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1 INTRODUCTION

These Guidelines should be read in conjunction with State Planning Policy 5.4: Road and Rail Noise (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 the Policy. 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 into chapters that follow the logical steps a proponent and or decision-maker will need to undertake for the preparation and assessment of a planning proposal to which the policy applies. Further guidance on noise assessment methodology, site verification, worksheets, and example templates for management plans, and planning instruments are included in the appendix.

1.3 MAPPING

The Policy and these Guidelines are supported by maps which specify Western Australia’s major road and rail networks to which the policy applies that are considered of key economic importance due to their high vehicle movements and freight handling functions but can also adversely affect land adjacent to these corridors due to noise (Refer to appendix 9).

The major 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.

The trigger distances act as a mechanism for further investigation to ascertain likely noise levels through a Noise Exposure Forecast and or Noise Management Plan (refer to Table 1 of the Policy).

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 or an update to Main Roads Western Australia’s Road Information Mapping System) and considered by the WAPC where it can be demonstrated that the noise generated by those corridors is sufficient to justify application of the Policy.

Discretion should be exercised for areas not subject to a region scheme, which are less likely to be affected by noise generated by the transport corridors subject to the policy. For example, many rural areas where roads classified as Primary Distributors in the State’s road hierarchy carry comparatively low levels of traffic and therefore generate levels of noise that are not sufficiently high to justify the Policy being applied. Similarly, many railways operated solely to carry grain are only in use seasonally, which do not satisfy the general principle that transport corridors subject to the policy must generate high levels of noise consistently.
2 POLICY APPLICATION

This section provides guidance to determine if and when the policy 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 documents such as sub-regional strategies and frameworks, and local planning strategies guide land use and infrastructure planning for relatively large areas through broad coordination of land use provision and distribution, infrastructure and community facilities. At this stage of planning, the principle aim is to avoid land use conflict from the impact of transport noise. This is achieved through measures that rely on compatible land use zones, and reserves to provide spatial separation (refer to section 4: Noise Mitigation).

As a minimum, high-order strategic planning should clearly map the transport corridors to which the policy applies and the surrounding areas potentially impacted by transport noise. A Noise Exposure Forecast work sheet and/or Noise Level Contour Map are required where the level of information is available to provide greater detail on the transport noise impacts (refer to section 3: Assessing Noise).

Where the provision of noise-sensitive land use and/or development within the trigger distance cannot be avoided 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 criteria.

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. At this stage there is still an opportunity to avoid the introduction or intensification of noise-sensitive land use and/or development. The proponent should consider design solutions that utilise street and lot configuration, and densities that inform built form outcomes (refer to section 4: Noise Mitigation).

Where it is unavoidable to propose new or additional noise-sensitive development on any part of the site, a Noise Exposure Forecast worksheet 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 criteria, a Noise Management Plan is 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 for a noise-sensitive land use or a transport corridor is constructed, the practicable options for achieving the noise criteria are more limited and generally more expensive.

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
covered by State Agreements as advised by the Department of Jobs, Tourism, Science and Innovation. Special Control Areas should not define alternative noise metrics. Appendix 7 includes model Special Control Area provisions for inclusion in local planning schemes.

### 2.3 SUBDIVISION AND DEVELOPMENT

An assessment of the noise impacts should have been undertaken prior to this stage of planning. In the absence of a structure plan and/or noise assessment, the provision and/or intensification of noise-sensitive land use and/or development should be determined to be appropriate through an initial completion of a Noise Exposure Forecast worksheet as per the above. The Noise Exposure Forecast worksheet will assist with determining how the subject land/development is affected by noise and what exposure category and subsequently which mitigation measures apply.

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 (refer to section 4: Noise Mitigation). A Local Development Plan or other localised planning mechanisms may also be considered to support the design and coordination of appropriate development outcomes that address noise constraints.

This stage of planning generally focuses on physical mitigation measures that, once implemented, will contribute to the achievement of the Policy’s noise criteria. Conditions of subdivision should be imposed as appropriate in order to ensure that the recommendations of any Noise Exposure Forecast worksheet and or Noise Management Plan are implemented, as relevant. If there are measures recommended in a Noise Management Plan that relate to the subsequent development stage, advice should also be included indicating the WAPC’s expectation that such measures will be implemented at that stage.

Notifications on title are required informing of the existence of road and/or railway transport noise for all proposals where noise levels are forecasted to exceed the Policy’s outdoor noise criteria (refer to Appendix 6 and 7 - 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 infrastructure providers prepare a Noise Management Plan.

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 criteria. Land use planning controls and infrastructure upgrades can only mitigate noise to a certain extent; it is imperative that service providers contribute to minimising the generation and emission of noise.

While the Policy does not apply to increases in road 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;
- 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; or
- where there may be a substantial change in noise from that currently, such as metropolitan fringe greenfield sites or rural areas.

