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1 INTRODUCTION

These guidelines should be read in conjunction with State Planning Policy 5.4: Road and Rail Noise (SPP 5.4 or the policy). These guidelines replace the Implementation Guidelines for State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning published in 2014.

1.1 PURPOSE OF THESE GUIDELINES

These guidelines provide supporting information for decision-making authorities, planners, landowners/proponents, referral agencies and infrastructure providers to implement SPP 5.4. Specifically, they assist with:

- determining appropriate land-use planning in areas impacted by transport noise;
- identifying, assessing and managing the impacts of transport noise; and
- specifying the requirements of the policy at each stage of the planning process.

1.2 HOW TO USE

These guidelines are structured to help proponents or decision-maker to undertake the preparation and assessment of a planning proposal to which the policy applies. Further guidance on noise assessment methodology, site verification, checklist and example templates for management plans are included in the appendix.

1.3 MAPPING

The policy and these guidelines are supported by maps which specify Western Australia’s road and rail networks to which the policy applies. These road and rail networks are considered of key economic importance due to their high vehicle movements and or freight handling functions but can also adversely affect land adjacent to these corridors due to noise (Refer to schedules 1 to 3).

The roads and rail, along with approximate trigger distances for each transport corridor classification, can also be viewed on the Department of Planning, Lands and Heritage public map viewer, PlanWA at [www.dplh.wa.gov.au](http://www.dplh.wa.gov.au). The inclusion of other transport corridors and their trigger distance will be added to the mapping in the event of a road/rail being reclassified into one of the corridor types listed in Table 1 of the policy (for example, a region scheme amendment, an update to Main Roads Western Australia’s Road Information Mapping System and/or an existing closed freight rail line becoming operational again) and considered by the Western Australian Planning Commission (WAPC) where it can be demonstrated that the noise generated by those corridors is sufficient to justify application of the policy.

1.4 TRIGGER DISTANCE

The trigger distance set within Table 1 of the policy act as a mechanism that requires a proponent to investigate likely noise levels either through a preliminary screening assessment using Table 2: noise exposure forecast and/or through a more comprehensive site specific noise management plan.

The trigger distances has been informed by comprehensive noise monitoring and modelling, which is reflected in Table 2 of these guidelines, which demonstrates the correlation between distance from the noise source and the level of noise to be experienced assuming flat level ground.
2 POLICY APPLICATION

This section provides guidance to determine if and when SPP 5.4 applies as outlined in section 4 and Table 1 of the Policy.

Western Australia’s planning system includes strategic and statutory planning functions set out in the Planning and Development Act 2005. The planning system is hierarchical, requiring increasing levels of detail as a proposal progresses through regional, district and local planning to subdivision and development of individual sites. It is intended that transport noise considerations and any mitigation measures are addressed as early as possible in the planning process, with the level of information provided becoming progressively more detailed.

Table 1 of these guidelines provides an overview of how the policy is addressed at each stage of the planning process.

2.1 HIGH-ORDER STRATEGIC PLANNING

High-order planning strategies and frameworks guide land-use and infrastructure planning through broad coordination of land-use provision and distribution, infrastructure and community facilities. At this stage of planning, the principle aim is to distinguish the type and function of transport corridors and the desired land-uses to avoid land-use conflict from the impact of transport noise. This is achieved through measures that rely on compatible land-use zones, and/or reserves to provide spatial separation to adequately mitigate noise constraints and meet the policy’s noise target (refer to section 4: Noise avoidance and mitigation).

As a minimum, high-order strategic planning should clearly identify and map the transport corridors to which the policy applies and the surrounding areas potentially impacted by transport noise. A noise level contour map will provide greater detail on the transport noise impacts (refer to section 3: Assessing Noise), however not all information may be known at the early planning stages and accordingly generic assumptions with regard to vehicle volumes and share of heavy vehicles may be used for these studies.

Where the provision of noise-sensitive land-use and/or development within the trigger distance of transport corridors cannot be avoided or in some instances is encouraged such as in proximity to urban corridors, high-order planning documents should outline options for site-specific statutory planning processes to be addressed later in the planning process such as the designation of new zones and reserves to adequately mitigate noise constraints and meet the policy’s noise target.

2.2 SCHEMES AND AMENDMENTS, STRUCTURE PLANS AND ACTIVITY CENTRE PLANS

The level of information available at this stage of planning should allow for a more comprehensive assessment of the noise constraints. There is still an opportunity to avoid the introduction or intensification of noise-sensitive land-use and/or development particularly in the vicinity of strategic freight routes; and to consider design solutions that utilise street and lot configuration, and densities that inform built form outcomes (refer to section 4: Noise avoidance and mitigation).

The noise exposure forecast table and/or a noise level contour map can be used to facilitate the introduction or intensification of noise-sensitive land-uses and/or development in areas likely to be affected by transport noise. Where the noise estimated to be affected by noise levels is above the target, then some form of noise mitigation and or a more detailed noise management plan will be required (refer to section 3: Assessing Noise). While noise management plans represent an initial cost, they provide the opportunity to avoid land-use conflict and achieve better land planning outcomes. Once land is zoned and/or a transport corridor is constructed, the practicable options for achieving the noise target are more limited and generally more expensive.

Designation of a Special Control Area may be considered where special circumstances require the need for specific controls, such as within the vicinity of known noisy sections of freight rail corridors. The designation of a Special Control Area may assist to address site-specific noise modelling; topography and natural environment; existing and proposed built environment; site-specific noise mitigation; and/or interface management necessary to address railways.
2.3 SUBDIVISION AND DEVELOPMENT

This stage of planning generally focuses on physical mitigation measures that, once implemented, will contribute to the achievement of the policy’s noise target. An assessment of the noise impacts should have been undertaken prior to this stage of planning as per section 2.1 and 2.2. In the absence of any previous planning, and/or previous noise assessment, the provision and/or intensification of noise-sensitive land-use and development should be determined to be appropriate through an initial screening assessment using the noise exposure forecast table. **Table 2: noise exposure forecast** will assist with determining how the subject land or development is affected by noise and what exposure category. Subsequently this will determine whether a deemed-to-comply route is suitable for the planning proposal or if it requires a site-specific assessment as part of a noise management plan.

In a proposed residential development, typically only the first one or two rows of houses adjoining the transport corridor is significantly affected and therefore be required to undertake further steps to mitigate noise impacts. This includes those housing sites that are separated from the transport reserve by a service road. Proponents are advised the screening capacity of frontage development may vary from site to site, and can only be confirmed after undertaking an initial screening assessment or a detailed noise assessment has been undertaken.

More complex and large scale subdivision and development applications may require the preparation of a site-specific noise management plan that may result in a recommendation to construct physical barriers and/or quiet house requirements. Noise management plans are automatically required if from undertaking an initial screening assessment using the noise forecast table, planning proposals fall into exposure categories D and E. Conditions should be imposed as appropriate in order to ensure that the recommendations of the noise exposure forecast table and/or noise management plan are implemented, as relevant. A local development plan or other localised planning mechanisms may be required to support the design and coordination of appropriate development outcomes that address noise constraints.

For guidance on where and when a noise barrier or quiet house requirements are appropriate refer to **section 4: Noise avoidance and mitigation**.

If there are measures recommended in a noise management plan that relate to the subsequent development stage, it is WAPC’s expectation that such measures will be implemented at that stage.

Notifications on title are required for all lots of subdivision and development proposals where noise levels are forecasted to exceed the policy’s outdoor noise target, informing of the existence of road and/or railway transport noise (refer to **Appendix 5 - Recommended wording for a notification on title**).

2.4 ROAD AND RAILWAY CONSTRUCTION PROPOSALS

Road and railway transport infrastructure providers are responsible for ensuring that proposals for new infrastructure, and for upgrades of infrastructure constituting a major upgrade, are compliant with the relevant requirements of the policy. For these proposals it is expected that a noise management plan is prepared on behalf of the transport infrastructure providers to be reviewed by relevant government agencies.

It is expected that transport infrastructure providers will implement design and construction features aimed at minimising the generation and emission of noise (as far as is practicable within the transport corridor), with the objective of achieving the noise target. Land-use planning controls and infrastructure upgrades can only mitigate noise to a certain extent; it is imperative that infrastructure providers contribute to minimising the generation and emission of noise.

While the policy does not apply to increases in road and rail noise in the absence of physical construction works, infrastructure providers are encouraged to maintain or enhance assets to reduce noise levels.
Other types of proposals that are likely to impact on noise-sensitive land-use and/or development and as such may also require a noise management plan include:

- road or rail infrastructure (including intersections) that result in undergrounding or grade separations;
- roads that have significant gradients or may become a future freight route; or
- rail segments that have newly introduced elements that could create additional noise impacts, such as track switch points, crossings, or track curve radii less than 600 metres.

