Guide to assessing road-traffic noise using NZS 6806 for state highway asset improvement projects

This guide describes the processes to be used on NZ Transport Agency asset improvement projects for assessing and, where required, determining appropriate mitigation for road-traffic noise. These processes are based on NZS 6806:2010. The guide also gives effect to the NZ Transport Agency’s state highway project development and delivery standards, in particular Z19 Environmental and Social Responsibility Standard.

August 2016, Version 1.1
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Wellington 6141

www.nzta.govt.nz

The NZ Transport Agency is part of, and contributes to, the Safer Journeys programme.
Safer Journeys is the government’s strategy to guide improvements in road safety over the period 2010-2020. The strategy’s vision is a safe road system increasingly free of death and serious injury. It is a coordinated effort across partner agencies to improve each aspect of road safety – better behaviours, a safer road environment, safer speeds and higher vehicle standards.
For more information visit www.transport.govt.nz/saferjourneys
DOCUMENT MANAGEMENT PLAN

1. PURPOSE
This management plan outlines the updating procedures and contact points for the document.

2. DOCUMENT INFORMATION

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<td>SP/M/023</td>
</tr>
<tr>
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<td>This document is located in electronic form on the NZ Transport Agency’s website at <a href="http://www.nzta.govt.nz">http://www.nzta.govt.nz</a></td>
</tr>
<tr>
<td>DOCUMENT OWNER</td>
<td>Greg Handane</td>
</tr>
<tr>
<td>DOCUMENT SPONSOR</td>
<td>Rob Hannaby</td>
</tr>
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3. AMENDMENTS AND REVIEW STRATEGY
All corrective action/improvement requests (CAIRs) suggesting changes will be acknowledged by the document owner.

<table>
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<tr>
<th>ACTIVITY</th>
<th>COMMENTS</th>
<th>FREQUENCY</th>
</tr>
</thead>
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<tr>
<td>Amendments (minor revisions)</td>
<td>Updates incorporated immediately when they occur.</td>
<td>As required</td>
</tr>
<tr>
<td>Review (major revisions)</td>
<td>Amendments fundamentally changing the content or structure of the document will be incorporated as soon as practicable. They may require coordinating with the review team timetable.</td>
<td>Five yearly</td>
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<tr>
<td>Notification</td>
<td>All users who have subscribed to HNO Technical Advice Notes (<a href="http://hip.nzta.govt.nz/tan">http://hip.nzta.govt.nz/tan</a>) will be advised by email of amendments and updates.</td>
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RECORD OF AMENDMENT

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<tr>
<td>1.1</td>
<td>Address changes in NZ Transport Agency processes and case studies</td>
<td>July 2016</td>
<td>Greg Haldane</td>
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1 INTRODUCTION

BACKGROUND
The NZ Transport Agency aims to be a good neighbour, taking social and environmental responsibility seriously.

Transport noise and vibration can cause a range of impacts on people and communities including annoyance and interference with daytime activities such as work, study and domestic living. Other effects include potential sleep disturbance, and long-term health impacts such as increased stress and hypertension.

The State highway environmental and social responsibility plan provides our approach to implementation of our environmental and social responsibility policy, in relation to the planning, design, operation and maintenance of New Zealand’s state highway network.

The plan details how the Transport Agency addresses the environmental requirements of the following statutes:
- Land Transport Management Act 2003
- Resource Management Act 1991

In accordance with these requirements the plan articulates how the Transport Agency seeks to responsibly manage human health and nuisance effects. For road-traffic noise from state highway asset improvement projects, that is to be achieved through the processes set out in this guide.

NEW ZEALAND STANDARD NZS 6806
For assessing noise from new and altered state highways, the Transport Agency has adopted New Zealand Standard NZS 6806:2010. It was prepared by an independent committee facilitated by Standards New Zealand, which included several acoustics experts, and representatives from government departments, including the Transport Agency.

While the standard is intended to be a relevant matter when considering applications under the Resource Management Act, it is not a National Environmental Standard, and unless referenced in a district plan or designation condition, adoption is not mandatory.