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 cumulative noise levels exceed the noise criteria; 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>
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<tbody>
<tr>
<td>High-order strategic planning</td>
<td>• Map of major transport / freight routes</td>
<td>• Land use plan</td>
<td>WAPC - 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></td>
</tr>
<tr>
<td></td>
<td>• Identify potential noise sensitive land use through Noise Exposure Forecast sheet and/or contour map</td>
<td>• Contour Map</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Review land use compatibility and seek avoidance</td>
<td>• Noise Exposure Forecast sheet</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Where cannot be avoided consider appropriate land use configuration and density</td>
<td>• Management Plan</td>
<td>WAPC - Providing technical advice primarily in relation to Noise Management Plan and the effectiveness of performance-based recommendations.</td>
</tr>
<tr>
<td></td>
<td>• Determine if management plan is appropriate</td>
<td>• Special Control Areas</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Recommend policy advice including whether Special Control Areas should be established</td>
<td>• Developer Contribution Plans</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Local planning policy</td>
<td></td>
</tr>
<tr>
<td>Region and local schemes and amendments, structure plans and activity plans</td>
<td>• Identify potential noise sensitive land use through Noise Exposure assessment forecast sheet</td>
<td>• Noise Exposure Forecast sheet</td>
<td>Local Government - Ensuring that local strategies, schemes and plans are consistent with the objectives of the Policy.</td>
</tr>
<tr>
<td></td>
<td>• Where cannot be avoided consider design of the street and lot layout, and building configuration</td>
<td>• Contour Map</td>
<td>- Determining whether Special Control Areas should be established. Refer Appendix 6 for model Special Control Area provisions for inclusion in local planning schemes.</td>
</tr>
<tr>
<td></td>
<td>• Determine if management plan is appropriate</td>
<td>• Management Plan</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>• Consideration to the preparation of a site specific Local Development Plan</td>
<td>• Local Development Plan</td>
<td>- Incorporating noise mitigation measures, as appropriate, into Developer Contribution Plans consistent with State Planning Policy 3.6 - Development Contributions for Infrastructure.</td>
</tr>
<tr>
<td></td>
<td>• Consideration to mitigation measures such as quiet house requirements</td>
<td>• Subdivision conditions for noise mitigation measures such as quiet house requirements and notification on title</td>
<td>Department of Transport - 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></td>
<td></td>
<td>Department of Water and Environmental Regulation - Provide expert technical advice primarily in relation to Noise Management Plan and the effectiveness of performance-based recommendations.</td>
</tr>
<tr>
<td>Subdivision and development</td>
<td>• Identify potential noise sensitive land use through Noise Exposure assessment forecast sheet</td>
<td>• Noise Exposure Forecast sheet</td>
<td>WAPC - 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 cannot be avoided consider design of the street and lot layout, and building configuration</td>
<td>• Contour Map</td>
<td>- Impose conditions of subdivision approval. Refer Appendix 5 for recommended wording for a notification on title.</td>
</tr>
<tr>
<td></td>
<td>• Determine if management plan is appropriate</td>
<td>• Management Plan</td>
<td>Local Government – 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 included ensuring any quiet house requirements required through a Local Development Plan are implemented through the building permit process.</td>
</tr>
<tr>
<td></td>
<td>• Subdivision conditions for noise mitigation measures such as quiet house requirements and notification on title</td>
<td>• Local Development Plan</td>
<td>- Advising the WAPC/Department of Planning, Lands and Heritage 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></td>
<td></td>
<td>Department of Water and Environmental Regulation - Provide expert technical advice primarily in relation to Noise Management Plan and the effectiveness of performance-based recommendations.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Department of Jobs, Tourism, Science and Innovation (building commission) - 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 or track) and rail noise (generally interaction/shunting between cars and wheel squealing on tight curves) to which the Policy applies.

3.2 NOISE CRITERIA

Table 2 of the Policy sets out the noise criteria 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>Painful</th>
<th>120</th>
<th>Jet aircraft take off at runway edge</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>110</td>
<td>Rock concert</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>225mm angle grinder at 1 metre</td>
</tr>
<tr>
<td></td>
<td>90</td>
<td>Heavy industrial factory interior</td>
</tr>
<tr>
<td>Noisy</td>
<td>80</td>
<td>Shouting at 1 metre</td>
</tr>
<tr>
<td></td>
<td>70</td>
<td>Freeway at 20 metres</td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>Normal conversation at 1 metre</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>Night time outdoor noise target</td>
</tr>
<tr>
<td>Quiet</td>
<td>40</td>
<td>Office air conditioning</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>Typical bedroom design target</td>
</tr>
<tr>
<td>Very Quiet</td>
<td>20</td>
<td>Whisper, rural bedroom at night</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Human breathing at 3 metres</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>Threshold of typical hearing</td>
</tr>
</tbody>
</table>

Note: The levels above are $L_{eq}$ (dB re 20 μ Pa). 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 μ Pa) – 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 μ Pa’, 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 ‘LAeq’. Care should be taken to note that LAeq 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 LAeq value may indicate.

3.2.1 Exceeding the noise criteria

The Policy recognises that in some instances it may not be ‘reasonable’ and/or ‘practicable’ to implement noise mitigation measures in order to achieve the noise criteria. The determination of ‘reasonable’ and/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.

About the term ‘reasonable’

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

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 of mitigation
- existing and future noise levels, including changes in noise levels
- aesthetic amenity and visual impacts
- compatibility with other planning policies
- differences between metropolitan and regional situations
- differences between greenfield and infill development
- the benefits arising from the proposed development.

About the term ‘practicable’

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

These may include:
- limitations of the different mitigation measures to reduce transport noise
- safety issues (such as impact on crash zones or restrictions on road vision)
- topography and site constraints (such as space limitations)
- drainage requirements
- access requirements (for driveways, pedestrian access and the like)
- maintenance requirements
- suitability of the building for acoustic treatments.

3.3 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 planning proposals to provide decision makers with information on the likely impacts of transport noise upon the subject site.

The Noise Level Contour Map can be prepared in two different ways.