Infrastructure providers should consider the policy measures and the benefits of preparing a noise management plan where:

- the nature of the noise emissions likely to emanate as a result of the minor redevelopment will probably increase in level or duration, for example, a new crossing where there was none previously or tighter track curvature leading to new or additional wheel squeal;
- projected noise levels exceed the noise target; and/or
- past consultations with State environmental agencies indicated a need to apply policy measures on similar minor redevelopments.
### Table 1: **Policy measures and implementation at different planning stages**

<table>
<thead>
<tr>
<th>Planning stage</th>
<th>Steps to address</th>
<th>Plan provision</th>
<th>Implementation responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High-order strategic planning</strong></td>
<td>• Map of major transport/freight routes</td>
<td>• Land-use plan</td>
<td><strong>WAPC</strong> - Preparation and assessment of strategies, schemes and plans, and assessment of accompanying noise level contour maps, noise exposure forecasts and noise management plans.</td>
</tr>
<tr>
<td></td>
<td>• Estimates of traffic volumes through a traffic management strategy</td>
<td>• Policy advice</td>
<td><strong>Local government</strong></td>
</tr>
<tr>
<td></td>
<td>• Identify potential noise-sensitive land-use through noise exposure screening assessment and/or contour map</td>
<td>• Contour map</td>
<td>- Determining whether Special Control Areas should be established.</td>
</tr>
<tr>
<td></td>
<td>• Review land-use compatibility and seek avoidance</td>
<td>• Noise exposure forecast-screening assessment</td>
<td>- Preparing local planning policies consistent with this policy to complement or clarify requirements of the policy and help inform and guide the preparation, assessment and discretionary decision-making of planning applications at the local government level.</td>
</tr>
<tr>
<td></td>
<td>• Where proposals cannot be avoided consider appropriate land-use configuration and density</td>
<td></td>
<td><strong>State Government transport portfolio</strong> - Provide input into strategic planning including route selection and design and ensuring that the policy mapping is kept updated as new infrastructure and major upgrades of infrastructure proceed.</td>
</tr>
<tr>
<td></td>
<td>• Determine if management plan is appropriate</td>
<td></td>
<td><strong>Department of Water and Environmental Regulation</strong> - Provide expert technical advice primarily in relation to noise management plans and the effectiveness of performance-based recommendations.</td>
</tr>
<tr>
<td></td>
<td>• Recommend policy advice including whether Special Control Areas should be established</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Region and local schemes and amendments</strong>, <strong>structure plans and activity plans</strong></td>
<td>• Identify potential noise-sensitive land-use through noise exposure screening assessment</td>
<td>• Land-use plan</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Where proposals cannot be avoided consider design of the street and lot layout; and building configuration</td>
<td>• Policy advice</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Determine if management plan is appropriate</td>
<td>• Contour map</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Comply with Special Control Area provisions</td>
<td>• Noise exposure forecast-screening assessment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Consideration to the preparation of a site-specific local development plan</td>
<td>• Management plan</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Consideration to mitigation measures such as quiet house requirements</td>
<td>• Special Control Areas</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Local planning policy</td>
<td></td>
</tr>
<tr>
<td><strong>Subdivision and development</strong></td>
<td>• Identify potential noise-sensitive land-use through noise exposure screening assessment</td>
<td>• Noise exposure forecast-screening assessment</td>
<td><strong>WAPC</strong> - Assessment and determination of subdivision plans, and accompanying noise level contour maps, noise exposure forecasts and noise management plans.</td>
</tr>
<tr>
<td></td>
<td>• Where proposals cannot be avoided consider design of the street and lot layout; and building configuration</td>
<td>• Contour map</td>
<td><strong>Local government</strong> - Assessing as per the above in addition to assessing and determining development applications, local development plans and building permits in accordance with the requirements of the policy. This includes ensuring any quiet house requirements required through a local development plan is implemented through the building permit process.</td>
</tr>
<tr>
<td></td>
<td>• Determine if management plan is appropriate</td>
<td>• Management plan</td>
<td>- Advising the <strong>WAPC/Department of Planning, Lands and Heritage</strong> of proposals for new infrastructure likely to trigger application of the policy and for major upgrades of such infrastructure.</td>
</tr>
<tr>
<td></td>
<td>• Comply with Special Control Area provisions</td>
<td>• Local development plan</td>
<td><strong>Department of Water and Environmental Regulation</strong> - Provide expert technical advice primarily in relation to noise management plans and the effectiveness of performance-based recommendations.</td>
</tr>
<tr>
<td></td>
<td>• Consideration to the preparation of a site-specific local development plan</td>
<td>• Subdivision conditions for noise mitigation measures such as quiet house requirements, construction of noise walls and notification on title.</td>
<td><strong>Department of Mines, Industry Regulation and safety (building commission)</strong> - Administering the Building Act 2011 and Building Regulations 2012 that set out the building approval process for Western Australia, including the requirement to obtain a building permit to carry out building work. Administering and applying the Building Code of Australia in Western Australia.</td>
</tr>
</tbody>
</table>
3 ASSESSING NOISE

This section sets out the key assessment and management tools of noise impacts to enable implementation of the policy measures outlined in section 6 of the policy.

For further guidance on measurement and on-site verification and noise assessment methodology, refer to Appendix 3 and 4.

3.1 UNDERSTANDING NOISE

Sound may be simply described as what we hear. Noise is unwanted sound, which carries a variety of negative effects that can adversely affect community health and amenity. Figure 1 shows a range of typical noise levels.

Figure 2 illustrates the road noise source (typically engine exhausts, braking vehicle aerodynamics-flow turbulence and the interaction between wheel and road); and rail noise (generally interaction/shunting between cars and wheel squealing on tight curves) to which the policy applies.

3.2 NOISE TARGET

Table 2 of the policy sets out the noise targets that apply to proposals for new noise-sensitive land-use and/or development or new/upgraded major roads and railways assessed under this policy.

Transport 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).

<table>
<thead>
<tr>
<th>Noise Level</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Painful</td>
<td>Jet aircraft take off at runway edge</td>
</tr>
<tr>
<td></td>
<td>Rock concert</td>
</tr>
<tr>
<td>Noisy</td>
<td>225mm angle grinder at 1 metre</td>
</tr>
<tr>
<td></td>
<td>Heavy industrial factory interior</td>
</tr>
<tr>
<td>Quiet</td>
<td>Shouting at 1 metre</td>
</tr>
<tr>
<td></td>
<td>Freeway at 20 metres</td>
</tr>
<tr>
<td></td>
<td>Normal conversation at 1 metre</td>
</tr>
<tr>
<td>Very Quiet</td>
<td>Night time outdoor noise target</td>
</tr>
<tr>
<td></td>
<td>Office air conditioning</td>
</tr>
<tr>
<td></td>
<td>Typical bedroom design target</td>
</tr>
<tr>
<td></td>
<td>Whisper, rural bedroom at night</td>
</tr>
<tr>
<td></td>
<td>Human breathing at 3 metres</td>
</tr>
<tr>
<td></td>
<td>Threshold of typical hearing</td>
</tr>
</tbody>
</table>

Note: The levels above are LAeq (dB re 20 μPa). 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.

Figure 1: Typical noise levels

Figure 2: Experience of noise
Given the above, the unit used in this policy is the ‘A-weighted equivalent continuous sound pressure level’, or $L_{Aeq}$. Care should be taken to note that $L_{Aeq}$ values are averages over 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 $L_{Aeq}$ value may indicate.

These guidelines acknowledge the limitations in applying the $L_{Aeq}$ value to short-term noise events such as freight rail noise. For this reason the noise exposure forecast table 2 in these guidelines applies a greater level of conservatism in terms of predicted noise levels and assumptions around the frequency of events for freight rail. These guidelines also include additional quiet house design packages (A/B/C+) that take into account the need to mitigate short-term noise events through additional building construction standards, where deemed appropriate and endorsed by the decision-making authority.

### 3.2.1 Exceeding the noise target

SPP 5.4 recognises that in some instances it may not be ‘reasonable’ or ‘practicable’ to implement noise mitigation measures in order to achieve the noise target. The determination of ‘reasonable’ or ‘practicable’ is to be to the satisfaction of the responsible decision-maker.

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.

Some level of discretion may be applied to take into consideration the reasonable and practical matters. This generally would apply in established urban areas where development has already occurred or been planned for making it difficult to strictly comply with the noise target.

Discretion may also be applied in regional areas, where there may be greater variation in factors which affect noise emissions such as seasonal traffic volumes, often varying low frequencies, lower ambient sounds levels, lower building densities and different building standards to take into consideration bushfire resistance or bushfire attack level (BAL) ratings.

There is a general presumption against applying discretion for planning of ‘greenfield’ areas and for proposals located in exposure category D and E of the noise forecast table for strategic freight transport corridors.

#### 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, have reasonable efforts been made to design, relocate or vegetate a proposed noise barrier to address community concerns about the noise barrier height?

Whether a noise mitigation measure is reasonable might include a consideration of:

- the noise reduction benefit provided
- the number of people protected
- the relative cost vs benefit of mitigation
- road conditions (speed and road surface) significantly differ from noise forecast table assumptions
- existing and future noise levels, including changes in noise levels
- aesthetic amenity and visual impacts
- compatibility with other planning policies

#### About the term ‘practicable’

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

These may include:

- limitations of the different mitigation measures to reduce transport noise
- competing planning policies and strategies
- safety issues (such as impact on crash zones or restrictions on road vision)
- topography and site constraints (such as space limitations)
- engineering and drainage requirements
• access requirements (for driveways, pedestrian access and the like)
• maintenance requirements
• bushfire resistance or BAL ratings
• suitability of the building for acoustic treatments.

3.3 NOISE EXPOSURE FORECAST TABLE

When it is determined that the policy applies to a planning proposal, proponents should refer to Table 2: noise exposure forecast table prior to the submission of a planning proposal. The noise exposure forecast table enables proponents and/or decision-makers to undertake a simple initial screening assessment to estimate the potential risk of noise impacts on noise-sensitive land-use and/or development within the trigger distance of road or railway infrastructure (refer to figure 3).

The noise exposure forecast table is based on conservative estimates of future noise levels which have been informed from field data obtained across a broader number of sites and been verified by a professional acoustic engineer.

The noise exposure forecast table will determine whether any further action is required; and if so provides an opportunity for deemed-to-comply measures through the application of quiet house packages. This will help to reduce the need for a more comprehensive noise management plan which is often more costly and can take longer to prepare, assess and determine, particularly for simple small scale subdivision and development proposals.