The standard provides both criteria and a mitigation design process. Unlike previous standards, noise mitigation is considered in a more holistic manner as part of an integrated design process.

Where noise levels would exceed the specified criteria, the standard requires the Transport Agency to investigate options for reducing noise levels. In the first instance, this is using low-noise road surfaces and noise barriers in the road corridor. In some instances, however, noise mitigation may not be practicable or efficient, or adverse effects from the inclusion of noise barriers (typically visual) outweigh the noise reduction benefits that they provide. In these instances, NZS 6806 allows a pragmatic decision to be made.

If noise levels remain above the criteria in NZS 6806, because the above mitigation is not practical, the Transport Agency will offer to treat individual buildings, such as the provision of mechanical ventilation so that windows can be left closed. Acoustic treatment should be designed to achieve reasonable internal noise levels in accordance with NZS 6806.
PURPOSE OF THIS DOCUMENT

The aim is to consistently and efficiently consider noise effects within the framework of the Transport Agency’s State highway professional services contract proforma manual (SMO30) and perform assessments as required by the Environmental and Social Responsibility Standard.

This guide assists in determining what level of assessment is required during project development, and how noise mitigation evolves during the delivery phase and into construction.

Where noise mitigation is required, this guide describes the processes to be used, including tools and templates prepared by the Transport Agency.

For road-traffic noise (not construction noise) this guide is aimed at:

- Transport Agency project managers who need to schedule and budget for the relevant processes.
- Acoustics specialists who need to perform and present assessments in a consistent manner.
- Planners who need to understand the way designation conditions for noise are drafted.
- For each project, a suitably qualified expert (such as an environmental manager, planner or other person with a holistic viewpoint) who has responsibility for the final determination of the noise mitigation.

The Transport Agency has prepared other guides, which are also relevant, including:

- State highway noise barrier design guide
- Guide to state highway road surface noise
- State highway guide to acoustic treatment of buildings
- Guide to the management of effects on noise sensitive land use near to the state highway network


An online eLearning training module on road-traffic noise is available, which includes the application of NZS 6806. (nzta.onlearn.co.nz).

SPECIFICATION P40

The Transport Agency has a specification (P40) for noise mitigation, which covers the design, construction, documentation and post-construction review of state highway road-traffic noise mitigation.

This guide should be read in conjunction with P40, as understanding how mitigation will be implemented in practice is essential for an accurate assessment of effects, and an efficient design process.

FIGURE 1: NZ TRANSPORT AGENCY STATE HIGHWAY NOISE GUIDES
# 2 TERMINOLOGY

A summary of key terms is provided here, but many have complex definitions and reference to NZS 6806 is essential.