1. A map (Figure 3) can be prepared using the noise level information contained within the Noise Exposure Forecast *Table 2*.
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 3: Example Noise Level Contour Map](image-url)
Table 2: Noise forecast

<table>
<thead>
<tr>
<th>Transport Corridor Classification</th>
<th>Vehicles/day</th>
<th>Forecast noise level (LAeq,Day) and exposure category based on distance from nearest road carriageway (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary roads</strong>1</td>
<td></td>
<td><strong>Exposure Category</strong></td>
</tr>
<tr>
<td>* State roads (Freeways, highways, primary distributors)</td>
<td>up to 25,000</td>
<td>71</td>
</tr>
<tr>
<td></td>
<td>~ 30,000</td>
<td>71</td>
</tr>
<tr>
<td></td>
<td>~ 35,000</td>
<td>72</td>
</tr>
<tr>
<td></td>
<td>~ 40,000</td>
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<td></td>
<td>~ 45,000</td>
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<td>~ 50,000</td>
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<td>~ 55,000</td>
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<td>~ 60,000</td>
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<td>~ 70,000</td>
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<td>~ 80,000</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>~ 100,000</td>
<td>77</td>
</tr>
<tr>
<td></td>
<td>more than 140,000</td>
<td>78</td>
</tr>
<tr>
<td><strong>Regional freight roads</strong> (Regional freight roads are defined by Department of Transport Western Australian Regional Freight Transport Network Plan) Map 2 and 3</td>
<td>up to 10% heavy vehicles</td>
<td>74</td>
</tr>
<tr>
<td></td>
<td>more than 10,000</td>
<td>74</td>
</tr>
<tr>
<td></td>
<td>10 to 20% heavy vehicles</td>
<td>76</td>
</tr>
<tr>
<td></td>
<td>more than 10,000</td>
<td>76</td>
</tr>
<tr>
<td></td>
<td>more than 20% heavy vehicles</td>
<td>77</td>
</tr>
<tr>
<td><strong>Secondary roads</strong>1</td>
<td>up to 5,000</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>~ 7,500</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td>~ 10,000</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>~ 15,000</td>
<td>66</td>
</tr>
<tr>
<td></td>
<td>~ 20,000</td>
<td>67</td>
</tr>
<tr>
<td></td>
<td>~ 25,000</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td>~ 30,000</td>
<td>69</td>
</tr>
<tr>
<td></td>
<td>more than 35,000</td>
<td>70</td>
</tr>
</tbody>
</table>

**Transport Corridor Classification**

- **Passenger railways** Map 3
  - Joondalup-Butler 260
  - Midland 170
  - Fremantle 160
  - Armadale-Thomville 290
  - Mandurah 230
  - Other lines 300

- **Freight railways** Map 1, 2, 3 (LAeq,Night)

Assumptions:
- The NEF table does not account for the risk of short-term noise / vibration impacts which have historically been the cause of various complaints in Western Australia.
- Forecast noise levels assume level and open ground between the noise source and the receiver and neutral weather effects.
- All values include a +2.5 dB façade correction.

For more information, visit mrapps.mainroads.wa.gov.au/TrafficMap.
3.4 NOISE EXPOSURE FORECAST

When it is determined that the Policy applies to a planning proposal the Noise Exposure Forecast enables proponents and/or decision-makers to undertake a simple assessment of the risk of noise impacts on noise-sensitive land use and/or development within the trigger distance of road or railway infrastructure through forecasts on noise levels which has been verified through noise monitoring. Proponents can complete the worksheet (Appendix 1) to accompany subdivision, development and building licence applications to demonstrate the forecast noise levels at a noise-sensitive land use and/or development and the required noise mitigation measure through quiet house requirements.

Proponents and/or decision-makers can also identify future development areas 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.

The Noise Exposure Forecast can be used to prepare a Noise Level Contour Map to inform high-order planning documents and planning proposals.

3.4.1 Noise reductions from existing screening building 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/fencing that is 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.

A 4dB reduction to the noise levels contained in the Noise Exposure Forecast table which equates to at least one exposure category/quiet house specification (i.e. quiet house C (63dB) to quiet house B (59dB)) can be applied in the following situations.

- An existing building or structure (at least one storey high) screens more than 50% (not intermittently) of the most exposed frontage of a noise-sensitive land use and/or development (Figure 4).
- An existing solid continuous two metre noise wall/fence.
- Topographical difference of at least four metres that is not a direct line of sight (that is, where the infrastructure corridor is lower than the subject site) as illustrated in Figure 5.

Figure 4: Illustration of a building or structure screening more than 50% of the most exposed, habitable façade of a noise-sensitive building

Figure 5: Illustration of a topographically uninterrupted and interrupted line-of-sight between a noise source and the most exposed, habitable façade of a noise-sensitive building
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 the 4dB reduction.

### 3.5 NOISE MANAGEMENT PLAN

A Noise Management Plan provides a site-specific noise assessment and recommended noise mitigation measures to achieve the Policy’s criteria. 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 are:

- a person holding 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
- 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 4 includes a checklist for road and rail noise modelling.

Appendix 5 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 criteria (see Figure 6 and 7);
- recommended mitigation measures for the proposal including extent of noise walls/bunds and consideration of amenity impacts and residential lots with quiet house requirements;
- outlining the stage of the planning process, responsible parties, staging and timing;
- a description of other noise management measures, for example post-construction noise monitoring, complaint response, ongoing maintenance requirements; and/or
- 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.