For larger planning proposals it is typically more appropriate and cost-effective to undertake a more detailed noise management plan.

The noise exposure forecast can also be used to prepare a noise level contour map to inform high-order planning documents and planning proposals, particularly where transport noise may present an unacceptable impact on noise-sensitive land-use and/or development which may result in consideration of more compatible land-uses.

When using the table it is acceptable to estimate noise levels where values lie between distance intervals. The table forecast levels includes in-built cumulative noise factors for urban areas. Where a proposal being assessed is within the trigger distance of more than one transport corridor to which the policy applies, the greater noise forecast level should be chosen.

The noise levels in the noise exposure forecast table are based on level and open ground between the noise source and the receiver. Where screening development exists the proponent can apply a 4dB reduction which results in a change in noise exposure category. Refer to section 3.3.1 for more information.

The noise exposure forecast can also be used to prepare a noise level contour map to inform high-order planning documents and planning proposals, particularly where transport noise may present an unacceptable impact on noise-sensitive land-use and/or development which may result in consideration of more compatible land-uses.

When using the table it is acceptable to estimate noise levels where values lie between distance intervals. The table forecast levels includes in-built cumulative noise factors for urban areas. Where a proposal being assessed is within the trigger distance of more than one transport corridor to which the policy applies, the greater noise forecast level should be chosen.

The noise levels in the noise exposure forecast table are based on level and open ground between the noise source and the receiver. Where screening development exists the proponent can apply a 4dB reduction which results in a change in noise exposure category. Refer to section 3.3.1 for more information.

Figure 3: Initial screening assessment
### Table 2: Noise exposure forecast

<table>
<thead>
<tr>
<th>Transport Corridor Classification</th>
<th>Forecast noise exposure category based on lot distance (m) from edge of nearest main road carriageway (not entrance/exit ramps)</th>
<th>Forecast noise exposure category based on lot distance (m) from edge of nearest main road carriageway (not entrance/exit ramps)</th>
<th>Forecast noise exposure category based on lot distance (m) from edge of nearest main road carriageway (not entrance/exit ramps)</th>
<th>Forecast noise exposure category based on lot distance (m) from edge of nearest main road carriageway (not entrance/exit ramps)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10</td>
<td>20</td>
<td>30</td>
<td>40</td>
</tr>
<tr>
<td>Strategic freight/major traffic route</td>
<td>2 to 4 lanes</td>
<td>72</td>
<td>70</td>
<td>66</td>
</tr>
<tr>
<td></td>
<td>5 to 6 lanes</td>
<td>74</td>
<td>71</td>
<td>69</td>
</tr>
<tr>
<td></td>
<td>7 to 8 lanes</td>
<td>76</td>
<td>72</td>
<td>69</td>
</tr>
<tr>
<td></td>
<td>9 to 10 lanes</td>
<td>77</td>
<td>73</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>10 or more lanes</td>
<td>78</td>
<td>74</td>
<td>71</td>
</tr>
<tr>
<td>Other significant freight/traffic routes</td>
<td>Urban Region Scheme areas 60-90 km/hr</td>
<td>1 to 2 lanes</td>
<td>67</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td>3 to 6 lanes</td>
<td>69</td>
<td>66</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td>1 to 2 lanes</td>
<td>70</td>
<td>67</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>3 to 6 lanes</td>
<td>74</td>
<td>70</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td>Rural areas 60-80 km/hr</td>
<td>1 to 2 lanes</td>
<td>62</td>
<td>59</td>
</tr>
<tr>
<td></td>
<td>3 to 4 lanes</td>
<td>66</td>
<td>63</td>
<td>61</td>
</tr>
<tr>
<td></td>
<td>Rural areas 100+ km/hr</td>
<td>1 to 2 lanes</td>
<td>67</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td>3 to 4 lanes</td>
<td>69</td>
<td>66</td>
<td>64</td>
</tr>
</tbody>
</table>

The noise levels in noise exposure forecast table are based on a number of assumptions including:
- Level and open ground between the noise source and the receiver and neutral weather effects
- All values include a +2.5 dB façade correction, typical ground absorption, some scattering from buildings in line with measured data for urban and rural scenarios; and include in-built cumulative noise factors for urban areas
- Development building outline is within 10metres of the lot boundary facing transport corridor
- Number of road lanes roughly scale with traffic volume (at up to ~18,000/vehicle per day for a 2 lane road)
- Railway noise levels are based on level straight track with adjustments included for future growth over 20 years in line with historical averages
- For railway noise levels 3 dB per doubling of traffic per hour can be added if higher noise levels may be expected near tight curves and turnouts

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**Passenger railways**
- Fremantle, Midland and Thornlie main lines only
- All other metro passenger rail lines, and where multiple metro rail services share the same transport corridor

**Freight railways, up to 1 movement per hour**
- 72 68 65 63* 62** 60* 59* 58* 57* 56 55 54 53 52 51 50 49 48
3.3.1 Noise reductions from existing screening buildings and structures

The noise exposure forecast table contains noise levels assuming open and level ground. It does not account for existing screening buildings, terrain, structures or noise walls that are located between the noise source and the receiver, which enable reductions in noise levels lower than what is presented in the noise exposure forecast table. However, to take into consideration existing screening, a one-off reduction in exposure level which equates to a 4dB deduction (i.e. quiet house C to B) can be applied in the following situations when using the noise exposure forecast:

- an existing building or structure of similar scale and height which screens more than 50 per cent (not intermittently) of the most exposed frontage of a noise-sensitive land-use and/or development (Figure 4);
- an existing and or proposed solid continuous 1.8 metre noise wall/fence on the entire lot boundary facing the corridor without gaps or openings; and
- through a combination of permanent structures and terrain there is no reasonable direct line of sight between occupants of vehicles on any part of the transport corridor and assessable positions on the noise-sensitive premises (Figure 5).

Caution should be applied when considering a reduction to noise levels contained in the noise exposure forecast table if proponents desire a higher quality acoustic environment that would be achieved through the customised performance-based mitigation measures.

This is particularly relevant for above ground floor levels not screened that have a direct line of sight to the road or rail line and are therefore still significantly impacted by the noise source.

A site-specific noise management plan is required to quantify the noise reduction performance of existing screening buildings and structures beyond this reduction.
3.4 NOISE MANAGEMENT PLAN

A noise management plan provides a site-specific noise assessment and recommended noise mitigation measures to achieve the policy’s noise targets. The noise management plan has two parts: a noise assessment for the site providing contours with any recommendations for amelioration; and a plan with the commitment for noise amelioration to be implemented.

They are commonly prepared by a competent professional such as an acoustics engineer or other consultant on behalf of the developer or proponent.

Those accepted as being suitably qualified have appropriate expertise and experience in the assessment of transportation noise and:

• are eligible to hold membership of the Australian Acoustical Society (AAS) in the grade of Member or Fellow (designated by the post-nominal letters M.A.A.S. or F.A.A.S. respectively); and/or
• represent a company holding current corporate membership of the Australian Association of Acoustical Consultants (AAAC).

An acoustics engineer is defined as a person eligible for professional membership to the Institute of Engineers Australia (MIEAust).

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.

Section 2 outlines when a noise management plan is to be prepared, with a preference of it being prepared as early as possible in the planning process.

For noise-sensitive land-use and/or development proposals, where there is an existing road or railway, noise measurement to inform preparation of the plan must be undertaken. Noise modelling in the absence of noise measurement should only be undertaken where a road or railway is proposed but not yet constructed. Appendix 3 includes a checklist for road and rail noise modelling.

Appendix 4 provides a recommended template for the content of a noise management plan which typically outlines:

• how the proposed noise mitigation measures will achieve the noise target (see Figure 6 and 7)
• recommended mitigation measures for the proposal including extent of noise walls/bunds
• residential lots with quiet house requirements
• the stage of the planning process, responsible parties, staging and timing
• a description of other noise management measures, for example post-construction noise monitoring, ongoing maintenance requirements
• outcomes of community and stakeholder consultations (where a noise wall is proposed on a common boundary).

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 to ensure that what is designed and constructed remains consistent with the noise management plan.

The Department of Water and Environmental Regulation provides noise-related advice and expertise on management plans submitted with planning proposals, as well as other stakeholders potentially affected such as the State government transport portfolio. Local government may play a role in the clearance of certain conditions.
3.5 NOISE LEVEL CONTOUR MAP

A noise level contour map is a scale map of the subject site illustrating the likely noise levels and associated noise exposure categories. It is typically used for large scale planning proposals to provide decision-makers with information on the likely impacts of transport noise upon the subject site (refer to Figure 6 and 7).

The noise level contour map can be prepared in two different ways.

1. A map can be prepared using the noise level information contained within the Table 2: Noise exposure forecast.

2. A map can be prepared using site-specific noise level information provided by a suitably qualified acoustic consultant/engineer, usually as part of the preparation of a noise management plan.

![Figure 6: Noise management plan contour map - prior to any proposed noise mitigation](image1)

![Figure 7: Noise management plan contour map - showing noise mitigation measures](image2)
4 TECHNIQUES FOR NOISE AVOIDANCE AND MITIGATION

This section outlines the various ways to minimise road and rail noise from the strategic planning stage through to the detailed design at the development approval stage.

The most straightforward way of minimising the noise-related impact of transport corridors is to avoid new noise-sensitive land-use and/or development in close proximity to such infrastructure, in particular freight transport routes.

4.1 TRANSPORT CORRIDOR FUNCTION

To determine whether physical separation or other compatible land-uses are appropriate it is important to understand the function of the transport corridor. This will help inform the level and type of noise mitigation measures that is commensurate with the function of the transport corridor and preferred land-use interface.

