to comply with $R_w + C_r$ 28 dB, and from Table 6.4 this can be achieved with a six millimetres toughened glass suite with acoustic seals according to Section 6.3.3.

The proponent may also here nominate a glass sliding door system acoustically rated to $R_w$ 31dB by a manufacturer or professional acoustical consultant.
Superior construction standards may be required to comply with National Construction Code requirements or otherwise as recommended by the Western Australian Planning Commission, e.g. for new housing in areas forecast to be seriously affected by aircraft noise.

Table 6.3 introduces several new terms:

- **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). See example below.

- **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.

The approval may require that the construction drawings be checked for compliance with the detailed assessment, and that follow-up verification be carried out to certify compliance. The following subsections provide further details on various building components.

### 6.3.1 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*. Fresh intake and relief air paths will need to be fully ducted to allow windows to be closed, and be located at positions furthest from the traffic noise sources where practicable.

For acceptable treatment packages A, B and C, if a ventilation system is provided in addition to operable windows, on all sides facing or side on to the transport corridor it must either provide:

- closed roof eaves and wall openings on those sides; or
- acoustically rated openings and ductwork arrangements to provide a minimum sound reduction performance of $R_w$ and 40dB into sensitive spaces.

### 6.3.2 External walls

In Table 6.5 two different external wall ratings of $R_w + C_{tr}$ 45dB and 50dB are provided. Suitable constructions for these ratings are listed within Table 6.5 and Specification F5.2 within Volume 1 Part F of the National Construction Code. These construction values are based on the installation and sealing of joints and penetrations being in accordance with Specification F5.2.

#### Determining building face orientation

The following sketch shows two residences in proximity to a road.

‘Facing’ façades are identified by drawing straight lines (b) perpendicular (at a 90 degree angle) to the road (a). Where these lines intersect a façade — without obstruction — the façades are shown in red as ‘facing’ the road.

Façades shown in blue are not ‘facing’ but have clear lines (c) that intersect the road at any angle, and are therefore classed as ‘side on’ to the road.

The remaining façades are ‘opposite’ to the road.
Table 6.3: Acceptable treatment packages

<table>
<thead>
<tr>
<th>Area</th>
<th>Orientation to road or rail corridor</th>
<th>Package A</th>
<th>Package B</th>
<th>Package C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$L_{Aeq,day}$ up to 60dB $L_{Aeq,night}$ up to 55dB</td>
<td>$L_{Aeq,day}$ up to 63dB $L_{Aeq,night}$ up to 58dB</td>
<td>$L_{Aeq,day}$ up to 65dB $L_{Aeq,night}$ up to 60dB</td>
</tr>
<tr>
<td>Bedrooms</td>
<td>Facing</td>
<td>• Walls to $R_{w+Ct}$ 45dB</td>
<td>• Walls to $R_{w+Ct}$ 50dB</td>
<td>• Walls to $R_{w+Ct}$ 50dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Windows and external door systems: Minimum $R_{w+Ct}$ 28dB (Table 6.4), total glazing area up to 40% of room floor area. [if $R_{w+Ct}$ 31dB: 60%] [if $R_{w+Ct}$ 34dB: 80%]</td>
<td>• Windows and external door systems: Minimum $R_{w+Ct}$ 31dB (Table 6.4), total glazing area up to 40% of room floor area. [if $R_{w+Ct}$ 34dB: 60%]</td>
<td>• Windows and external door systems: Minimum $R_{w+Ct}$ 34dB (Table 6.4), total glazing area limited to 40% of room floor area. [if 20% of floor area or less, $R_{w+Ct}$ 31dB]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Roof and ceiling to $R_{w+Ct}$ 35dB (1 layer 10mm plasterboard)</td>
<td>• Roof and ceiling to $R_{w+Ct}$ 35dB (1 layer 10mm plasterboard)</td>
<td>• Roof and ceiling to $R_{w+Ct}$ 40dB (2 layers 10mm plasterboard)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Mechanical ventilation as per Section 6.3.1</td>
<td>• Mechanical ventilation as per Section 6.3.1</td>
<td>• Mechanical ventilation as per Section 6.3.1</td>
</tr>
<tr>
<td></td>
<td>Side-on</td>
<td>• As above, except glazing $R_{w+Ct}$ values for each package may be 3dB less, or max % area increased by 20%</td>
<td>• As per Package A ‘Side On’</td>
<td>• As per Package A ‘Facing’</td>
</tr>
<tr>
<td></td>
<td>Opposite</td>
<td>• No requirements</td>
<td>• No requirements</td>
<td>• No requirements</td>
</tr>
<tr>
<td>Indoor living and work areas</td>
<td>Facing</td>
<td>• Walls to $R_{w+Ct}$ 45dB</td>
<td>• Walls to $R_{w+Ct}$ 50dB</td>
<td>• Walls to $R_{w+Ct}$ 50dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Windows and external door systems: Minimum $R_{w+Ct}$ 25dB (Table 6.4), total glazing area limited to 40% of room floor area. [if $R_{w+Ct}$ 28dB: 60%] [if $R_{w+Ct}$ 31dB: 80%]</td>
<td>• Windows and external door systems: Minimum $R_{w+Ct}$ 28dB (Table 6.4), total glazing area up to 40% of room floor area. [if $R_{w+Ct}$ 31dB: 60%]</td>
<td>• Windows and external door systems: Minimum $R_{w+Ct}$ 34dB (Table 6.4), total glazing area up to 40% of room floor area. [if $R_{w+Ct}$ 34dB: 80%]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• External doors other than glass doors to $R_{w+Ct}$ 26dB (Table 6.4)</td>
<td>• External doors other than glass doors to $R_{w+Ct}$ 26dB (Table 6.4)</td>
<td>• External doors other than glass doors to $R_{w+Ct}$ 30dB (Table 6.4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Mechanical ventilation as per Section 6.3.1</td>
<td>• Mechanical ventilation as per Section 6.3.1</td>
<td>• Mechanical ventilation as per Section 6.3.1</td>
</tr>
<tr>
<td></td>
<td>Side-on</td>
<td>• As above, except the glazing $R_{w+Ct}$ values for each package may be 3dB less, or max % area increased by 20%</td>
<td>• As per Package A ‘Side On’</td>
<td>• As per Package A ‘Facing’</td>
</tr>
<tr>
<td></td>
<td>Opposite</td>
<td>• No requirements</td>
<td>• No requirements</td>
<td>• No requirements</td>
</tr>
<tr>
<td>Other indoor areas</td>
<td>Any</td>
<td>• No requirements</td>
<td>• No requirements</td>
<td>• No requirements</td>
</tr>
<tr>
<td>Outdoor living areas</td>
<td>Any (Section 6.2.3)</td>
<td>• As per Package C, and/or</td>
<td>• As per Package C, and/or</td>
<td>• At least one outdoor living area located on the opposite side of the building from the transport corridor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 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</td>
<td>• 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</td>
<td></td>
</tr>
</tbody>
</table>