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

The Department of Water and Environmental Regulation is available to provide noise-related advice and expertise, 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.
3.5m
2.4m
Edge of road carriageway
Cadastre
Noise abatement wall
Application example

Figure 6: Noise Management Plan Contour Map - prior to any proposed noise mitigation

Exposure category A - requires Quiet House Package A
Exposure category B - requires Quiet House Package B on upper floor and Package A on ground floor
Exposure category C - requires Quiet House Package C on upper floor and Package B on ground floor

Figure 7: Noise Management Plan Contour Map - showing noise mitigation measures
4 TECHNIQUES FOR NOISE AVOIDANCE AND MITIGATION

This section outlines the various ways to minimise noise from road and rail 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 proposing noise-sensitive land use and/or development in close proximity to such infrastructure.

4.1 PHYSICAL SEPARATION AND COMPATIBLE LAND USES

The allocation of non-noise-sensitive land uses in the vicinity of transport corridors serves two purposes. Firstly, it provides spatial separation for noise-sensitive land use and/or development and secondly it can, depending on built form, create a physical barrier protecting land beyond.

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

- Local streets and road reserves including shared paths/cycle lanes (in compliance with Liveable Neighbourhoods) that provide further separation from the noise source, promote passive surveillance of the street and allow for planting and landscaping;
- Open public spaces of a size and function that can be designed to ensure the spaces are usable to residents and preferably have areas that are quieter; and
- Defined easements or building setbacks in new estates along road/rail corridors should be considered. The vesting/management authority for such reserves on greenfield site subdivisions should be local government.

At the strategic planning stage proponents should consider route alignment for a new road or railway that maximises separation distances from existing or future noise-sensitive land uses is critical to achieving overall noise management outcomes. 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 is important to ensure that suitable set-back distances to receivers can be achieved and that, if necessary, bunds and barriers can be constructed close to either the source or receiver, but preferably closer to the source.

In the vicinity of transit stations and precincts, non-noise-sensitive land uses such as commercial buildings, including mixed use developments, community and recreational facilities will help to facilitate a self-contained walkable neighbourhood that can support public transport and reduce car dependence.

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.

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. If residential development is unavoidable, consideration should be given to the siting and layout of dwellings and form particularly of multiple dwellings, which are built at a scale that is more likely to make mitigation measures more economically feasible.
4.2 NOISE WALLS

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

Noise walls used near Perth major roads generally reduce transport noise ($L_{eq}$) 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 not economical.

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. 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 depicts that overlapping barriers can be used to suit pedestrian walkways, egress points or service roads.
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 such as post and rail and sheet steel are not substitutes for noise walls but provide some benefit for heights up to two metres and locations immediately adjacent to outdoor living areas and ground floor openings to habitable rooms. Lightweight materials may be sheeted on both sides of supports to form a double layer construction for comparable performance and planks or sheeting must be tight fitting and overlaid by a minimum of 30 millimetres, with no gaps between materials or between the base of the fence and the ground.

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/or variation of:

- colour;
- pattern;
- height;
- non-linear forms;
- texture;
- transparency;
- materials; 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 block work, 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, for example in rural areas. However they are generally not suitable in urban areas as they require large footprints. They also attract ongoing maintenance costs 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 BUILDING DESIGN AND CONFIGURATION

Acoustic design to mitigate noise for single and multi-storey buildings 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).

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

Figure 13: Locating noise-sensitive rooms away from the noise source

Figure 14: Shielding effects of commercial podium developments

Figure 15: Acoustic design for the effective orientation of buildings in transport noise zones
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 criteria, implementation of quiet house requirements (Table 3) is an acceptable solution.

Quiet house acoustic 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.

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 façade 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.

The most common approaches to acoustic treatment of a building are providing mechanical ventilation or air conditioning so windows can remain closed; providing acceptable glazing thicknesses (refer to Figure 17); and improving insulation to the roof and above-ceiling space.

A mechanical ventilation system is usually required to allow windows to be closed when quiet indoor conditions are required. Mechanical ventilation systems need to comply with AS 1668.2 – The use of mechanical ventilation and air-conditioning in buildings and natural ventilation arrangements of F4.6 and F4.7 of Volume One and 3.8.5.2 of Volume Two of the National Construction Code.

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 be otherwise be met. The proponent elects to implement the first option, which for LAeq, Day 58dB 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 Rw + 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.

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

Side on to the corridor, the glass door is included in the area calculation (11m² total/20m² = 55%), however the allowance for Rw+Ctr 28dB glazing is increased to 60 per cent, meaning the same window system facing the road can be used. The glass door needs to comply with Rw+Ctr 28 dB, and from Table 3 this can be achieved with a six millimetre toughened glass suite with acoustic seals.

The proponent may also here nominate a glass sliding door system acoustically rated to Rw 31dB by a manufacturer or professional acoustical consultant.
## Table 3: Quiet house requirements