<table>
<thead>
<tr>
<th>TERM</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>AADT</td>
<td>Annual average daily traffic - the vehicle count for an entire year in both directions past a point on the road, divided by the number of days in the year.</td>
</tr>
<tr>
<td>Acoustics specialist</td>
<td>A person with: an engineering or science degree including study of acoustics; at least five years professional experience in acoustics; and chartered or certified status with a body that audits continuing professional development.</td>
</tr>
<tr>
<td>Altered road</td>
<td>An existing road that is subject to a change in the horizontal or vertical alignment that without specific noise mitigation would cause an increase in road-traffic noise above thresholds defined in NZS 6806. NZS 6806 applies to new and altered roads. It does not apply to existing roads that are not being ‘altered’. An online screening tool to help determine whether or not NZS 6806 applies to a particular project is provided on the Transport Noise website (<a href="http://www.acoustics.nzta.govt.nz">www.acoustics.nzta.govt.nz</a>). Maintenance works such as resurfacing are not classified as an altered road project.</td>
</tr>
<tr>
<td>Build now designation</td>
<td>A designation that is obtained with the intention of commencing construction in the immediate future.</td>
</tr>
<tr>
<td>Building-modification mitigation</td>
<td>Measures to reduce the effects of internal traffic noise levels in buildings include: • acoustic insulation • voice amplification systems (eg in schools) • building relocation.</td>
</tr>
<tr>
<td>Decibels ($dB$ $L_{eq(24h)}$)</td>
<td>Road-traffic noise levels under NZS 6806 are measured in decibels ($dB$) as the A-frequency-weighted, time-average level over 24 hours ($L_{eq(24h)}$).</td>
</tr>
<tr>
<td>Design year</td>
<td>10 to 20 years after the opening of a new or altered road.</td>
</tr>
<tr>
<td>Do-nothing</td>
<td>The scenario of no change to the existing road, but with traffic growth that would have occurred at the design year.</td>
</tr>
<tr>
<td>Do-minimum</td>
<td>The scenario at the design year of a new or altered road having been constructed, but with no specific noise mitigation measures implemented.</td>
</tr>
<tr>
<td>Free-field</td>
<td>Under NZS 6806 road-traffic noise is now assessed at the position of the building facade excluding noise reflected from the building, as if it wasn’t there (a free-field level). A free-field level (NZS 6806) is approximately 2.5 dB less than a facade level.</td>
</tr>
<tr>
<td>Protected Premises and Facilities (PPFs)</td>
<td>Spaces in buildings used for: • residential activities • marae • overnight medical care • teaching (and sleeping) in educational facilities • playgrounds that are part of educational facilities that are within 20m of buildings used for teaching purposes. PPFs are the locations where road-traffic noise is assessed and for which noise mitigation measures may be required. NZS 6806 does not apply to PPFs in urban areas that are located more than 100m from the edge of the closest traffic lane for the new or altered road, or PPFs in rural areas located more than 200m from the edge of the closest traffic lane.</td>
</tr>
<tr>
<td>Route protection designation</td>
<td>A designation obtained where there is not an immediate need for a new state highway, however land is to be set aside for future needs.</td>
</tr>
<tr>
<td>Structural mitigation</td>
<td>Measures to reduce noise such as: • low-noise road surface materials • noise barriers (including walls, fences and bunds).</td>
</tr>
<tr>
<td>Urban/rural</td>
<td>An urban environment is a main urban area, a satellite urban community or an independent urban community (Statistics New Zealand). Any area that is not urban is classified as a rural environment for the purposes of NZS 6806. Details of these areas are available from Statistics New Zealand (<a href="http://www.stats.govt.nz">www.stats.govt.nz</a>).</td>
</tr>
</tbody>
</table>
3 ASSESSMENT METHOD

BACKGROUND
Prior to 2010, road-traffic noise from state highways was assessed using the Transit guidelines. One of the weaknesses of the guidelines is that they often led to noise mitigation solutions to achieve perfect compliance with the specified noise limits, resulting in poorly integrated designs and at the expense of value-for-money. In some instances this has resulted in poor visual and urban design outcomes, and construction of substantial barriers for the sake of 1 dB attenuation, which is an insignificant benefit.

The assessment method in NZS 6806 requires consideration of a number of noise mitigation options depending on the scale of a project. These options are subject to an integrated design process, in which the costs and benefits of the mitigation is considered. In some instances the best practicable option is the ‘do-minimum’ design with no specific noise mitigation.

District plans generally exclude noise from vehicles on public roads, or reference Transit guidelines or NZS 6806. As new state highways are authorised through designations, district plan rules are not directly applicable.

CRITERIA
NZS 6806 does not set rigid noise limits. It gives categories (A, B and C) of noise criteria, and requires that the best practicable option (BPO) be identified to mitigate road-traffic noise (table 1). This process promotes integrated design encompassing a wide range of factors as well as noise levels. The upper category (C) provides a backstop against adverse health effects, such as sleep disturbance, by requiring the insulation of houses if the external noise would not be sufficiently reduced using the BPO.

Noise mitigation options are to be assessed and, if practicable, the Category A criterion should be achieved. If this is not practicable, then mitigation should be assessed against Category B. However, if it is still not practicable to comply with Categories A or B then mitigation should be implemented to ensure the internal criterion in Category C is achieved.