Any penetrations in a part of the building envelope must be acoustically treated so as not to degrade 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.
6.3.3 Door and window seals

The sound reduction values provided in Table 6.4 are based on the requirement that suitable acoustic seals are provided to prevent sound leakage around each building element.

To comply with the ratings provided in this table, all external glass windows and doors specified under Packages A, B and C must:

- have a seal to restrict air infiltration fitted to each edge of an operable window;
- within doors or fixed framing, glazing must be set and sealed using an airtight arrangement of non-hardening sealant, soft rubber (elastomer) gasket and / or or glazing tape, or be verified by manufacturer or otherwise approved person that the construction system as to be installed complies with the relevant R_w+Ctr value; and
- all external doors must have compressible silicon based rubber seals to the full perimeter and a drop seal to provide an airtight seal when closed.

In this context, a seal is foam or silicon based rubber compressible strip, fibrous seal with vinyl fin interleaf or the like. Brush / pile type seals without this seal included are not allowed.

<table>
<thead>
<tr>
<th>Building element</th>
<th>Type</th>
<th>Airborne weighted sound reduction rating with traffic correction R_w+Ctr, dB</th>
<th>Example constructions, with airtight seals according to Section 6.3.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Window, uPVC, aluminium or timber frame</td>
<td>Sliding or double hung opening</td>
<td>23</td>
<td>• 4mm monolithic glass</td>
</tr>
<tr>
<td></td>
<td></td>
<td>26</td>
<td>• Single pane glazing to R_w 33dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 6mm monolithic or laminated glass</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 6mm toughened safety glass</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• ‘6-12-6’ double insulated glass unit (IGU)</td>
</tr>
<tr>
<td></td>
<td>Fixed sash, awning or casement type opening</td>
<td>29</td>
<td>• Single pane glazing to R_w 36dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 10mm monolithic (aka float) glass</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 10mm laminated or toughened safety glass</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 6mm-12mm-10mm double insulating</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 4mm monolithic glass</td>
</tr>
<tr>
<td>Single external door, aluminium uPVC or timber frame</td>
<td>Fully glazed sliding door</td>
<td>24</td>
<td>• Certified R_w 31dB acoustically rated door and frame including seals</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 6mm monolithic or laminated</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 5 or 6mm toughened safety glass</td>
</tr>
<tr>
<td></td>
<td>Fully glazed hinged door</td>
<td>27</td>
<td>• 10mm monolithic or laminated</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 10mm toughened safety glass</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Certified R_w 34dB acoustically rated door and frame including seals</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 6mm monolithic or laminated</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 5 or 6mm toughened safety glass</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 35mm solid core timber</td>
</tr>
<tr>
<td></td>
<td>Solid core timber frame, side hinged</td>
<td>31</td>
<td>• Certified R_w 34dB acoustically rated door and frame including seals</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 10mm monolithic or laminated</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 10mm toughened safety glass</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Certified R_w 28dB acoustically rated door and frame system including seals</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 35mm solid core timber</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Certified R_w 32dB acoustically rated door and frame system including seals</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 40mm solid core timber without glass insert</td>
</tr>
</tbody>
</table>
| | | | • 40mm solid core timber with not less than 6mm
<table>
<thead>
<tr>
<th>Building element</th>
<th>Type</th>
<th>$R_w + C_w$, dB</th>
<th>Example constructions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Steel framed</strong></td>
<td>45</td>
<td></td>
<td>One row of 92mm studs at 600mm centres with —</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• resilient steel channels fixed to the outside of the studs; and</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 9.5mm hardboard or 9mm fibre cement sheeting or 11mm fibre cement weatherboards fixed to the outside of the channels; and</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 75mm thick glass or mineral wool insulation with a density of 11kg/m$^3$ or</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 75mm thick polyester insulation with a density of 14kg/m$^3$, positioned between the studs; and</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• two layers of 16mm fire-protective grade plasterboard fixed to the inside face of the studs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>One row of 92mm studs at 600mm centres with —</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• resilient steel channels fixed to the outside of the studs; and</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• one layer of 19mm board cladding fixed to the outside of the channels; and</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 6mm fibre cement sheets fixed to the inside of the channels; and</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 75mm thick glass or mineral wool insulation with a density of 11 kg/m$^3$ or</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 75mm thick polyester insulation with a density of 14 kg/m$^3$, positioned between the studs; and</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• two layers of 16mm fire-protective grade plasterboard fixed to the inside face of the studs.</td>
</tr>
<tr>
<td>External wall</td>
<td>Single leaf masonry, brick veneer</td>
<td>50</td>
<td>Single leaf of 150mm brick masonry with 13mm cement render on each face.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Single leaf of 90mm clay brick masonry with —</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• a row of 70mm x 35mm timber studs or 64mm steel studs at 600mm centres; and</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• a cavity of 25mm between leaves; and</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 75mm thick glass or mineral wool insulation with a density of 11kg/m$^3$ or 75mm thick polyester insulation with a density of 14kg/m$^3$ positioned between studs; and</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• one layer of 10mm plasterboard fixed to the inside face.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Single leaf of 220mm brick masonry with 13mm cement render on each face.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>150mm thick unlined concrete panel.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>200mm thick concrete panel with one layer of 13mm plasterboard or 13mm cement render on each face.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Two leaves of 90mm clay brick masonry with a 20mm cavity between leaves.</td>
</tr>
<tr>
<td>Double brick</td>
<td>50</td>
<td></td>
<td>Two leaves of 90mm clay brick masonry with —</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• a 50mm cavity between leaves; and</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 50mm thick glass wool insulation with a density of 11kg/m$^3$ or 50mm thick polyester insulation with a density of 14 kg/m$^3$ in the cavity; and</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Where wall ties are required to connect leaves, the ties are of the resilient type.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Two leaves of 110mm clay brick masonry with —</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• a 50mm cavity between leaves; and</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 50mm thick glass wool insulation with a density of 11kg/m$^3$ or 50mm thick polyester insulation with a density of 14 kg/m$^3$ in the cavity.</td>
</tr>
</tbody>
</table>
6.4 Alternative solutions