<table>
<thead>
<tr>
<th>Exposure Category</th>
<th>Orientation to corridor</th>
<th>Walls</th>
<th>Windows / external doors</th>
<th>Roof and ceiling</th>
<th>Outdoor living areas</th>
<th>Mechanical ventilation / air conditioning</th>
</tr>
</thead>
</table>
| **A Quiet House A** | Facing | Bedroom and indoor living and work areas to Rw+Ctr 45dB | - One row of 92mm studs at 600mm centres with:  
  - 9.5mm hardwood or 9mm fibre cement weatherboards or 1 mm fibre cement weatherboards or 1 layer of 19mm board cladding fixed to the outside of the channel; and  
  - A 9mm tongue and groove timber plankboard fixed to the inside face of the studs; and  
  - A layer of 16mm fire-protective grade plankboard fixed to the inside face of the studs; and  
  - A row of concrete or terracotta tiles or metal sheet roof with sarking or minimum 240mm cavity between leaves; and  
  - A cavity of 25mm between leaves  
- Double brick: two leaves of 90mm clay brick masonry with a 20mm cavity between leaves. | Bedroom to Rw+Ctr 28 dB, total glazing area up to 40% of room floor area [if Rw+Ctr 31dB: 60%] [if Rw+Ctr 34dB: 80%] | - Sliding or double hung window with single pane glazing to Rw 36dB (or 10mm glass) or 6mm-12mm-6mm double insulated glass;  
- Fully glazed hinged door with certified Rw 31dB rated door and frame including seals and 6mm glass; and/or  
- Glazed sliding door with 10mm glass | To Rw+Ctr 35dB | - Concrete or terracotta tile or metal sheet roof with sarking and at least 10mm plankboard ceiling  
- A cavity of 240mm cavity between leaves; and  
- A cavity of 25mm between leaves  
- A layer of 16mm fire-protective grade plankboard fixed to the inside face of the studs; and  
- A cavity of 25mm between leaves  
- Double brick: two leaves of 90mm clay brick masonry with a 20mm cavity between leaves. | **Footnotes:**  
- The airborne weighted sound reduction index (Rw) and traffic correction term (Ctr) are published by manufacturers/suppliers, can be determined by acoustic consultants or measured in accordance with AS ISO 717-1. Higher Rw+Ctr values infer greater sound insulation. All values are minimum Rw+Ctr (dB)  
- Example construction for different external wall ratings of Rw+Ctr 45dB and 30dB are provided and are listed within Specification F3.2 in Volume 3 Part F of the National Construction Code. These values are based on the installation and sealing of joints and penetrations in accordance with Specification F3.2.  
- 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 drop seal to provide an air tight seal when closed  
  - Within doors or fixed framing, glazing must be set and sealed using an air tight arrangement of non-hardening sealant, soft rubber (foam) 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+Ctr 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 caulking gaps with non-hardening mastic or suitable mortar  
- No requirements for other indoor areas other than bedrooms and indoor living or work areas
4.6 AT THE 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 (e.g. noise from loose items).

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

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

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.** Track grinding, loco exhaust refurbishment, wheel alignment, track lubrication, brake refurbishment, 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. For example, 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 (i.e. designated freight routes) and alternative transport modes (i.e. 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 OTHER CONSIDERATIONS

5.1 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:

- Being aware of the road and railway transport noise impacting the subject land, with an understanding that such noise cannot be completely eliminated.
- Consulting with the State government transport portfolio, Department of Planning, Lands and Heritage, and/or 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, as required.
- Ensuring the initial and ongoing implementation of any noise management plan applying to the subject land.

5.2 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 the Policy 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 of 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.

5.3 VIBRATION

The Policy does not address ground-borne vibration. 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 rail track grinding, wheel maintenance or speed restrictions in built up areas.

Vibration is challenging and costly to mitigate generally and mitigation options for single detached housing is generally cost prohibitive. Feasible mitigation options do exist for larger scale multi residential development. Industry leaders do assess and if required, mitigate vibration.
**APPENDIX 1: THE NOISE EXPOSURE FORECAST WORKSHEET AND STEP-BY-STEP GUIDE**

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>Identify the relevant noise source (road or rail) from SPP 5.4 policy mapping and list in the Noise Exposure Forecast worksheet. If subject site is near multiple mapped corridors, all need to be included in the worksheet. For road vehicle per day data and % heavy vehicle mix information, visit the Main Roads Western Australia Traffic Map website: <a href="https://mrapps.mainroads.wa.gov.au/TrafficMap">https://mrapps.mainroads.wa.gov.au/TrafficMap</a>. Locate the nearest site for which there is monitoring data and use the most recent vehicle per day and heavy vehicle mix information available. Round up to the nearest vehicle per day line or heavy vehicle mix line in the Noise Exposure Forecast.</td>
</tr>
</tbody>
</table>
| Step 2 | Measure the distance from relevant noise source(s) to receiver. The distance is defined as the three-dimensional distance between the edge of the nearest road carriageway or the centreline of the nearest rail tracks to either:  
- if the position and extent of the noise sensitive building position can be reasonably determined, one metre outside the nearest external façade or opening to a normally occupied space; or  
- a point which reasonably represents where each future noise-sensitive development could be constructed nearest the transport asset and is within three (3) metres of the lot boundary.  
Insert measured distances into the Noise Exposure Forecast table. |
| Step 3 | Locate the closest scenario in the Noise Exposure Forecast table (rounding up or down to the closest VPD/Heavy vehicle mix). Identify the forecast noise level (dB) and corresponding exposure category in the Noise Exposure Forecast table (rounding to the nearest noise level (dB) where measured distance is between intervals) and put this into the worksheet. |
| Step 4 | If the subject site is impacted upon by multiple noise sources, use the formula in table to arrive at a single noise level. Use Noise Exposure Forecast table to identify a single relevant noise exposure category and corresponding policy requirements (Noise Management Plan required, quiet house requirements or no further measures). |
| Step 5 | For scenarios with multiple noise sources, add the highest noise source value (column 3) to the correction. |
| Step 6 | If there is existing development between the subject site and the road or rail corridor (as defined), describe this in the worksheet. It is permissible to drop 4dB (approximately one noise exposure category) to account for screening effects. |
| Step 7 | Determine final noise level/exposure category and corresponding policy requirements in the Noise Exposure Forecast worksheet, which is to accompany your planning or development application. |