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>ALtered ROADS</th>
<th>NEW ROAD</th>
<th>NEW ROAD &gt; 75,000 AADT</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>External</td>
<td>64 dB $L_{Aeq(24h)}$</td>
<td>57 dB $L_{Aeq(24h)}$</td>
</tr>
<tr>
<td>B</td>
<td>External</td>
<td>67 dB $L_{Aeq(24h)}$</td>
<td>64 dB $L_{Aeq(24h)}$</td>
</tr>
<tr>
<td>C</td>
<td>Internal</td>
<td>40 dB $L_{Aeq(24h)}$</td>
<td>40 dB $L_{Aeq(24h)}$</td>
</tr>
</tbody>
</table>
4 TRANSPORT AGENCY PROCESSES

INTRODUCTION
Actions are required throughout the lifecycle of a state highway to consider and address road-traffic noise effects. Different project stages are defined and included in the Environmental and social responsibility standard, which are shown in figure 2.

There are three major processes, although each is split into smaller segments.
• Project development, where a need is established and the preferred option is confirmed.
• Project delivery, where statutory approvals are obtained, detailed design performed, and a contractor engaged to construct the project.
• Maintenance and operation, which is once the state highway is open. Maintenance contracts will be in place and will include noise barrier and road surface requirements.

This guide is particularly relevant to the Development Phase and the consenting component of the Delivery Phase. Specification P40 should be referenced for the Delivery and Maintenance phases.

PROJECT DEVELOPMENT
In the Business Case approach, the transportation need is assessed before undertaking detailed analysis of environmental effects such as noise.
This means noise assessments in the early phases are limited to identifying whether noise is a significant issue, and the likely scale of mitigation required.
Where different route options are being investigated, noise will be one of many factors to be considered and may form part of a multicriteria analysis.
The consenting strategy will be confirmed during the Detailed Business Case, however the technical assessments required to secure the consents will often not be performed until a decision to construct the project has been made and funding allocated.

CONSENTING
A robust technical assessment is required for obtaining the statutory approvals, however the level of detail will vary depending on the project. The noise mitigation design process detailed in NZS 6806 requires significant effort, and for many routine Transport Agency projects, noise mitigation is not warranted and neither is a full assessment.
Critical to getting the right noise outcome, is obtaining the necessary approvals with appropriate conditions. The Transport Agency has model conditions that should be used.

PROJECT DELIVERY
For ‘build now’ designations, which applies to most projects, the delivery phase will include the detailed design of noise mitigation identified in the consenting stage. The noise mitigation design and noise levels at individual properties should not be revisited, unless any alterations to the designation are required.
In the case of a ‘route protection’ designation, a detailed noise assessment may not be performed until the project delivery design stage.

NOISE ASSESSMENT TIERS
The Transport Agency has adopted a three-tiered approach to noise assessment. Noise tiers have been developed to allow consistent noise assessments, but as the tiers are not bound to specific business cases phases, the assessments may be performed earlier or later, depending on the size and complexity of the project.
The appropriate tier of noise assessment varies for each stage, depending on the risk associated with the project.
For many projects the Tier 1 and 2 assessments can be quickly and simply conducted by Transport Agency project staff without the need for acoustics specialists. Tier 3 assessments are not required on all projects, but do require acoustics specialists.
Generally, for larger higher-risk projects, the more detailed Tier 2 and 3 assessments will be required in earlier stages. The ‘noise risk’ associated with the project is determined from the Tier 1 assessment. The Tier 1 and 2 noise assessments are conducted separately for each project option.
The Tier 3 noise assessment is only conducted for the preferred option determined in the Detailed Business Case.
The purpose and output of each tier are summarised in table 2. Figure 2 shows the normal timeframes for the assessment tiers.