The acceptable treatment packages are not the only option to achieve compliance with the environmental noise goals, and are based on general assumptions regarding likely building constructions, traffic noise spectra, and internal furnishings and finishes.

In practice, these aspects vary considerably and there are often cases where these provisions may be unreasonably excessive.

Proponents can obtain specialist input via a detailed assessment to determine the minimum requirements for their own specific project and site conditions.

Approval agencies may assess alternative designs offered by proponents by:

- determining whether the alternative design(s) and design basis were developed using specialist input – for example, check for the contents listed in Section 7.1.1, and / or proof of review by an acoustics specialist (Section 3.4.3);
- referral to the Noise Regulation Branch of the State environment agency for review; or
- review by a third party independent acoustical consultant.
7 Detailed noise assessment and management

In these guidelines, a detailed assessment refers to the process of an outright assessment against the environmental criteria (e.g. the noise target and the noise limit), and / or also documentation (sometimes presented separately as a noise management plan) outlining what actions will be undertaken to address any non-compliance.

7.1 Detailed assessment

Detailed assessments under the Policy are generally referred to as noise assessment reports, acoustic reports, noise reports or similar.

Detailed assessments are used to carefully consider high risk issues or complex arrangements. For this reason, detailed assessments should only be undertaken by competent professionals.

If a detailed assessment is to be undertaken, it should be done as early as possible. This is because once transport infrastructure or a building is constructed, the practicable options for correcting a non-compliant construction to the original design target are generally highly expensive and in many cases completely unaffordable.

7.1.1 What should be included

- The document must have some level of document control, detailing the date of issue, author and reviewer.

- An adequate description of the project should be provided including all relevant information such as background history, relevant previous studies, noise issues addressed and the commissioned scope of work.

- Site details should include location of major transport corridor/s, noise receiver locations (i.e. existing and proposed future residential areas) site information, and assessment locations. Maps with site details and a scale and north point should be provided.

- Applicable noise criteria must be accurately referenced and justified. These include:
  - Outdoor noise criteria in SPP5.4 (refer to Table 1 in the Policy)
  - for proposed new major road and rail infrastructure or proposed noise sensitive developments.
  - Where applicable, indoor noise criteria in Section 5.3.1 of the Policy.
  - Agreed noise-level objectives for redevelopment of major road and rail infrastructure (determined in consultation with the State environment agency and / or based on existing transport noise levels via site measurements).

- The methodology for the assessment and stated assumptions must be reported. Noise assessment reports are typically based on either noise measurement or noise modelling prediction (Section 7.1.2).

- Results must be presented clearly in a suitable format (tabulated format for individual point calculations and contour maps for grid point calculations) and should incorporate details of outcomes for measurement and / or modelling prediction and the stated level of uncertainty. Noise levels should be rounded to the nearest whole number.

- Discussion and / or recommendations must also be provided and summarised within the document where some level of non-compliance and / or direct opportunity to improve amenity is found.

- A summary must be provided which clearly outlines to the intended reader the projected level of compliance with applicable criteria.

7.1.2 Measurement and modelling prediction

The level of transport noise at a particular point in relation to the noise source can be determined through a combination of field measurement and modelling prediction.

Noise measurements are appropriate if the transport corridor already exists, as they are generally more representative of conditions specific to the site. Some corrections will still be needed to forecast future noise levels or assess the performance of any scheduled measures. The noise measurement methodology should be in accordance with Appendix C.

Noise prediction models are appropriate where transport corridors are not yet operating at their forecast capacity; for proposed new major
7.1.3 Indoor noise levels

In noise-sensitive development proposals where indoor spaces face outdoor areas that are above the noise limit, mitigation measures should be implemented to achieve acceptable indoor noise levels as specified in section 5.3.2 of the Policy.

For noise sensitive buildings other than residential buildings, e.g. educational buildings, the Policy specifies acceptable indoor noise levels “that meet the recommended design sound levels in Table 1 of Australian Standard AS 2107:2000 Acoustics – Recommended design sound levels and reverberation times for building interiors”. AS2107 specifies two criteria for recommended sound levels: a ‘satisfactory’ level and a ‘maximum’ level.