In general, strategic freight routes (road and rail) and major traffic routes (as per Table 1 of the policy) are defined by noisy, high speed routes with restricted access; and lower amenity environments. Therefore it is reasonable to expect more stringent noise measures that may consist of a combination of spatial separation, noise barriers, compatible land-uses and quiet house design.

The remaining transport corridors (other significant freight/traffic routes and passenger rail) that the policy applies to are generally characterised by lower speed, higher amenity environments therefore mitigating noise through built form outcomes rather than physical separation and noise barriers will help preserve the streetscape character and amenity.

4.1.1 PHYSICAL SEPARATION

At the strategic planning stage proponents should consider route alignment for a new road or railway so that strategic freight routes are adequately separated from existing or future noise-sensitive land-uses critical to achieving overall noise management outcomes.

Increasing the distance between transport corridors and noise-sensitive areas is effective but not a total solution as it carries potential cost impacts in lower land utilisation. The planning and design should also consider the likely hours of operation of those routes, for example whether they will carry increased numbers of freight vehicles during night periods. Natural ground topography can also 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.

Acquiring or preserving adequate space in the corridor reserve in a defined reserve along road/rail corridors should be considered in new estates. The vesting or management authority for such reserves on greenfield site subdivisions should be the relevant authority, as it is important to ensure that suitable set-back distances to receivers can be achieved particularly, bunds and barriers are be constructed close to either the source or receiver, but preferably closer to the source.

Physical separation between the transport infrastructure and noise-sensitive areas can also include:

- Local streets and road reserves including shared paths or cycle lanes that provide further separation from the noise source, promote passive surveillance of the street and allow for planting and landscaping; and
- Open public spaces of a size and function that can be designed to ensure the spaces are usable to residents and designed with areas that are quieter.

4.1.2 COMPATIBLE LAND-USES

The allocation of non-noise-sensitive land-uses in the vicinity of transport corridors can help to create a physical barrier protecting land beyond particularly noise-sensitive land-use and/or development from noise and also help manage other potential land-use interface issues.
Along freight corridors, service, commercial and industrial activity would be more appropriate and would benefit from proximity to transport links. Establishment and maintenance of land along transport corridors for non-noise-sensitive development is achievable through the designation of appropriate land-use zones in local planning schemes.

Along urban activity corridors, non-noise-sensitive land-uses such as commercial buildings, including mixed-use developments, community and recreational facilities (not defined as a noise-sensitive use) will help to manage noise and also help to support public transport and reduce car dependence. Transport strategies should be considered to help reduce overall vehicle noise such as reducing vehicle speed.

Any noise-sensitive development along urban activity corridors should take into consideration quiet house design principles; and should generally discourage noise barriers such as noise walls.

For locations where land zoned for residential purposes abuts or is in close proximity to a transport corridor, opportunities for non-noise-sensitive development are more limited but do exist. Drainage corridors and community facilities are examples of non-noise-sensitive development that could be located along transport corridors.

4.2 NOISE WALLS

Where a subdivision or development backs onto a strategic freight corridor and/or major traffic route from which access is not permitted, it is generally acceptable to provide a continuous wall along the property boundary. This will help reduce the noise levels and minimise the need for more stringent building construction standards through quiet house design. However noise walls should not be encouraged on other roads, particularly along urban activity corridors as these routes are generally dependent on activated streetscapes, pedestrian access and built form that supports public transport and reduce the reliance on cars.

Any noise-sensitive development along urban activity corridors should take into consideration quiet house design principles; and should generally discourage noise barriers such as noise walls.

Noise walls – also referred to as noise screens and barriers – are a solid wall or fence designed to reduce airborne noise. In this context, ‘walls’ usually refer to heavy or primary walls immediately adjacent to transport infrastructure. Fences usually refer to lighter and shorter structures located on residential lot boundaries and are limited in effectiveness for noise attenuation.

Commercially purpose-built noise walls used near Perth major roads generally reduce transport noise \( L_{Aeq} \) levels by between 5dB and 10dB, depending on the design (materials, density, height and other such factors) of the barrier and the topography of the site. Reducing noise by more than this with a wall is usually very difficult and often not economical. For other non-commercially built masonry walls a reduction of 5dB in noise levels is possible if built to block the line of sight to the source.

Noise walls constructed in close proximity to a residential boundary with outdoor area generally should not exceed 3.6 metres in height above the natural ground level. However, larger walls may be mutually agreed with consideration of other factors as local terrain, visual impact and residential sensitivities as discussed in the following subsections.

![Figure 8: Effect of a noise barrier on the path of noise](image-url)
4.2.1 Positioning

The most effective place to position a noise wall is generally as close as possible to the road or railway, as this will tend to reduce the overall height of the wall required to attenuate traffic noise (see Figure 8). However, construction of such a barrier is usually limited to transport infrastructure providers who operate within the province of the road or railway reserve.

Figure 9 depicts that 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. 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 10 identifies the need for frequent permeable pedestrian and cyclist access or breaks through the wall that can be achieved using a gap created by overlapping walls. Excessively long walls (along cycle paths) without breaks should be avoided.

4.2.2 Materials

Noise walls must be continuously airtight or without gaps but 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.

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.

Lightweight fences constructed from polymer, timber, fibre cement and steel can also be effective noise walls with professional engineering input regarding location and construction, particularly in locations immediately adjacent to the noise source or noise-sensitive spaces. Lightweight materials may be sheeted on both sides of supports to form a double layer construction for improved performance, with no gaps between materials or between the base of the fence and the ground. Weatherproof sound absorptive linings, angling and edge detailing can also be used to provide substantial improvements over default straight edge hard faced walls depending on application.
4.2.3 Reducing visual impacts

Often the strongest resistance to implementing noise walls is in relation to their appearance. The design should consider scale, proportion, deliberate use and variation of colour, texture, pattern, transparency, height, materials, non-linear forms and lighting to improve the aesthetics of the noise wall. The design should consider the local character taking account of the urban fabric and natural, historic and cultural context. In some cases it may also be appropriate to integrate the noise wall design with an entrance statement or public art. Where practical planting can assist with breaking down the scale of a noise wall by reducing its visual dominance, which is more critical on the receiver side of the transport noise barrier.

Figure 11 shows the use of transparent viewing panels, textured surfaces and planting to reduce the visual impact of noise walls and Figure 12 shows how blockwork, planting and the incorporation of other pedestrian elements give a noise wall a more human scale.

4.3 EARTH MOUNDS/BUNDS

Landscaped earth mounds or bunds can provide benefits in terms of natural landscape values and good visual screening where there is fill and space available. This is particularly the case in rural areas where there is a greater expectation in reducing landscape and amenity impacts and preserving the route for its strategic tourism value.

The use of earth mounds should be discussed with the decision-making authority early in the planning process to ensure they are placed (preferably into a reserve, vested in the local government or amalgamated as part of the road reservation) so to avoid future implementation issues, particularly in terms of maintenance or management arrangements.

In urban areas earth mounds or bunds are generally not suitable as they require large footprints. They also attract ongoing maintenance for weeding, erosion, litter, fire prevention, and may need structural retaining of the soil to enable steeper vertical slopes to bring the bund closer to the transport corridor, or to enable the retention of mature trees on lower slopes.

Bunds will often need to be built slightly higher than an equivalent vertical wall because the top of the bund cannot be placed as close to the noise source and requires significant horizontal spacing. 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.
4.4 QUIET HOUSE DESIGN

Quiet house design aims to reduce the impact of noise to meet the noise targets where reasonable and practical, through a combination of lot and building design and configuration; and if required through bespoke construction standards that generally rely on improving wall and roof insulation and glazing thickness.

4.4.1 BUILDING DESIGN AND CONFIGURATION

Acoustic design to mitigate noise generally recommend:

- positioning noise-sensitive spaces such as bedroom and living areas away from noise source and less noise-sensitive spaces, such as the garage, bathrooms and laundry, closer to the noise source (Figure 13);
- private and communal open space located furthest away from the noise source, preferably screened by the building itself;
- use of podiums and extended facade elements to provide useful shielding of floors above and provide distance offset (Figure 14);
- designing balustrades to be continuous without gaps to shield noise sources below;
- fully enclosing balconies with operable windows to create winter gardens;
- applying sound-absorptive/diffusive elements to the underside of balcony ceilings (soffit) to reduce reflected sound into the dwelling; and
- avoiding designs and configurations which ‘collect’ and ‘focus’ noise (Figure 15).

![Figure 13: Locating noise-sensitive rooms away from the noise source](image1)

![Figure 14: Shielding effects of commercial podium developments](image2)

![Figure 15: Acoustic design for the effective orientation of buildings in transport noise zones](image3)
The positioning of noise-sensitive spaces away from noise sources should not be considered in isolation and should be balanced against other relevant considerations such as solar access, privacy and crime prevention through urban design.

Refer to State Planning Policy 7.3 Apartment Design for more detailed guidance on built form design for multi-storey buildings.

4.5 QUIET HOUSE REQUIREMENTS

Where outdoor and indoor noise levels received by a noise-sensitive land-use and/or development exceed the policy’s noise target, implementation of quiet house requirements (Table 3) is an acceptable solution.

Quiet house requirements can be proposed early in the planning process (scheme amendment/structure plan stages) either by utilising the noise forecast table but more likely from a site-specific detailed noise management plan. At the subdivision and development stage utilising the quiet house requirements in the noise forecast table can provide a deemed to comply route and conditioned accordingly. A combination of quiet house design and physical barriers may be required in circumstances where the noise levels exceed the criteria by 11dB or more and conditioned accordingly.

Quiet house design aims to minimise the extent of noise insulation needed to meet the indoor noise level standards and provide for at least one protected outdoor living area. The approaches to acoustic treatment of a building is generally through providing acceptable glazing thicknesses (refer to Figure 17) and improving insulation to walls, roofs and above-ceiling space.