<p>| TABLE 2: NOISE ASSESSMENT TIERS |</p>
<table>
<thead>
<tr>
<th>Purpose</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier 1</td>
<td>Identify issues/fatal flaws for single or multiple options</td>
</tr>
<tr>
<td>Tier 2</td>
<td>Confirm whether NZS 6806 applies</td>
</tr>
<tr>
<td>Tier 3</td>
<td>Determine appropriate noise mitigation after robust evaluation process based on NZS 6806</td>
</tr>
<tr>
<td></td>
<td>Assessment of effects for RMA approvals</td>
</tr>
<tr>
<td>Tier 1</td>
<td>Environmental and Social Responsibility Screen</td>
</tr>
<tr>
<td>Tier 2</td>
<td>Preliminary Technical Assessment Report</td>
</tr>
<tr>
<td>Tier 3</td>
<td>Technical Assessment Report</td>
</tr>
</tbody>
</table>
FIGURE 2: ASSESSMENT PROCESS

<table>
<thead>
<tr>
<th>PROCESS</th>
<th>TASKS</th>
<th>NOISE ASSESSMENT TIER</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEVELOPMENT BUSINESS CASE</td>
<td><strong>Point of Entry</strong></td>
<td><strong>This guide</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Strategic Business Case</strong></td>
<td>Tier 1 High risk only</td>
</tr>
<tr>
<td></td>
<td><strong>Programme Business Case</strong> Identify context and constraints</td>
<td>Tier 2 High risk only All projects</td>
</tr>
<tr>
<td></td>
<td><strong>Indicative Business Case</strong> Option analysis</td>
<td>Tier 3 High risk only Project dependant</td>
</tr>
<tr>
<td></td>
<td><strong>Detailed Business Case</strong> Confirm preferred option</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Consenting</strong> Obtain statutory approvals</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Procurement</strong> Decide model and develop Principal’s Requirements</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Design</strong> Detailed design of mitigation</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Construction</strong> Refinement of mitigation and validation</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Procurement</strong> Instruct a contractor</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Management</strong> Ongoing maintenance</td>
<td></td>
</tr>
<tr>
<td>DELIVERY</td>
<td><strong>Consenting</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Procurement</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Design</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Construction</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Procurement</strong></td>
<td></td>
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<tr>
<td></td>
<td><strong>Management</strong></td>
<td></td>
</tr>
<tr>
<td>MAINTAIN AND OPERATE</td>
<td><strong>Consenting</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Procurement</strong></td>
<td></td>
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<tr>
<td></td>
<td><strong>Design</strong></td>
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<td></td>
<td><strong>Construction</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Procurement</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Management</strong></td>
<td></td>
</tr>
</tbody>
</table>

P40 – Specification for noise mitigation
TIER 1 – NOISE RISK ASSESSMENT

A Tier 1 assessment is a qualitative assessment that forms part of the Environmental and Social Responsibility (ESR) Screen. As the project progresses through the business cases process, the assessment for each current option should be reviewed and updated as necessary. Where multiple routes or corridors are being considered, the Tier 1 assessments can form one input into a multi-criteria analysis.

In its simplest form, a Tier 1 assessment can be based solely on the volume of traffic at the opening year and the number of PPFs within 200m of the proposed alignment. These parameters can provide an initial indication of potential noise exposure.

If an acoustics specialist is involved, the assessment can be expanded to include the number of PPFs in different noise categories. Noise levels can either be calculated with a 3-dimensional acoustics model or a 2-dimensional GIS model, depending on the complexity of the environment and availability of data. An example of different parameters that can be used to provide acoustic ranking of different options is provided below:

1. Approximate number of PPFs within 100 metres (urban) or 200 metres (rural) of the route option.
2. Approximate number of PPFs within Category B and within Category C without mitigation. Categories B and C are less desirable as they describe higher noise levels at PPFs.
3. Potential for mitigation to reduce traffic noise levels to achieve noise levels within Category A.
4. Potential for mitigation to reduce traffic noise levels by a significant or noticeable amount (i.e. more than 5 decibels noise level reduction).
5. Expected change in noise level due to the option.

These factors should each be rated using a non-numeric scale. Using non-numeric rating discourages direct comparison of noise criteria with other multi-criteria analysis parameters without providing proper weighting and context. Further guidance on multi-criteria analysis is in development and will be available on the HIP. The approach adopted should conform with that guidance. An example of ratings for acoustic factors using a seven point scale from --- to +++ is provided in table 3.