For the purposes of these Guidelines, it is recommended that the satisfactory levels generally be used, however if the maximum levels are to be used then the detailed assessment report should justify the reasons for using this approach.

7.1.4 Acceptable methodologies

General

- Predicted traffic noise levels should be reported only to the nearest whole number.
- Various industry traffic noise prediction models produce overall single-number noise emission results, however where internal noise levels are to be predicted, assessment should include octave band analysis of noise sources, diffraction/shielding effects and the varying sound reduction through building elements.
- Cadastral and topographical data inputs to a predictive noise model can be obtained from the Landgate website: [www.landgate.wa.gov.au](http://www.landgate.wa.gov.au)
- Future traffic levels can be based upon a logarithmic relationship which assumes incoherent addition of sound pressures, i.e. 
  \[ \text{Change (dB)} = 10 \log_{10} \left( \frac{\text{Future traffic}}{\text{existing}} \right) \] or suitable modelling appropriate to Austroads traffic engineering guidelines.
- The cumulative impact from existing road and rail noise sources should be included in the assessment for new noise-sensitive development, but not for new transport infrastructure.
- Under SPP5.4, assessment criteria for new road or rail infrastructure proposals apply to ground floor levels only; however for informative purposes, detailed assessments can include analysis for receivers at all anticipated floor levels.
- For the purpose of assessing freight trains only, day and night noise levels must be assessed on the basis of each period having a minimum of one train per hour, and estimates of LAeq,Night values may be made on the basis of a maximum train passby noise level Lmax or sound exposure level L Leq.

Numerical codes

- Road traffic may be assessed using the UK Calculation of Road Traffic Noise (CoRTN) algorithm which yields L10,18 values, provided a suitable conversions to Australian conditions are made to obtain the appropriate L10,16 values, or L10,8 values as specified in the Policy.
It is preferable to undertake direct noise measurements of the roadway being investigated to determine the existing differences between relevant noise parameters. Where this is not possible, reference should be made to the DEFRA publication “Method for Converting the UK Road Traffic Noise Index L_{eq,10,18hour} to the EU Noise Indices for Road Noise Mapping”, which provides conversion formulae.

Also, where traffic noise measurement data are unavailable and the road traffic noise model cannot be calibrated against existing noise conditions, it is standard practice to apply a further correction of -1.7dB.6

- Rail traffic may be modelled using the Nordic Rail Prediction Method (Kilde 130-1984) algorithms with appropriate corrections for train class, speeds and local conditions. The algorithms have L_{eq,24hour} noise prediction outputs, and they can be readily converted to an L_{eq,18hour} or L_{eq,10hour} noise level using a logarithmic relationship.

- ISO9613-2, suitably corrected Harmonoise or Nord2000 algorithms may be used exclusively with neutral wind and stable temperature conditions for environmental attenuation effects for source to receiver distances up to 100 metres.

Beyond this distance or alternatively, variance due to environmental meteorological effects should be considered. Reference may be made to guidance on noise modelling provided by the Department of Environmental Regulation.

Source heights and receiver locations

- Unless otherwise determined by a competent person for specific situations, the noise source heights should be as follows7:
  - Passenger vehicles (Austroads Class 1 and 2) +0.5m
  - Heavy vehicles (Austroads Class 3 and up) – Engine +1.5m
  - Heavy vehicles (Austroads Class 3 and up) – Exhaust +3.6m
  - Passenger rail 0m
  - Freight rail locomotive +4.0m
  - Freight rail wagons +0.8m

• Receiver heights for predictions should be 1.4 metres above floor level.
• For new or redevelopment of road and rail infrastructure proposals, at the most exposed habitable façade8 of existing noise-sensitive premises, at ground floor level only.
• For new noise-sensitive development proposals, at the most exposed habitable façade of the proposed buildings, at heights of 1.4 metres above all proposed floor levels.

Source corrections

- For rail surface discontinuities or tight curves, the following corrections may be applied to segment exposure (L_{eq}) or maximum L_{max}S levels:
  - Mechanical/uneven joint +3dB
  - Curve radius less than 600m +3dB
  - Turnout +6dB
  - Curve radius less than 300m +8dB
  - Diamond crossing +10dB

The above is a basic guide and other corrections for effects such as bridges, brake noise, car bunching, blowers, air compressors and wheel-rail components should be stated.

• Accepted corrections for various road surfaces are:
  - 14mm chip seal +3.5dB
  - 10mm chip seal +2.5dB
  - 5mm chip seal +1.5dB
  - Dense graded asphalt 0.0dB
  - Novachip -0.2dB
  - Stone mastic asphalt -1.5dB
  - Open graded asphalt -2.5dB

• For the CoRTN algorithms, it is recommended to apply the ‘three strings’ approach, i.e. use three road strings of different heights to represent traffic from passenger vehicles, heavy vehicle engines and exhausts.

For the passenger vehicle, the noise emissions are determined in accordance with the CoRTN algorithms.

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6 This adjustment comes from a 1982 Australian Road Research Board study, “An Evaluation of the U.K. DoE Traffic Noise Prediction” (Report No 122, ARRB – NASSRA Planning Group) which found that the CoRTN calculations were over-predicting road traffic noise by this margin.

7 Rail noise source heights are relative to the wheel contact surface of the tracks.

8 The most exposed habitable façade would not include the wall or door of an enclosed carport or the like.
For the heavy vehicles, noise level corrections of -0.8dB and -8dB are recommended to be applied to the string of engines and exhausts respectively, relative to the source sound power level of heavy vehicles. As such, the noise model can reasonably reflect the difference of noise emissions from heavy vehicle engines and exhausts, and the overall noise emissions from the heavy vehicles in accordance with the CoRTN algorithms remain unchanged.