Table 3 provides three levels of quiet house packages that have been designed specifically to address noise from road and rail and be applied as a deemed-to-comply solution. Proposed quiet house design packages within a noise management plan can also take into account the need to mitigate short-term noise events from freight rail through additional building construction standards, that will increase the level of protection for residents, as per the additional quiet house + requirements specified in both Table 2 and Table 3 of these guidelines.

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

Table 3 also introduces several new terms defined below and illustrated in Figure 16:

- ‘Facing’ the transport corridor (red): Any part of a building facade is ‘facing’ the transport corridor if any straight line drawn perpendicular (at a 90 degree angle) to its nearest road lane or railway line intersects that part of the facade without obstruction (ignoring any fence).
- ‘Side on’ to transport corridor (blue): Any part of a building facade that is not ‘facing’ is ‘side on’ to the transport corridor if any straight line, at any angle, can be drawn from it to intersect the nearest road lane or railway line without obstruction (ignoring any fence).
- ‘Opposite’ to transport corridor (green): Neither ‘side on’ nor ‘facing’, as defined above.
### Table 3: Quiet house requirements

<table>
<thead>
<tr>
<th>Exposure Category</th>
<th>Orientation to corridor</th>
<th>Walls</th>
<th>Acoustic rating and example constructions</th>
<th>Roofs and ceilings of highest floors</th>
<th>Outdoor living areas</th>
<th>Mechanical ventilation / air conditioning considerations</th>
</tr>
</thead>
</table>
| **A Quiet House A** | Facing                  | Bedroom and indoor living and work areas to Rw+Ctr 45dB | • A row of 92mm studs at 600mm centres with:  
  - Resilient steel channels fixed to the outside of the studs; and  
  - 9.5mm hardboard or 5mm fibre cement sheeting or 11mm fibre cement weatherboards on one layer of 10mm board cladding fixed to the outside of the channels; and  
  - 75mm glass wool (1.4kg/m3) or 7.5mm polyester (146kg/m3) insulation, positioned between the studs; and  
  - Two layers of 16mm fire-protective grade plasterboard fixed to the inside face of the studs.  
  - Single leaf of 100mm brick masonry with 13mm cement render on each face  
  - Double brick: two leaves of 90mm clay brick masonry with a 20mm cavity between leaves. | As per ‘Facing’ above, except Rw+Ctr values may be 3dB less, e.g. glazed sliding door with 10mm glass and weather seals for bedrooms. | As per Quiet House A Bedrooms. | As per Quiet House A, except that  
  • ‘Side-on’ requirements same as ‘Facing’.  
  • All windows comprise minimum 6 mm thick laminated or toughened glass in sealed awning or casement frames.  
  • Evaporative air conditioning systems are not recommended.  
  • No external doors for bedrooms with entry ‘Facing’ transport corridor. | No specific requirements |
| **A Quiet House A+** | All                      | As per Quiet House A, except double leaf masonry / brick construction only. | As per Quiet House A Bedrooms. | As per Quiet House A, except that  
  • ‘Side-on’ requirements same as ‘Facing’.  
  • All windows comprise minimum 6 mm thick laminated or toughened glass in sealed awning or casement frames.  
  • Evaporative air conditioning systems are not recommended.  
  • No external doors for bedrooms with entry ‘Facing’ transport corridor. | As per Quiet House A Bedrooms from up to 60% area (Rw+Ctr 34 dB). | As per Quiet House A Bedrooms from up to 60% area (Rw+Ctr 34 dB). | No specific requirements |
| **B Quiet House B** | Facing                  | Bedroom and indoor living and work areas to Rw+Ctr 50dB | • A row of 70mm x 35mm timber studs or 64mm steel studs at 600mm centres;  
  - A cavity of 25mm between leaves;  
  - 50mm glass wool or polyester cavity insulation (R2.0+) insulation between studs; and  
  - One layer of 10mm plasterboard fixed to the inside face  
  - Single leaf of 220mm brick masonry with 13mm cement render on each face  
  - 150mm thick undulated concrete panel or 200mm thick concrete panel with one layer of 13mm plasterboard or 13mm cement render on each face  
  - Double brick: two leaves of 90mm clay brick masonry with:  
    - A 50mm cavity between leaves  
    - 50mm glass wool or polyester cavity insulation (R2.0+)  
    - resilient ten where required to connect leaves  
  - Double brick: two leaves of 110mm clay brick masonry with a 50mm cavity between leaves and R2.0+ cavity insulation | As per Quiet House A ‘Facing’ above (Rw+Ctr values may be 3dB less, or max % area increased by 20%). | As per Quiet House A Bedrooms. | As per Quiet House A Bedrooms from up to 60% area (Rw+Ctr 36 dB). | As per Quiet House A Bedrooms from up to 60% area (Rw+Ctr 36 dB). | No specific requirements |
<p>| <strong>B Quiet House B+</strong> | All                      | As per Quiet House B example above, except use double leaf masonry construction only. | As per Quiet House B Bedrooms. | As per Quiet House B Bedrooms. | As per Quiet House B Bedrooms. | As per Quiet House C (to Rw+Ctr 40dB). | As per Quiet House C (to Rw+Ctr 40dB). | No specific requirements |</p>
<table>
<thead>
<tr>
<th>Exposure Category</th>
<th>Orientation to corridor</th>
<th>Walls</th>
<th>External doors</th>
<th>Windows</th>
<th>Roofs and ceilings of highest floors</th>
<th>Outdoor living areas</th>
<th>Mechanical ventilation / air conditioning considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>C Quiet House C</td>
<td>Facing</td>
<td>Bedroom and indoor living and work areas to Rw+Ctr 50dB</td>
<td>• As per Quiet House B example above</td>
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<td>To Rw+Ctr 40dB</td>
<td>As per Quiet House B</td>
<td>• Acoustically rated openings and ductwork to provide a minimum sound reduction performance of Rw 40dB into sensitive spaces.</td>
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<td>As per Quiet House C, except</td>
<td>As per Quiet House C, except that</td>
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<td>To Rw+Ctr 65dB</td>
<td>As per Quiet House C, except</td>
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<td>• ‘Side-on’ requirements same as Quiet House C ‘Facing’.</td>
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<td>• the roof must be concrete or terracotta tile construction with sarking (i.e. no steel sheet roof option).</td>
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<td>• All windows into habitable areas comprise minimum 6 mm thick glazing in sealed awning or casement frames. Polyester (e.g. upVC) window framing and hardware which cannot rattle loose should be used throughout.</td>
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<td>• Ceilings to bedrooms must be constructed from at least 2 overlapping layers of flush plasterboard.</td>
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<td>• Evaporative air conditioning systems are not recommended.</td>
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<td>Side-on</td>
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Footnotes:

- The airborne weighted sound reduction index (Rw) and traffic correction term (Ct) are published by manufacturers/suppliers, can be determined by acoustical consultants or measured in accordance with AS ISO 717.1: Higher Rw+Ct values infer greater sound insulation. All values are minimum Rw+Ct (dB).
- Example construction for different external wall ratings of Rw+Ct 45dB and 50dB are provided and are listed within Specification F5.2 in Volume 1 Part F of the National Construction Code. These values are based on the installation and sealing of joints and penetrations in accordance with Specification F5.2.
- Window and external door sound reduction values provided are based on the provision of suitable acoustic seals to prevent sound leakage. To comply with the above ratings, all external glass windows and doors specified under requirements A, B and C, must have the following:
  - Operable windows and external doors must have a seal to restrict air infiltration fitted to each edge and doors must have a drip seal to provide an air tight seal when closed.
  - Within doors or fixed framing, glazing must be set and sealed using an artigally arranged non-hardening sealant, soft rubber (elastomer) gasket and/or glazing tape, or be verified by manufacturer or approved person that the construction system as to be installed achieves the relevant Rw+Ct value.
  - 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.
  - Glazing referenced can be monolithic, laminated or toughened safety glass.
- 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 caulkings with non-hardening mastic or suitable mastic.
The approval agency advises that the development proponent can elect to implement quiet house A treatment or prepare a noise management plan which demonstrates to the satisfaction of the approval agency how the requirements will otherwise be met. The proponent elects to implement the first option, which for $L_{day}^{eq} 58 \text{dB}$ corresponds to quiet house A according to the noise exposure forecast table.

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 $R_w + Ctr$ value of 28dB. From Table 3, 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.

Side-on to the corridor, the area calculation includes the balcony door and two windows, which at 11 m² / 20 m² is 55 per cent. At 60 per cent, the requirement for ‘Facing’ is $R_w+Ctr 31 \text{ dB}$, so for side-on it is 3 dB less and therefore $R_w+Ctr 28 \text{ dB}$. From Table 3 this can be achieved with the same systems as those facing.

The proponent may also here nominate a glass sliding door system acoustically rated to $R_w 31 \text{ dB}$ (or $R_w+Ctr 28 \text{ dB}$) by a manufacturer or professional acoustical consultant.

If for example, the window facing the road is now increased to 60 per cent (or 12m² in this example), then the acoustic rating must be increased to $R_w+Ctr 31 \text{ dB}$, requiring 10 millimetres fixed pane glass or keep the same six millimetres glass but use a sealed awning type frame.

**Figure 17:** Example of determining acceptable treatment glazing
5 OTHER CONSIDERATIONS

5.1 AT SOURCE (ON-CORRIDOR)

Management of noise at its source (known as ‘at-source’ or, more specifically for road and railway noise, ‘on-corridor’) is beyond the scope of the planning system. As such, effective mitigation of road and railway transport noise is reliant on measures that minimise the generation and emission of noise.