<table>
<thead>
<tr>
<th>Site description and summary of proposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) list road / rail corridors (as mapped) and VPD/heavy vehicle mix</td>
</tr>
<tr>
<td>2) for each corridor, measure the distance to subject site/development</td>
</tr>
<tr>
<td>3) Noise Exposure Forecast noise level (dB)/Exposure category</td>
</tr>
</tbody>
</table>
| 4) Where there are multiple roads/rail noise sources: (4) Add correction if the two highest values in highlighted column (3) above are:  
  - dB equal or within 1dB of each other = +3dB;  
  - different by 2 or 3dB = +2dB;  
  - different by 4-7dB= +1dB |
| 5) Sum of the maximum LAeq value from column 3) and the above correction |
| 6) Screening development? Drop 4dB (one Exposure Category if desired) |
| 7) Final noise level and Exposure Category |
APPENDIX 2:
EXAMPLE OF A NOISE
EXPOSURE FORECAST WORKSHEET

A new residential development is proposed near the intersection of Marmion Avenue and Burns Beach Road. Being residential, it is noise-sensitive. Both roads are secondary roads (Category 2).

The closest carriageway edges of Marmion Avenue is approximately 44 metres, and approximately 80 metres for Burns Beach Road.

According to most recent traffic volume data, Marmion Avenue carries 46,393 vehicles a day, and Burns Beach Road carries 27,249 vehicles a day.

From the Noise Exposure Forecast table, the contribution from Burns Beach Road (secondary road, 25,000 vehicles, 80 metres distant) is estimated as $L_{Aeq,\text{day}} 58\text{dB}$. The Marmion Avenue contribution (secondary road, more than 35,000 vehicles per day, 44 metres distant) is estimated as $L_{Aeq,\text{day}} 62\text{dB}$. These two values are 4dB different, so a cumulative correction of $+1\text{dB}$ is added. Therefore the highest value of $62\text{dB} + 1\text{dB}$ in corrections is $L_{Aeq,\text{day}} 63\text{dB}$.

In this scenario, there is a single residential house which qualifies as screening development. If desired, a $-4\text{dB}$ reduction (one exposure category) can be applied. After applying this reduction, the final noise level is $60\text{dB}$ and exposure category B.

| 1) list road/rail corridors (as mapped) and VPD/   | 2) for each corridor, measure the distance to subject | 3) Noise Exposure Forecast noise level (dB)/           |
| heavy vehicle mix                   | site/development                                       | Exposure category                                      |
| Marmion Avenue 46,393 8%        | 45 metres                                              | $62\text{dB} \text{ Exposure Category B}$               |
| Burns Beach Road 27,249 8%      | 80 metres                                              | $58 \text{ Exposure category B}$                        |

4) Where there are multiple roads/rail noise sources: (4) Add correction if the two highest values in highlighted column (3) above are:
- dB equal or within 1dB of each other = $+3\text{dB}$,
- different by 2 or 3dB = $+2\text{dB}$,
- different by 4-7dB= $+1\text{dB}$

<table>
<thead>
<tr>
<th>4) Where there are multiple roads/rail noise sources:</th>
<th>corrected</th>
</tr>
</thead>
<tbody>
<tr>
<td>(4) Add correction if the two highest values in highlighted column (3) above are:</td>
<td>$+1\text{dB}$</td>
</tr>
</tbody>
</table>

5) Sum of the maximum $L_{Aeq}$ value from column 3) and the above correction

6) Screening development? Drop 4dB (one Exposure Category if desired

| 5) Sum of the maximum $L_{Aeq}$ value from column 3) and the above correction | $63\text{dB} \text{ Exposure Category C}$               |
| 6) Screening development? Drop 4dB (one Exposure Category if desired | Residential house $-4\text{dB}$                           |

7) Final noise level and Exposure Category

| 7) Final noise level and Exposure Category | $59 \text{dB} \text{ Exposure Category B}$               |
APPENDIX 3:
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 (e.g. facade correction if free field)

Several of these aspects are discussed in the following table.

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 $L_{eq}$ 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.

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

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.

GENERAL PROCEDURES

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.

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 $L_{eq}$ parameter. It may also be useful for the equipment to be capable of measuring $L_{10}$, $L_{90}$, $L_{15}$ and $L_{MAX}$ parameters.

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

The number of measurement locations is to be determined on a project-by-project basis by a competent person. Refer to Austroads Modelling, Measuring and Mitigating Road Traffic Noise for guidance on the minimum number of noise monitoring locations including:

- Sparsely settled rural areas: About 20% of the residence within 500m of the alignment.
- Rural townships: About 10% of the residences nearest the alignment.
- Built-up areas: At least one site at each major crossroad and at least one site between crossroads.
MEASUREMENT DURATION

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

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

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

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

• Where adjustments are made to hourly measured data, based on professional judgment, this must be highlighted. A reasonable estimate of an affected one-hour period can normally be obtained by taking the average of the hourly values on either side.

• Hourly and averaged data, where tabulated, can be shown to one decimal place (up to three significant figures); however, values for comparison with criteria are to be rounded to the nearest whole number.
APPENDIX 4: 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; and
- road surface/track configuration and condition.