Receiver corrections

- When predicting transport noise levels immediately outside a façade, a +2.5dB façade correction is to be applied for both road and rail to account for the increase in noise caused by reflections from the façade. Similarly, for internal noise predictions based on a measurement immediately outside a façade, 2.5dB should first be deducted.

7.2 Noise management plans

Noise management plans outline commitments in relation to noise mitigation and management. Having received a detailed noise assessment report and considered reasonable and practicable mitigation measures, the developer or infrastructure provider may be required to prepare a comprehensive noise management plan.

A specific noise management plan may be requested by authorities as part of the approvals process, in which case it should contain:

- a brief description of the relevant features of the project;
- a copy or summary of the detailed noise assessment report;
- outcomes of consideration of reasonable and practicable noise-mitigation measures;
- results of community and stakeholder consultations;
- a description of the noise-mitigation measures to be adopted;
- a description of other noise management measures, e.g. post-construction noise monitoring, complaint response;
- predicted noise levels for the project incorporating the adopted measures; and
- a statement of commitment to the above, identifying responsible parties and timing.

Noise management plans are commonly prepared on behalf of the developer or infrastructure provider by an acoustics engineer or other consultant. It is expected that the developer or infrastructure provider will commit to the implementation of the noise management plan.
8 Additional information

This section lists various relevant standards and information resources.

8.1 Key terms

Units of noise (dB)

Sound and noise is measured in decibels (dB). It is important to realise that the decibel is just a ratio between two quantities, and there needs to be a common reference value (‘re’).

The usual reference value for sound pressure in air is 20 micropascals (20 μPa) – a value associated with the minimum threshold of typical hearing.

Although the correct way to present a unit of a sound pressure level against this reference value is in ‘dB re 20 μPa’, the reference value is very common and some simplify the measurement result to just ‘dB’.

The equivalent continuous level (L_{eq})

Transportation noise levels can change very quickly so it is more convenient to use a single number which is equivalent (‘eq’) in level (L) to the total sound energy measured over a given time period.

Sound is also perceived differently according to its frequency. In general, human hearing is less sensitive to airborne sound at lower frequencies (such as a rumble) compared to those at higher frequencies (like a hiss).

To correct this difference, noise levels measured and assessed under the Policy are adjusted according to their frequency using what is called the ‘A-weighting’. A-weighted values have the subscript ‘A’; some instead use the unit ‘dB(A)’.

Given the above, the unit here used is the ‘A-weighted equivalent continuous sound pressure level’, or L_{eq}. The Policy uses this industry-standard term L_{eq} to describe noise levels.

Care should be taken to note that L_{eq} values are averages over generally large time periods. Consider that a quiet night with a loud single event (such as a road train passing) may result in a higher degree of annoyance than the overall L_{eq} value may indicate.

Weighted sound reduction index (R_w) and traffic correction term (C_t):

The airborne weighted sound reduction index (R_w), and R_w with traffic correction (R_w+C_t), are published by manufacturers and suppliers. R_w and R_w+C_t values can be determined by acoustical consultants and/or measured in accordance with AS ISO 717.1. Higher R_w+C_t values infer higher levels of sound insulation.

8.2 Standards

- International Organization for Standardization (ISO) Guides to the expression of uncertainty in measurement (ISO GUM series).

8.3 References and further guidance

The document Reducing Traffic Noise - A Guide for Homeowners, Designers and Builders (published in 1991 by the State Pollution Control Commission, Roads and Traffic Authority, NSW Department of Housing) also provides appropriate guidance on site planning, housing design and building techniques to reduce road traffic noise. It can also be applied to rail noise.

The following references are useful for those seeking to enhance the aesthetic quality of transport noise barriers:

- Environmental Noise Barriers – A Guide to their Acoustic and Visual Design;
- A Guide to Visual Quality in Noise Barrier Design; and
- Noise Wall Design Guideline – Design guidelines to improve the appearance of noise walls in NSW.
WAPC publications


Noise effects

- ICBEN – The International Commission on the Biological Effects of Noise, Congress held every three years, http://www.icben.org

Noise measurement and prediction

- Department of Environment and Climate Change (NSW), Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects (2007).

- Department of Transport, Calculation of Road Traffic Noise (1988).
- Main Roads Western Australia, Traffic Noise Measurement Specification Rev 5 (Refer to MRWA website for further information).

Noise-compatible land use planning

- Western Australian Planning Commission, Residential Design Codes of Western Australia (2008).

Road and rail infrastructure design

- Austroads, Modelling, Measuring and Mitigating Road Traffic Noise, Chapter 16 - Noise Control at the Source (2005).

Noise barriers


Residential design and construction


• Government of South Australia Department of Planning, Transport and Infrastructure, Reducing noise and air impacts from road, rail and mixed land use — A guide for builders, designers and the community (2013).

Vibration


• British Standard BS6472-2008: Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80 Hz).


Appendix A – Quick guide for planners

The Western Australian State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning (SPP 5.4) applies to:

- proposals for new noise sensitive developments;
- new railways or major roads, or major redevelopments of existing railways or major roads, or minor developments of existing railways that are likely to adversely affect a noise sensitive land use; and
- new freight-handling facilities.

Noise-sensitive development is “any proposed development for a noise-sensitive land use that would normally require planning approval by a local government authority or the WAPC.” Where applicable, the Policy and these Guidelines must be complied with.