Controlling noise at its source is often the most cost-effective way to minimise noise impacts as part of the planning and design of new road and railway infrastructure proposals. The key noise mitigation options available to transport infrastructure operators are briefly summarised as follows:

Design and construction

- 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 (for example noise from loose items).
- Minimising gradients. Reducing gradients reduces noise from freight vehicles. This can be an effective noise mitigation tool. Engines work harder and produce 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.

Maintenance

- Investment in new vehicles and rolling stock. Investing in modern road vehicles and railway rolling stock (including locomotives, carriages and wagons) takes advantage of new technologies that improve their operational efficiency and quietness.
- Infrastructure maintenance such as track grinding, loco exhaust refurbishment, wheel alignment, track lubrication, brake refurbishment, and road surface management.
- Monitoring. Collation of complaints data in a centralised repository and the use of monitoring equipment such as noise monitoring cameras allows noise ‘hotspots’ and vehicles or rolling stock requiring targeted maintenance to be identified.

Driver behaviour

- Education. Educating drivers about the importance of responsible driving and vehicle maintenance (particularly for road traffic) can lessen noise impacts.
- Minimising the use of horns (within safety parameters) and minimising the use of compression braking in residential areas through the use of signage and enforcement.
- Demand management. Encouragement of alternative routes (that is designated freight routes) and alternative transport modes (that is public transport) can result in reduced noise levels in areas comprising noise-sensitive development.

Standards

- Vehicle and infrastructure standards. New or more stringent vehicle standards or regulations can be used to limit noise emissions from road and rail vehicles.
5.2 FREIGHT TRAIN NOISE AND VIBRATION

SPP 5.4 applies the $L_{\text{Aeq}}$ noise metric, which represents an average noise level. State Government generally accepts that there are alternative noise metrics such as $L_{\text{Amax}}$ that reflects the intermittent nature of freight rail noise and impacts of freight rail operations. However, in the absence of any clear wider regulatory framework and/or any implementation strategy to reduce the noise levels at source, the policy does not mandate its application.

State Government and railway transport infrastructure providers are working collaboratively to investigate the impact of noise from freight and passenger rail. Industry leaders are encouraged to apply the use of an $L_{\text{Amax}}$ trigger for major infrastructure upgrades and strategic planning proposals in accordance with advice from Department of Water and Environmental Regulation, where a noise management plan is required. However where the agreed external $L_{\text{Amax}}$ noise level is exceeded by freight rail, the $L_{\text{Aeq}}$ noise target must be met.

Vibration is a common emission involving the same physical processes as air-borne noise and the two are interrelated in a complicated manner. Vibration is most commonly associated with freight and passenger railways and at close distances to rail corridors, can cause a loss of amenity to sensitive land-uses.

Vibration levels are dependent on ground composition and groundwater levels, rail track and rolling stock condition, train speeds and other factors, making it difficult to predict and mitigate. Vibration is best and most cost-effectively addressed ‘at-source’ through measures including the use of alternative vibration absorbing track formation designs or the installation of sub-ballast matting.

Ballast matting is a proven mitigation measure which can reliably reduce vibration levels in the order of 10dB.

Vibration is challenging and costly to mitigate generally and mitigation options for single detached housing is generally cost prohibitive. Feasible vibration mitigation options do exist for larger scale multi-residential development and industry leaders are encouraged to assess and if required, mitigate vibration through best practice measures.

5.3 STAKEHOLDER ENGAGEMENT

The management of road and railway transport noise is the shared responsibility of various stakeholders and noise mitigation is most effective when balanced, comprehensive and coordinated action occurs.

Proponents should engage with decision-making authorities and any other relevant stakeholders as early as possible where any proposal is located within the policy’s trigger distance (refer to Table 1 of the policy). This provides opportunities for early design to minimise the exposure of noise-sensitive land-use and/or development to sources of transport noise. Doing so may result in reducing the need for physical barriers, such as noise walls, quiet house requirements and/or notifications on title.

Specifically, proponents’ responsibilities include (but are not limited to) the following:

- consulting with the State Government transport portfolio, Department of Planning, Lands and Heritage, and the local government in relation to strategic planning for the infrastructure;
- preparing noise level contour maps or a noise management plan in accordance with the policy requirements, and in doing so, seeking advice from the Department of Water and Environmental Regulation on technical matters; and
- ensuring the initial and ongoing implementation of any noise management plan applying to the subject land.

5.4 MONITORING AND EVALUATION

Monitoring and evaluation is an integral part of the policy lifecycle and is vital for continuous improvement.

The Department of Planning, Lands and Heritage will, on behalf of the Western Australian Planning Commission, monitor the implementation of SPP 5.4 and the planning and development outcomes delivered, to determine if outcomes are being achieved as intended.

The mapped road and railway corridors to which the policy applies will be regularly reviewed to ensure the planning and construction of new road and railway corridors or deletion of any road or railway reservations is reflected in the policy’s mapping. Mapping may also need to be updated to reflect movement per day increases.

Future policy review, amendment or changes to the policy’s mapping will be subject to full consultation with relevant stakeholders.
APPENDIX 1: GUIDELINES FOR MEASUREMENTS AND ON-SITE VERIFICATION

Measurements and/or on-site verification may be required as part of any noise management plan. Generally, these should be undertaken in accordance with relevant standards 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 facade correction if free field.

Several of these aspects are discussed in this section.

EQUIPMENT DETAILS

Noise measurements should follow the procedures set by *Australian Standard 2702-1984* and *Australian Standard 2377-2002* (Appendix 7). 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 need to be of the ‘integrating averaging’ type to measure the $L_{Aeq}$ values for comparison with the policy’s 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. This 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 $+0.5$dB.

Instruments must be calibrated by a NATA-accredited laboratory within the previous two years.

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.

Where a noise-sensitive building exists, for example, 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 facade of that building.

GENERAL PROCEDURES

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 $+2.5$dB correction should be added to the measured noise levels to account for facade 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 suitable competent person. The number of locations should ensure that the distribution of transport noise across the entire study area (and not just the most exposed position) can be estimated with reasonable certainty.
MEASUREMENT DURATION

Given that traffic volumes change on a daily and weekly basis, the measurement duration is left to the reasonable discretion of the competent person. For small scale proposals:

- Suitable attended measurements may be undertaken at the reasonable discretion of a competent person (at say peak noise periods) with appropriate and stated adjustments to estimate typical period levels for both day and night periods.

- Past field data from the same road class and configuration (for example similar traffic mix, volume, speed, number of lanes) may also be used in lieu of field measurements with appropriate and stated adjustments.

For all other projects:

- The duration of the measurement needs to account for the likely change in noise levels in various time periods each week.

- 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 traffic. Note that rail may not change during these periods. Similarly, monitoring should be discarded during times of abnormal traffic flow (for example, during construction works).

WEATHER CONDITIONS

The validity of data is mainly dependent on weather conditions. Acceptable weather conditions are defined by Main Roads WA 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. A full day or night period result may be estimated from enough partial data within that time period after removing weather affected results.

- Where adjustments are to be made to measured data based on professional judgement, this must be highlighted

- 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.
APPENDIX 2: NOISE ASSESSMENT METHODOLOGY

The methodology for the assessment and stated assumptions must be reported as part of a noise management plan.

MEASUREMENT AND MODELLING PREDICTION

Noise management plans are typically based on either noise measurement or noise 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 required if the transport corridor already exists, as they are 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.

Noise prediction models are appropriate where transport corridors are not yet operating at their forecast capacity; for proposed new or upgraded road or railway infrastructure; or to predict noise levels across a proposed development area.

The noise management plan must include details on:
- current traffic volumes and type of vehicles (that is, the percentage of heavy vehicles or locomotive class);
- forecasted changes
- traffic speeds
- road surface/track configuration and condition.

The noise management plan must clearly state what assumptions are being used for the modelling predictions and outline any verification procedures or model calibration.

In relation to noise-sensitive land-use and/or developments, noise predictions can delineate the areas likely to exceed the policy’s noise target, and evaluate various noise mitigation options separately.

ACCEPTABLE METHODOLOGIES

The general acceptable methodologies for noise prediction models are as follows:

- 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 indoor 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
- Future traffic levels can be based upon a logarithmic relationship which assumes incoherent addition of sound pressures, that is Change (dB) = 10 log10 (future traffic/existing) or suitable modelling appropriate to Austroads traffic engineering guidelines.
- The cumulative impact from existing road and railway noise sources should be included in the assessment for new noise-sensitive land-use and/or development, but not for new transport infrastructure.
- Under the policy, the noise target for new and upgraded road or railway infrastructure proposals apply to first two floors. However for informative purposes, noise management plans 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 or the actual number of train movements per day, whichever is the higher.
- Estimates of period average values may be made on the basis of suitably representative individual pass-by levels and traffic volumes.

The following table specifies acceptable methodologies.
Road and rail traffic noise may be predicted using field-calibrated numerical code which appropriately accounts for all significant noise generation and propagation factors, and presents results in terms directly comparable with applicable criteria (i.e. $L_{A_{eq\,day}}$ and $L_{A_{eq\,night}}$ values). Where code output values use different terms to the criteria, it is preferable to undertake direct noise measurements of the asset being investigated to correct for any differences between each noise parameter.