In relation to noise-sensitive land use and/or developments, noise predictions can delineate the areas likely to exceed the Policy’s noise criteria, 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 criteria 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 $L_{A_{night}}$ values may be made on the basis of a maximum train pass-by noise level ($L_{A_{max}}$) or average sound exposure level ($L_{A_{eq}}$).

The following table specific acceptable methodologies.
Road traffic may be assessed using the UK Calculation of Road Traffic Noise (CoRTN) algorithm which yields LA10,18hour values, provided a suitable corrections to Australian conditions are made to obtain the appropriate LAeq,24hour or LAeq,night values as specified in the Policy.

It is preferable to undertake direct noise measurements of the roadway being investigated to determine the existing differences between relevant noise parameters. Where this is not possible, reference should be made to the DEFRA publication Method for Converting the UK Road Traffic Noise Index LA10,18 hour to the EU Noise Indices for Road Noise Mapping, which provides conversion formulae.

Also, where traffic noise measurement data are unavailable and the road traffic noise model cannot be calibrated against existing noise conditions, it is standard practice to apply a further correction of -1.7dB.\(^1\)

Rail traffic may be modelled using the Nordic Rail Prediction Method (Kilde 130-1984) algorithms with appropriate corrections for train class, speeds and local conditions. The algorithms have LAeq,18hour noise prediction outputs, and they can be readily converted to an LAeq,16hour or LAeq,8hour noise level using a logarithmic relationship.

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

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

Unless otherwise determined by a competent person for specific situations, the noise source heights should be as follows\(^2\):

- Passenger vehicles (Austroads Class 1 and 2) +0.5m
- Heavy vehicles (Austroads Class 3 and up) – Engine +1.5m
- Heavy vehicles (Austroads Class 3 and up) – Exhaust +3.6m
- Passenger rail 0 m
- Freight rail locomotive +4.0m
- Freight rail wagons +0.8m

Receiver heights for predictions should be 1.4 metres above floor level.

For new or upgrade of road and railway infrastructure proposals, at the most exposed habitable façade\(^3\) of existing noise-sensitive premises, ground floor level only.

For new noise-sensitive land use and/or development proposals, at the most exposed habitable façade of the proposed buildings, at heights of 1.4 metres above all proposed floor levels.

For rail surface discontinuities or tight curves, the following corrections may be applied to segment exposure (LAE) or maximum L\(_{Amax}\) levels:

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

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

Accepted corrections for various road surfaces are:

- 14mm chip seal +3.5dB
- 10mm chip seal +2.5dB
- 5mm chip seal +1.5dB
- Dense graded asphalt 0dB
- Novachip -0.2dB
- Stone mastic asphalt -1.5dB
- Open graded asphalt -2.5dB

For the CoRTN algorithms, it is recommended to apply the ‘three strings’ approach, that is, use three road strings of different heights to represent traffic from passenger, 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.

When predicting transport noise levels immediately outside a facade, a +2.5dB 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 – NAAstra 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 5:
### ROAD TRAFFIC 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]</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 traffic speed? km/h</td>
</tr>
<tr>
<td><strong>Noise prediction corrections</strong></td>
<td></td>
</tr>
<tr>
<td>Traffic emission</td>
<td>If using the Calculation of Road Traffic Noise algorithms, have the following corrections been applied?</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>Road pavement</td>
<td>Has one of the following road pavement corrections been applied to the tyre/road emission?</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>Novaclip</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>
<tr>
<td>Australian traffic</td>
<td>Has a -1.7 dB Australian Road Research Board study been applied? Y / N</td>
</tr>
<tr>
<td>Receptor façade</td>
<td>Has a +2.5 dB building façade correction been applied? Y / N</td>
</tr>
</tbody>
</table>

### 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?</td>
<td>Y / N</td>
</tr>
</tbody>
</table>

### Environmental inputs

<table>
<thead>
<tr>
<th>Checklist item</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receivers</td>
<td>Were receiver heights modelled at 1.4 m above floor level? 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>

### Rail traffic input data

<table>
<thead>
<tr>
<th>Checklist item</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rail line name</td>
<td>[insert rail line name]</td>
</tr>
<tr>
<td>16-hr daytime passenger rail movements</td>
<td></td>
</tr>
<tr>
<td>16-hr daytime freight rail movements</td>
<td></td>
</tr>
<tr>
<td>8-hr daytime passenger rail movements</td>
<td></td>
</tr>
<tr>
<td>8-hr daytime freight rail movements</td>
<td></td>
</tr>
<tr>
<td>Rail traffic heights</td>
<td>Have the rail noise sources been modelled at the following heights?</td>
</tr>
<tr>
<td>Passenger and freight trains at 0.5 m above rail height?</td>
<td>Y / N</td>
</tr>
<tr>
<td>Freight train locomotives at 4.0 m above rail height?</td>
<td>Y / N</td>
</tr>
<tr>
<td>Rail line speed</td>
<td>What is the modelled rail traffic speed? km/h</td>
</tr>
</tbody>
</table>

### Railway 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?</td>
<td>Y / N</td>
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### Environmental inputs

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<tr>
<td>Receivers</td>
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</tr>
<tr>
<td>Have noise levels been predicted at the most affected façade/s?</td>
<td>Y / N</td>
</tr>
</tbody>
</table>

### Rail noise predictions

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

### Noise prediction corrections

<table>
<thead>
<tr>
<th>Checklist item</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Train noise emissions</td>
<td>Has the assessment described how the following have been calibrated in the rail noise calculations?</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>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical/uneven joints</td>
<td>+3 dB Y / N</td>
</tr>
<tr>
<td>Curve radius less than 600 m</td>
<td>+3 dB Y / N</td>
</tr>
<tr>
<td>Turnout</td>
<td>+6 dB Y / N</td>
</tr>
<tr>
<td>Curve radius less than 300 m</td>
<td>+8 dB Y / N</td>
</tr>
<tr>
<td>Diamond crossing</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