A.1 When to apply the Policy

The Policy is best applied as early as possible to:

- scheme amendment;
- structure planning such as outline development and detailed area plans;
- subdivision and development applications; and
- Development Assessment Panel proposals.

A.2 How to apply the Policy

It is recommended that Section 4 of these Guidelines is read first, as it discusses in detail various noise controls and the process by which the Policy may be applied.

A.2.1 Noise-sensitive development

At any stage in planning, anyone can use the following approach in regards to noise-sensitive development:

1. Determine if the proposal has (or will have) a noise-sensitive land use.
2. Determine the site location and its proximity to road and rail transport infrastructure, for a 20 year planning horizon.
3. Generally, if the noise-sensitive location is:
   a. within 300 metres of a major freeway, primary freight road, freight railway or terminal;
   b. within 100 metres of a passenger railway or secondary roads; or
   c. otherwise reasonably close to current or future road and rail infrastructure at the discretion of WAPC or local government;

   then undertake a screening assessment, otherwise it may be declared that no further measures are presently required under SPP 5.4.

4. The screening assessment process will have one of three outcomes; noise levels for each day and night period either:
   a. meet the noise target, in which case no further measures are required;
   b. exceed the noise target but not the noise limit, in which case mitigation measures need to be implemented; or
   c. exceed the noise limit, in which case a detailed assessment (noise assessment report) in accordance with Section 7 is required.

5. If the noise target is exceeded under items 4(b) or 4(c) above, then a notification on title is required to advise further landowners of noise risks (Section 4.5).

The following sample worksheet can be used to perform a basic screening assessment (page 45).

A.2.2 Road and rail infrastructure

All road and rail infrastructure proposals should first undertake a detailed assessment, which demonstrates to the satisfaction of the State environment agency that no further measures are required.

If this finds noise levels will be in excess of the noise target, check that both a noise assessment report and a noise management plan are prepared in accordance with Section 7.

The Policy includes several Schedules outlining primary freight roads and rail routes; where these are unclear or insufficient the process will require direct consultation with state transportation departments.
SPP5.4 Screening assessment worksheet

Determine individual lot / site address __________________________________________________________________________ Date of assessment __________

Confirm if proposal has likely noise sensitive land uses such as:

- a building occupied solely or mainly for residential or accommodation purposes or rural premises;
- caravan park, camping ground or other tourist accommodation;
- hospital, home or institution for the care of persons, a rehabilitation centre, home or institution for persons requiring medical or rehabilitative treatments;
- tavern, hotel, club premises, reception lodge or other premises that provide accommodation for the public;
- educational institution;
- aged care or child care;
- prison or detention centre; and
- public worship.

(a) List the nearest roads and any railways up to 300 metres from the site.
(b) For each future road or railway, estimate the distance from property boundary to edge of road carriageway or centre of rail line, in metres.
(c) For each future road and railway, estimate latest average traffic volume per day (e.g. Main Roads Traffic Digest for roads), or forecast based on 20-year horizon.
(d) Estimate LAeq,Day from Table A.1, dB.

(e) Add correction if the two highest values in highlighted column (d) above are:
   - dB equal or within 1dB of each other = +3dB;
   - different by 2 or 3dB = +2dB;
   - different by 4-7dB, +1dB

(f) Add correction for forecast change in volume over 20 years dB (default is +2dB addition, and 0dB if forecasted volumes already used)

(h) Sum of maximum LAeq,Day value from highlighted area of column (d) and above corrections

From value obtained in (h) above, select as follows:

<table>
<thead>
<tr>
<th>LAeq,Day (dB)</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>less than 55dB (day period noise target), OR less than 50dB for any freight rail.</td>
<td>No further measures are required.</td>
</tr>
<tr>
<td>between 55dB and 60dB inclusive, OR between 50dB and 55dB for any freight rail.</td>
<td>Arrange for notification on each title of property affected according to Guidelines Section 4.5.</td>
</tr>
<tr>
<td>above 60dB (noise limit), OR above 55dB for any freight rail.</td>
<td>Arrange for notification on each title of property affected according to Guidelines (Section 4.5).</td>
</tr>
<tr>
<td></td>
<td>Detailed noise assessment required by competent professional to the satisfaction of authorities. The assessment may recommend some application of acceptable treatment provisions according to Section 6.3 or alternatives according to Section 6.4.</td>
</tr>
<tr>
<td></td>
<td>Confirm proponent is committed to implementing the recommendations of the noise assessment or separate noise management plan, and seek evidence of installation as deemed necessary.</td>
</tr>
</tbody>
</table>
### Implementation Guidelines for State Planning Policy 5.4

#### Road and Rail Transport Noise and Freight Considerations in Land Use Planning

Table A.1: Estimated outdoor noise level for road and rail screening assessments

<table>
<thead>
<tr>
<th>Road</th>
<th>Characteristics</th>
<th>Distance from edge of carriageway (metres)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Primary road / distributor (Urban) 80-100 km/hr and 7.5% heavy vehicles</td>
<td>20,000</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td></td>
<td>35,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>65,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>80,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>120,000</td>
</tr>
<tr>
<td></td>
<td>(Rural) 90-110 km/hr and 10% heavy vehicles</td>
<td>5,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20,000</td>
</tr>
<tr>
<td>Secondary road / district distributor (Urban) 60-80 km/hr and 2.5% heavy vehicles</td>
<td>20,000</td>
<td>67</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>60,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rail</th>
<th>Characteristics</th>
<th>Distance from rail centreline (metres)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Passenger (LAeq,Day), dB</td>
<td>80 km/hr Type A, 2 car sets.</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>200</td>
</tr>
<tr>
<td></td>
<td></td>
<td>300</td>
</tr>
<tr>
<td>Freight (LAeq,Night), dB</td>
<td>Typical mix S or Q, P and D, AB, DA etc. or L class</td>
<td>1 per hour (minimum) 65</td>
</tr>
<tr>
<td></td>
<td>locomotives, and numbers of wagons varying from 45 to 90. Notch settings 5-8.</td>
<td>2 per hour 68</td>
</tr>
</tbody>
</table>

1) Assumes level soft open ground between traffic and building, neutral weather effects. All values include +2.5 dB façade correction. It is acceptable to estimate values between intervals.