The UK Calculation of Road Traffic Noise (CoRTN) algorithm (which yields $L_{A_{eq\,18\,hour}}$ values) may be used with such suitable adjustments to obtain the appropriate $L_{A_{eq\,day}}$ or $L_{A_{eq\,night}}$ values as specified in the policy. Where this is not possible, reference should be made to the DEFRA publication Method for Converting the UK Road Traffic Noise Index $L_{A_{eq\,18\,hour}}$ to the EU Noise Indices for Road Noise Mapping, which indicates $L_{A_{eq\,day}} - L_{A_{eq\,18\,hour}}$ less 2.2 dB. A further correction may be required for Australian road and vehicle fleet conditions. Where traffic noise measurement data are unavailable and the road traffic noise model cannot be calibrated against existing noise conditions, a further correction of -1.7 dB 1 may be applied.

For railways, industrial numerical code such as the Nordic Rail Prediction Method (Kilde 130-1984), Nord2000, Schall 03, UK Calculation of Railway Noise (CRN) or CNOSSUS algorithms may be used with appropriate corrections for train class, speed and local conditions. Field measurements of track and rolling stock are essential to correct for local rail condition and features which can vary significantly along the alignment. Some algorithms output $L_{A_{eq\,24\,hour}}$ noise predictions, which can be readily converted to an $L_{A_{eq\,day}}$ or $L_{A_{eq\,night}}$ noise level on the basis of relative traffic volumes. Most algorithms are suitable for use with neutral weather effects for source to receiver distances up to 100 metres. Beyond this distance, variance due to environmental meteorological effects should be considered. Reference may be made to guidance on noise modelling provided by the Department of Water and Environmental Regulation.

**SOURCE CORRECTIONS**

For rail surface discontinuities or tight curves, the following corrections may be applied to segment exposure ($L_{A_{eq}}$) or maximum $L_{A_{max}}$ levels:

- Mechanical/uneven joint $+3\,dB$
- Curve radius less than 600m $+3\,dB$
- Turnout $+6\,dB$
- Curve radius less than 300m $+8\,dB$
- Diamond crossing $+10\,dB$

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 $+3.5\,dB$
- 10mm chip seal $+2.5\,dB$
- 5mm chip seal $+1.5\,dB$
- Dense graded asphalt $0\,dB$
- Novachip $-0.2\,dB$
- Stone mastic asphalt $-1.5\,dB$
- Open graded asphalt $-2.5\,dB$

For the CoRTN algorithms, it is recommended to apply the ‘three strings’ approach, that is, 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.

For 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 facade, a $+2.5\,dB$ facade correction is to be applied for both road and rail to account for the increase in noise caused by reflections from the facade. Similarly, for internal noise predictions based on a measurement immediately outside a facade, 2.5dB should first be deducted.

Notes:
1. 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 – NASRA Planning Group) which found that the CoRTN calculations were over-predicting road traffic noise by this margin.
2. Rail noise source heights are relative to the wheel contact surface of the tracks.
3. The most exposed habitable facade would not include the wall or door of an enclosed carport or the like.
## APPENDIX 3:
**NOISE MODELLING CHECKLIST**

<table>
<thead>
<tr>
<th>Checklist item</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Road traffic input data</strong></td>
<td></td>
</tr>
<tr>
<td>Road name</td>
<td>[insert road name] along with / chainage / date and time period</td>
</tr>
<tr>
<td>16-hr daytime road traffic volume</td>
<td></td>
</tr>
<tr>
<td>Percentage of heavy vehicles (daytime)</td>
<td></td>
</tr>
<tr>
<td>8-hr night-time road traffic volume</td>
<td></td>
</tr>
<tr>
<td>Percentage of heavy vehicles (night-time)</td>
<td></td>
</tr>
<tr>
<td>Road pavement</td>
<td>[insert road pavement surface type]</td>
</tr>
<tr>
<td>Road traffic heights</td>
<td>Have the road emissions sources been modelled at the following heights?</td>
</tr>
<tr>
<td>Light and heavy vehicle tyre-road height at +0.5 m</td>
<td>Y / N</td>
</tr>
<tr>
<td>Heavy vehicle engine height at +1.5 m</td>
<td>Y / N</td>
</tr>
<tr>
<td>Heavy vehicle exhaust height at +3.6 m</td>
<td>Y / N</td>
</tr>
<tr>
<td>Traffic speed</td>
<td>What is the modelled road posted (signal) traffic speed?</td>
</tr>
</tbody>
</table>

### Noise prediction corrections

<table>
<thead>
<tr>
<th>Checklist item</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Traffic emission</strong></td>
<td></td>
</tr>
<tr>
<td>If using the Calculation of Road Traffic Noise algorithms, have the following corrections been applied?</td>
<td></td>
</tr>
<tr>
<td>-0.8 dB correction to heavy vehicle engine emission?</td>
<td>Y / N</td>
</tr>
<tr>
<td>-8.0 dB correction to the heavy vehicle exhaust emission?</td>
<td>Y / N</td>
</tr>
<tr>
<td><strong>Road pavement</strong></td>
<td></td>
</tr>
<tr>
<td>Has one of the following corrections been applied to the tyre/road emission?</td>
<td>Y / N</td>
</tr>
<tr>
<td>14 mm chip seal</td>
<td>+3.5 dB Y / N</td>
</tr>
<tr>
<td>10 mm chip seal</td>
<td>+2.5 dB Y / N</td>
</tr>
<tr>
<td>5 mm chip seal</td>
<td>+1.5 dB Y / N</td>
</tr>
<tr>
<td>Dense graded asphalt</td>
<td>0.0 dB Y / N</td>
</tr>
<tr>
<td>Novachip</td>
<td>-0.2 dB Y / N</td>
</tr>
<tr>
<td>Stone mastic asphalt</td>
<td>-1.5 dB Y / N</td>
</tr>
<tr>
<td>Open graded asphalt</td>
<td>-2.5 dB Y / N</td>
</tr>
</tbody>
</table>

| **Australian traffic** | |
| Has a -1.7 dB Australian Road Research correction or reasonable equivalent applied? | Y / N |

| **Receptor façade** | |
| Has a +2.5 dB building façade correction been applied? | Y / N |

### Road noise barriers

<table>
<thead>
<tr>
<th>Checklist item</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise barriers</td>
<td>Have noise barriers been modelled as being fully reflective? Y / N</td>
</tr>
<tr>
<td>If noise barriers have not been modelled as being fully reflective, have absorptive barrier designs been considered? Y / N</td>
<td></td>
</tr>
</tbody>
</table>

### Environmental inputs

<table>
<thead>
<tr>
<th>Checklist item</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Receivers</strong></td>
<td></td>
</tr>
<tr>
<td>Were receiver heights modelled at 1.4 m above floor level?</td>
<td>Y / N</td>
</tr>
<tr>
<td>Have noise levels been predicted at the most affected façade/s?</td>
<td>Y / N</td>
</tr>
</tbody>
</table>

### Noise predictions

<table>
<thead>
<tr>
<th>Checklist item</th>
<th>Action</th>
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</thead>
<tbody>
<tr>
<td><strong>Predicted noise levels</strong></td>
<td></td>
</tr>
<tr>
<td>Have noise levels been predicted at all floors of the development?</td>
<td>Y / N</td>
</tr>
<tr>
<td>Have the noise predictions considered the 20-year planning horizon?</td>
<td>Y / N</td>
</tr>
</tbody>
</table>

| **Road traffic input data** | |
| Rail line name | [insert rail line name] |
| 16-hr daytime passenger rail movements | |
| 16-hr daytime freight rail movements | |
| 8-hr daytime passenger rail movements | |
| 8-hr daytime freight rail movements | |

| **Rail traffic heights** | |
| Have the rail noise sources been modelled at the appropriate heights? | |
| Rail line speed | What is the modelled rail traffic speed? |
| **Accuracy / calibration** | |
| How does the proposal account for variation in actual noise levels from that predicted? | |

### Noise prediction corrections

<table>
<thead>
<tr>
<th>Checklist item</th>
<th>Action</th>
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</thead>
<tbody>
<tr>
<td><strong>Train noise emissions</strong></td>
<td></td>
</tr>
<tr>
<td>Has the assessment described how the following have been calibrated in the rail noise calculations?</td>
<td></td>
</tr>
<tr>
<td>The various train classes in use on the rail line</td>
<td></td>
</tr>
<tr>
<td>Train speed</td>
<td>km/h</td>
</tr>
<tr>
<td>Train length</td>
<td>m</td>
</tr>
</tbody>
</table>

### Track features

<table>
<thead>
<tr>
<th>Checklist item</th>
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</thead>
<tbody>
<tr>
<td><strong>Mechanical/uneven joints</strong></td>
<td>+3 dB Y / N</td>
</tr>
<tr>
<td><strong>Curve radius less than 600 m</strong></td>
<td>+3 dB Y / N</td>
</tr>
<tr>
<td><strong>Turnout</strong></td>
<td>+6 dB Y / N</td>
</tr>
<tr>
<td><strong>Curve radius less than 300 m</strong></td>
<td>+8 dB Y / N</td>
</tr>
<tr>
<td><strong>Diamond crossing</strong></td>
<td>+10 dB Y / N</td>
</tr>
<tr>
<td>If appropriate has the assessment described how other noise sources such as bridges, brake noise, car bunching, blowers and air compressors been accounted for?</td>
<td>Y / N</td>
</tr>
</tbody>
</table>

### Receptor façade

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<tr>
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<td>Y / N</td>
</tr>
<tr>
<td>Have noise levels been predicted at the most affected façade/s?</td>
<td>Y / N</td>
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### Rail noise barriers

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APPENDIX 4:
NOISE MANAGEMENT PLAN CONTENT

This is a guide for the preparation and assessment of noise management plans. It is not intended to be a complete list of all issues that should be covered in a noise management plan, as no guide can anticipate all issues that may be relevant to individual proposals.