<table>
<thead>
<tr>
<th>Checklist item</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receptor façade</td>
<td>Has a +2.5 dB building façade correction been applied? Y / N</td>
</tr>
</tbody>
</table>

### Rail noise barriers

<table>
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<tr>
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<tr>
<th>Checklist item</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rail line speed</td>
<td>What is the modelled rail traffic speed? km/h</td>
</tr>
<tr>
<td>Environmental inputs</td>
<td></td>
</tr>
<tr>
<td>Receivers</td>
<td>Were receiver heights modelled at 1.4 m above floor level? Y / N</td>
</tr>
<tr>
<td>Have noise levels been predicted at the most affected façade/s?</td>
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### Rail noise predictions

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<tr>
<td>Predicted noise levels</td>
<td>Have noise levels been predicted at all floors of the development? Y / N</td>
</tr>
<tr>
<td>Have the noise predictions considered the 20-year planning horizon? Y / N</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX 6:
NOISE MANAGEMENT PLAN CONTENT

This is a guide for the preparation and/or 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

1.0 Executive summary
   - Scope of work
   - Criteria used in the assessment
   - Statement about compliance
   - Recommended noise mitigation measures (if required)
   - Other recommendations (e.g. further assessment)

2.0 Introduction

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

4.0 Site details
   - Location of major transport corridor(s)
   - Noise receiver locations (i.e. 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

5.0 Noise criteria
   - Outdoor noise criteria (Table 1) - 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 criteria (Table 1) - for noise-sensitive land use and/or development proposals (Reference AS/NZS 2107:2000 Acoustics – Recommended Design Sound Levels and Reverberation Times for Building Interiors for non-residential developments)

6.0 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 (i.e. for road noise, percentage of heavy vehicles of locomotive class; for rail noise, 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
   - 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 (e.g. 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 (e.g. SoundPlan, CadnaA, etc)
- Industry recognized prediction codes used (e.g. CoRTN for road noise, Nordic (Kilde Rep 130) for rail noise, etc)
- Model inputs in relation to noise emissions – number of trains, length, speed, passby noise exposure level (SEL or LAE) 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:
  - Wind speed, m/s
    - Day: 4.0
    - Night: 3.0
    - General direction is from source to receiver
  - Temperature gradient / inversion lapse rate, °C/100m
    - Day: Nil
    - Night: 2.0
    - Implementation dependent on specific software packages
  - Pasquill Stability Criterion
    - E
    - F
    - Implementation dependent on specific software packages
  - Temperature, °C
    - Day: 20
    - Night: 15
  - Relative humidity, %
    - Day: 50
    - Night: 50

Results for noise modelling prediction

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

8.0 Discussion, recommendations and conclusions

The discussion compares the relevant noise criteria 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 $L_{A_{eq,day}}$ and $L_{A_{eq,night}}$. For road traffic, $L_{A_{eq,night}}$ may be assumed to be 5 dB below the $L_{A_{eq,day}}$ value.
- 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 options to achieve compliance (noise control measures)
- Reasonable and practicable considerations relevant to the noise mitigation measures
- Predicted noise levels with/without reasonable and practicable noise mitigation measures in place
- Recommendations in sufficient detail to be turned into conditions of development

Overall, a suitable noise management strategy is to be clearly identified.
9.0 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
- 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)

10.0 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.

11.0 Appendices (as required)

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
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 – Record of Information (Memorials) on Title and the Model Subdivision Conditions Schedule.

APPENDIX 7: RECOMMENDED WORDING FOR NOTIFICATIONS ON TITLE

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 8:
MODEL SPECIAL CONTROL AREA PROVISIONS FOR LOCAL PLANNING SCHEMES

Provisions relating to Special Control Areas are included in Part 5 of Schedule 1 of the Planning and Development (Local Planning Schemes) Regulations 2015 (the model provisions for Local Planning Schemes). The following is a model Special Control Area for land in the vicinity of a transport corridor:

Special Control Area – Road and Railway Noise

X.X SCA X – Land affected by road and rail noise

X.X.1 Purpose
The purpose of Special Control Area X is to ensure that the requirements of State Planning Policy 5.4 – Road and Rail Noise (SPP 5.4) are satisfied by all proposed development and land use.

X.X.2 Objectives
The objectives of Special Control Area X are to:

a) Delineate land within which SPP 5.4 applies;

b) Ensure that SPP 5.4 is properly considered and implemented where development or a change of use is proposed on land within which SPP 5.4 applies.

X.X.3 Planning Approval

a) Notwithstanding any other provisions in this Scheme, planning approval is required for any development or change of use proposed for land within Special Control Area X.

b) In considering an application lodged pursuant to Section X.X.3(a), the local government will have due regard to SPP 5.4.

c) Approval of an application lodged pursuant to Section X.X.3(a) will only be forthcoming where the local government is satisfied that any applicable requirements of SPP 5.4 have been met, or can be met through the satisfaction of a condition of approval.

d) In considering an application lodged pursuant to Section X.X.3(a), the local government may seek technical advice from the Department of Planning, Lands and Heritage and Department of Water and Environmental Regulation, as appropriate, and will have due regard to that advice when making its decision.
Map 3: Perth and Peel