11) For freight rail traffic, levels for the day and night periods (LAeq,Day and LAeq,Night) are assumed equal to reflect the 24-hour nature of operations. Assessment is to be made on the basis of a one-hour period which includes at least one typical train movement. Site measurements to confirm are recommended.
Appendix B – Quick guide for developers

The following provides a short guide to the Western Australian State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning (SPP 5.4) from the perspective of a property development proponent.

This section is not intended for transport infrastructure proposals – refer to Section 5.

B.1 Determining if SPP5.4 applies to your development

SPP5.4 land use applies to proposals for new noise-sensitive developments.

Noise-sensitive development could include proposals for development, subdivision, structure plans, scheme amendments and new local planning schemes.

Such development would typically include:

- a building occupied solely or mainly for residential or accommodation purposes;
- rural dwelling;
- caravan park or camping ground or other tourist accommodation;
- public worship;
- hospital, home or institution for the care of persons, a rehabilitation centre, home or institution for persons requiring medical or rehabilitative treatments;
- educational institution;
- tavern, hotel, club premises, reception lodge or other premises that provide accommodation for the public;
- aged care or child care; and
- prison or detention centres.

The Policy must be complied with; and while the Guidelines are not mandatory, due regard should be given to them.

B.2 How SPP5.4 is applied

Figure B.1 on page 48 outlines the basic process of assessment under SPP5.4. It refers to a screening assessment and a detailed assessment.

The screening assessment may be undertaken at any stage by anyone, however the approval authority (local government or WAPC) may determine at what stage the screening assessment will be done. It is likely to be required during the scheme amendment stage, although it may also be required at the structure plan/subdivision stages if not undertaken previously.

A simple worksheet is provided in Appendix A. It may be completed during strategic planning stages prior to scheme amendments. The screening assessment determines the extent of treatments likely to be required to comply with the environmental noise goals. On the basis of a screening assessment, local authorities may decide that:

(a) no further treatments are required;
(b) mitigating measures (such as acceptable treatment provisions listed in Section 6.2) are required; or
(c) that a detailed assessment in accordance with Section 7 needs to be undertaken by a competent professional (e.g. by an acoustics engineer).

A detailed assessment can be undertaken at any stage of the development. While it represents an initial cost, it provides the opportunity for a tailored compliant design with lower overall material cost and / or constraint than the acceptable treatment provisions.

If the development is occurring prior to the construction of a nearby planned major road or railway, the developer should seek details of the infrastructure design and work with the infrastructure provider to develop a joint noise management plan to outline responsibilities and commitments in relation to noise mitigation.
Appendix B – Quick Guide for Developers

Implementation Guidelines for State Planning Policy 5.4
Road and Rail Transport Noise and Freight Considerations in Land Use Planning

**Identification of Development Site and Surrounding Context**
Identify development site and surrounding context, including all nearby existing and future road and rail transport infrastructure corridors.

**Assessment of Noise Sensitivity**
Is it likely that any part of the development will be noise sensitive in the next 20 years, and reasonably close to current or future road and rail infrastructure? (Appendix A.2.1)
Or is the development site within a Special Control Area requiring that a noise assessment be undertaken?

**Screening Assessment**
Determine noise sensitive usages within the study area, noting 20 year planning horizon. Then for each representative location, undertake a screening assessment.

**Detailed Assessment**
If all determined noise levels are below the noise target for each time period and noise sensitive location, no further action at this stage required with respect to noise mitigation – proceed with assessment of other factors.

**Detailed Assessment and Determination**
Detailed assessment and determination of appropriate mitigation treatments to meet SPP5.4 Noise Targets (or otherwise agreed). Noise management plan also required if the Detailed Assessment indicates potential for ongoing non-compliance with the Noise Targets.

**Subsequent Steps**
Submit to stakeholders for review and discuss potential implementation, cost sharing for procurement and maintenance with authorities and transport infrastructure providers. Amend documentation to reflect that agreed. Arrange for notification on title accordingly. Then proceed with assessment of other factors.

**Acceptable Treatment**
“Acceptable treatment” packages (aka ‘quiet house design’) may be specified according to Section 6, OR
At the option of the developer, a detailed assessment (Section 7) may instead be prepared which certifies compliance with the noise targets via alternative means.

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Figure B.1: Development Approval stage design management of sensitive noise impacts.
B.2.1 Quiet house design

Acoustic design guidelines for buildings are discussed in detail in Section 6.2 and they include:

- the building to shape away from the corridor;
- the building to shield courtyards and open space areas from the corridor;
- noise-sensitive spaces, such as bedrooms, to be shielded from noise by positioning less sensitive spaces, such as the garage, bathrooms and laundry, closer to the corridor;
- screen walls to be used to protect small outdoor areas or to shield windows; and
- the use of upgraded construction materials such as thicker glass and acoustic door and window seals.
Appendix C – Guidelines for measurements and on-site verification

Measurements and / or on-site verification may be required as part of any detailed assessment or noise management plan.

Generally, these should be undertaken in accordance with relevant standards (Section 8.2) and the associated reporting must document:

- equipment/instruments used
- measurement duration
- measurement locations
- equipment settings
- calibration details
- ambient/background activities/measurements (if indicated)
- relevant weather conditions (wind speed and direction)
- uncertainty of measurement
- operational conditions of noise source(s)
- adjustments made to measured levels (e.g. façade correction if free field)

Several of these aspects are discussed in the following sub-sections.