NOISE MANAGEMENT PLAN TABLE OF CONTENTS

1 Executive summary
   • Scope of work
   • Criteria used in the assessment
   • Statement about compliance
   • Recommended noise mitigation measures (if required)
   • Other recommendations (for example further assessment)

2 Introduction

3 Project description
   • Background history or relevant previous studies
   • Noise issues addressed and commissioned scope of work

4 Site details
   • Location of major transport corridor(s)
   • Noise receiver locations (existing and proposed future residential areas)
   • Site information including natural and constructed, existing development and surrounding land-uses that may affect noise propagation
   • Measurement or prediction locations
   • Maps with site details including north point and scale

5 Noise target
   • Outdoor noise target – for proposed new or upgraded road and rail infrastructure or for outdoor living areas in proposed noise-sensitive land-use and/or developments.
   • Indoor noise target – for noise-sensitive land-use and/or development proposals (Reference AS/NZS 2107:2016 Acoustics – Recommended Design Sound Levels and Reverberation Times for Building Interiors for non-residential developments).

6 Methodology
Acoustic assessments are typically based on either noise measurement or noise modelling prediction. The assessment must include details on all noise modelling input parameters (see below checklists) including the following transport factors:
   • Current traffic volumes and type of vehicles. For road noise, percentage of heavy vehicles, for rail noise, locomotive class or rail car series type (currently A or B series for Perth passenger trains))
   • Forecast traffic volumes (and basis for estimating future traffic volumes)

   • Horizon year for traffic projections
   • Posted (signal) traffic speeds
   • Road surface/track configuration and condition (if relevant).

Methodology for noise measurement
Direct noise measurement is appropriate if the transport corridor already exists, as it is generally more representative of conditions specific to the site. Also for some cases, noise modelling prediction requires on-site verification based on measurements. The noise measurement methodology should detail:
   • Equipment/instruments used
   • Measurement duration
   • Measurement locations
   • Equipment settings
   • Calibration details
   • Ambient/background activities/measurements (if indicated)
   • Relevant weather conditions (wind speed and direction, rainfalls)
   • Operational conditions of noise source(s)
   • Adjustments made to measured levels façade correction (if free field).

Methodology for noise modelling prediction
Noise modelling prediction is appropriate where transport corridors are not yet operating at their forecast capacity. For proposed new major road or rail infrastructure; for proposed major redevelopment of major road or rail infrastructure; or to predict noise levels across a proposed development area, the noise prediction methodology should detail:
Type of computer noise modelling software used (for example, SoundPlan, CadnaA)

Industry recognised prediction codes used. For example CoRTN for road noise, Nordic (Kilde Rep 130) for rail noise

Model inputs in relation to noise emissions – number of trains, length, speed, passby noise exposure level at a specific distance (usually 15 metres from track centerline)

Noise source heights and locations (where different from standards)

Topographical settings

Meteorological conditions - a ‘worst case’ scenario based on suitable historical weather observations for the time periods of interest, or the following default conditions:

- Receiver locations
- Any other relevant modelling parameters/assumptions (ground absorptions, for example)
- Details of adjustments made to predicted levels (façade correction, NAASRA correction, conversion from $L_{A10,18\text{hour}}$ to $L_{Aeq}$)
- Outline of any verification procedure or model calibration.

### Analysis and results

The traffic noise level results should be displayed clearly (normally in tabulated format for individual point calculations and/or noise contour format for grid point calculations) and should incorporate details of the following:

#### Results for noise measurement

- Measurement duration, date, time
- Distance from the noise source and operating conditions, as relevant
- Ensure at least three full days of road traffic, or 60 train passes unaffected by weather or school holidays is reported. For road traffic noise, the screening assessment tool estimates may be used in lieu of field data only
- Uncertainty of the measurement

#### Results for noise modelling prediction

- Individual receivers (point calculations) or contour maps (grid calculations) for modelling scenarios indicated
- Uncertainty of the modelling predictions

### Discussion, recommendations and conclusions

The discussion compares the relevant noise target with the measured/predicted results and carries out assessment for compliance. The following should also be addressed in the discussion:

- Assessment of compliance. Assessment should be made in terms of both $L_{Aeq,\text{day}}$ and $L_{Aeq,\text{night}}$
- Comparison of existing versus predicted future noise levels (if relevant)
- Comparison of predicted future noise levels versus a predicted no-build scenario (if relevant)

### Noise mitigation

- Recommended mitigation and control measures and relevant benefits
- Mitigation measures to be adopted
- Identification of the responsibilities of each party for construction and ongoing maintenance
- Approximate timeframes for implementation of commitments made
- Other management measures to be included, such as post-construction monitoring and complaint response procedure, for example
- Results of community stakeholder consultations (if relevant)

### Summary

The summary of the plan may be presented as a brief version of the executive summary, outlining the projected level of compliance with applicable criteria.
11 Appendices

Documents or data often referred to in the text of the plan including:

- Photographs of measurement sites
- Details of measurement site conditions
- Detailed charts and data from noise measurements
- Wind and meteorological data
- Ambient noise data
- Noise level contour maps preferably using policy criteria for the categories mapped.
APPENDIX 5:
RECOMMENDED WORDING
FOR NOTIFICATIONS ON TITLE

Notifications on title advise prospective purchasers of the potential for noise impacts from major transport corridors and help with managing expectations. A notification on title should be required as a condition of subdivision (including strata subdivision) or development approval for the purposes of noise-sensitive development as well as planning approval involving noise-sensitive development to advise that the site is located in a noise-affected area.

For subdivision approvals, use of notifications on title is guided by the WAPC’s Planning Bulletin 3 – Notifications on Titles (Memorials).

The condition (including the Notification itself) should be worded as follows:

“A Notification, pursuant to Section 165 of the Planning and Development Act 2005 is to be placed on the Certificate(s) of Title of the proposed lot(s) / subject lot(s) [DELETE AS APPLICABLE]. Notice of this Notification is to be included on the diagram or plan of survey (Deposited Plan).

The Notification is to state as follows:

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

(Western Australian Planning Commission)

For development approvals, local governments use Section 70A of the Transfer of Land Act 1893.

It is strongly encouraged that proponents make prospective purchasers aware of the existence of the Notifications on Title on affected lots, such as through Contracts of Sale.

Prospective purchasers of land/lots/dwellings located within the area to which the policy applies may wish to contact the relevant local government for further advice.
### APPENDIX 6: AUSTROADS CATEGORIES OF CLASS 7 TO 12 HEAVY VEHICLES

<table>
<thead>
<tr>
<th>CLASS</th>
<th>LIGHT VEHICLES</th>
<th>HEAVY VEHICLES</th>
<th>LONG VEHICLES AND ROAD TRAINS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SHORT</td>
<td>TWO AXLE TRUCK OR BUS</td>
<td><strong>B DOUBLE or HEAVY TRUCK and TRAILER</strong></td>
</tr>
<tr>
<td></td>
<td>Car, Van, Wagon, 4WD, Utility, Bicycle, Motorcycle</td>
<td><em>2 axles</em></td>
<td><em>7+ axles, 4 axle groups</em></td>
</tr>
<tr>
<td>2</td>
<td>SHORT - TOWING</td>
<td>THREE AXLE TRUCK OR BUS</td>
<td><strong>DOUBLE ROAD TRAIN</strong></td>
</tr>
<tr>
<td></td>
<td>Trailer, Caravan, Boat</td>
<td><em>3 axles, 2 axle groups</em></td>
<td><em>7+ axles, 5 or 6 axle groups</em></td>
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<tr>
<td></td>
<td></td>
<td>FOUR (or FIVE) AXLE TRUCK</td>
<td><strong>TRIPLE ROAD TRAIN</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>4 (5) axles, 2 axle groups</em></td>
<td><em>7+ axles, 7+ axle groups</em></td>
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<tr>
<td>3</td>
<td></td>
<td>THREE AXLE ARTICULATED</td>
<td><strong>SIX AXLE ARTICULATED</strong></td>
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<td></td>
<td></td>
<td><em>3 axles, 3 axle groups</em></td>
<td><em>6 axles, 3+ axle groups or 7+ axles, 3 axle groups</em></td>
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<td>4</td>
<td></td>
<td>FOUR AXLE ARTICULATED</td>
<td><strong>FIVE AXLE ARTICULATED</strong></td>
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<td></td>
<td><em>4 axles, 3 or 4 axle groups</em></td>
<td><em>5 axles, 3+ axle groups</em></td>
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<td></td>
<td>FIVE AXLE ARTICULATED</td>
<td><strong>FOUR AXLE ARTICULATED</strong></td>
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<td><em>5 axles, 3+ axle groups</em></td>
<td><em>4 axles, 3 or 4 axle groups</em></td>
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<td>SIX AXLE ARTICULATED</td>
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<td><em>6 axles, 3+ axle groups or 7+ axles, 3 axle groups</em></td>
<td><em>3 axles, 3 axle groups</em></td>
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<td>7</td>
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<td><strong>TWO AXLE TRUCK OR BUS</strong></td>
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<td><em>2 axles</em></td>
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<td><strong>THREE AXLE TRUCK OR BUS</strong></td>
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<td><em>3 axles, 2 axle groups</em></td>
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<td><strong>FOUR (or FIVE) AXLE TRUCK</strong></td>
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<td><em>4 (5) axles, 2 axle groups</em></td>
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<td><strong>B DOUBLE or HEAVY TRUCK and TRAILER</strong></td>
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<td><em>7+ axles, 4 axle groups</em></td>
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<td><strong>DOUBLE ROAD TRAIN</strong></td>
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<td><em>7+ axles, 5 or 6 axle groups</em></td>
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<td><strong>TRIPLE ROAD TRAIN</strong></td>
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<td></td>
<td></td>
<td></td>
<td><em>7+ axles, 7+ axle groups</em></td>
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</tbody>
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