C.1 Equipment details

Noise measurements should generally follow the procedures set by Australian Standard 2702-1984 “Acoustics – Methods for the Measurement of Road Traffic Noise” and Australian Standard 2377-2002 “Acoustics – Methods for the Measurement of Railbound Vehicle Noise”. Variations to these standards may be acceptable, provided that:

- they are grounded by professional experience;
- are reasonably justified; and
- that any implications are addressed in the measurement report.

Sound-level meters are used to measure noise. They need to be of the ‘integrating averaging’ type to measure the L_{eq} values for comparison with the SPP5.4 criteria. The meter must have a Class 1 or Class 2 level of precision, in accordance with AS IEC 61672 (usually marked on the body of the instrument).

Sound-level meters must be checked for accuracy in the field using a calibrator which provides a known sound level for reference. The calibrator must be compliant with AS IEC 60942 for Class 1 and Class 2 calibrators. The meter must be checked before and after each measurement period, with a drift in sensitivity not to exceed + or − 0.5dB.

Noise measurements must be carried out with instruments that have been calibrated by a NATA-accredited laboratory within the previous two years.

Attended measurements are always preferable; however traffic volumes change on a daily and weekly basis. In such situations, unattended noise data loggers, or noise monitors, are often used with post-measurement analysis of the data used to verify the noise results.

The duration of the measurement needs to account for the likely change in noise levels in various time periods each week. Consider the possible change in peak hour traffic to evening periods, freight route schedules, and changes in patterns between weekdays and weekends or public holidays. A deployment period of one week is generally sufficient, so that if weather or other environmental behaviour affects the result, at least three representative measurements are usually obtained in each time period.

Where a competent person considers that a recorded value from an unattended noise logger has been influenced by a noise source other than traffic, they are to exercise their professional judgment and adjust or omit the abnormal measurement value.

C.2 General procedures

- Where a noise-sensitive building exists, e.g. an existing residence adjoining a major transport corridor where a new major road or railway is proposed, the microphone is to be located one metre from the outside of the most exposed, habitable façade of that building.
- The microphone shall be at least one metre from any corner of the building, and 1.4 metres (+/-0.2 metres) above ground floor level.
- The microphone shall not be located in front of any door or window...
that can be opened, or, where this is not practicable, the door or window shall not be opened during the measurement period.

- Where no building exists, the microphone shall be located at least 3.5 metres from a reflecting surface (other than the ground plane) and a +2.5dB correction should be added to the measured noise levels to account for façade reflection.

- Where transport noise measurements are taken indoors, the microphone should be placed at least one metre from any window, door or wall surface and ideally in the centre of the room. All windows and doors must be closed during the measurement period. Indoor transport noise levels should be measured only in habitable spaces.

- A photograph should be taken to show the location of measurement location for future, repeat measurements.

- The monitoring equipment shall be capable of recording at least the $L_{Aeq}$ parameter. It may also be useful for the equipment to be capable of measuring $L_{Amax}$, $L_{A1}$, $L_{A10}$ and $L_{A90}$ parameters.

- The monitoring equipment should be set to record using the Slow time weighting.

- The number of measurement locations is to be determined on a project-by-project basis by a competent person. Austroads provides the following guidance in their report “Modelling, Measuring and Mitigating Road Traffic Noise”.

### C.3 Measurement duration

- The measurement period should not be less than 15 minutes and not more than one hour, to minimise data loss due to short-term noise events while capturing representative periods of transport activity.

- For major roads, a minimum of three ‘valid’ 24-hour weekday periods must be obtained for unattended measurements. This may require the monitoring equipment to be left for longer periods, depending on conditions. For railways, the measurement period should cover a sufficient number of train passes to obtain an acceptable level of repeatability.

- Noise measurements during school holidays, public holidays or weekends are generally not to be used for road and passenger rail traffic (freight rail may not change during these periods). Similarly, monitoring should be discarded during times of abnormal traffic flow (e.g. during construction works).

### C.4 Weather conditions

- The validity of data is mainly dependent on weather conditions. Acceptable weather conditions are defined by Main Roads Western Australia and have been adopted for the purpose of this guidance. They are as follows:

  - road or rail surface is to be dry;
  - source-receiver distance up to 20 metres:
    - variable wind during a 24-hour period up to 19 kilometres per hour; or
    - calm conditions, or continuous positive wind up to 19 kilometres per hour.
  - source-receiver distance greater than 20 metres:
    - variable wind during a 24-hour period up to 19 kilometres per hour; or
    - calm conditions, or continuous positive wind up to 11 kilometres per hour.

- Unacceptable weather conditions will not necessarily invalidate the measurements but will require comment.

<table>
<thead>
<tr>
<th>Type of Area</th>
<th>Minimum number of noise monitoring locations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sparsely settled rural areas</td>
<td>About 20% of the residences within 500m of the alignment</td>
</tr>
<tr>
<td>Rural townships</td>
<td>About 10% of the residences nearest the alignment</td>
</tr>
<tr>
<td>Built-up areas</td>
<td>At least one site at each major crossroad and at least one site between crossroads</td>
</tr>
</tbody>
</table>
• Where adjustments are made to hourly measured data, based on professional judgment, this must be highlighted. A reasonable estimate of an affected one-hour period can normally be obtained by taking the average of the hourly values on either side.

• Hourly and averaged data, where tabulated, can be shown to one decimal place (up to three significant figures); however, values for comparison with criteria are to be rounded to the nearest whole number.