<table>
<thead>
<tr>
<th>TABLE 3: TIER 1 EXAMPLE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OPTION A</strong></td>
</tr>
<tr>
<td>Value Rating</td>
</tr>
<tr>
<td>Total number of PPFs</td>
</tr>
<tr>
<td>PPFs in Cat B/C without mitigation</td>
</tr>
<tr>
<td>Mitigation to achieve Cat A</td>
</tr>
<tr>
<td>Mitigation to achieve significant reduction</td>
</tr>
<tr>
<td>Noise level change at PPFs</td>
</tr>
</tbody>
</table>
TIER 3 – TECHNICAL ASSESSMENT

A Tier 3 assessment determines the recommended noise mitigation and assesses the effects of the project. This requires an acoustics specialist.

Key parts of the assessment are:
- Noise modelling
- Mitigation design
- An assessment of effects
- Preparation of a Technical assessment report, which can be used to support a Notice of Requirement.

A Tier 3 assessment is not required for all projects. As discussed above, in some instances a Tier 2 assessment may be sufficient.

NOISE MODELLING

A detailed computer noise model is the cornerstone of the assessment and mitigation design. The Transport Agency has produce a draft noise mapping guide\textsuperscript{10}. While the focus of this guide is primarily on strategic noise maps, its recommendations for data processing and outputs should be adopted for Tier 3 assessments.

Road surface corrections should be based on the Guide to state highway road surface noise.

No corrections or ‘calibration’ for site measurements should be performed.

MITIGATION DESIGN

The noise mitigation design process is discussed in detail in section 5. It is important that this process is well documented to enable the consent authority to verify that a thorough assessment by the appropriate specialists has occurred.

Typically this would mean the assessment matrices and workshop discussion summaries are appended to the technical assessment report.

ASSESSMENT OF EFFECTS

All road projects requiring approvals under the Resource Management Act require an assessment of environmental effects. While closely related, this assessment is independent of the mitigation selection process and criteria from NZS 6806.

A clear assessment of the residual noise effects after mitigation is required. An evaluation of these impacts on indoor/outdoor amenity and health effects should be presented. While the NZS 6806 process should result in appropriate noise levels, this consideration may require additional actions to ensure amenity is preserved to a reasonable level.

Positive effects from the scheme should also be considered. In some instances it may be appropriate to model adjacent parts of the roading network that will receive a reduction in traffic as a result of the scheme.

REPORTING

Technical assessment reports should effectively present the factors that are considered in relation to the selection of the noise mitigation design. The influence of non-acoustical factors should be evaluated and presented.

The existing noise environment needs to be evaluated, although extensive ambient noise monitoring is generally not warranted as modelling can be used.

All PPFs need to be clearly identified on a set of plans. A table of predicted road-traffic noise levels should be included in the technical assessment report showing the existing, do-nothing, do-minimum and selected options for each PPF.

The assessment of effects should consider certain public spaces that are not PPFs, for example public reserves. In addition, effects on receivers outside the 100/200m buffers may need to be qualitatively assessed.
5 NOISE MITIGATION DESIGN

Key to the NZS 6806 process is the determination of the preferred noise mitigation taking into consideration noise levels and other inputs. NZS 6806 refers to this as the ‘best practicable option’; however, this RMA term is best avoided as it is the consent authority’s role to confirm what the best practicable option comprises.

In addition, the preferred mitigation design will change as the project is developed. There are two key stages of ‘Selected Options’ and ‘Detailed Mitigation Options’ as described in section 6.

During statutory approvals, the Selected Options are essentially the Transport Agency’s recommendation for what constitutes the best practicable option, having considered all relevant factors.

1 The project should be split into discrete assessment areas. In urban environments separate assessment areas should be used for each side of the state highway.

2 Detailed design of the mitigation is not required; however, general parameters such as height, extent and construction (e.g., noise bund vs noise wall) should be defined.

An A3 summary paper for each assessment area should be produced showing options for mitigation. Project examples are provided on the HIP. Any of the mitigation options developed could be used, but they will result in different proportions of PPFs in NZS 6806 categories A, B and C. Figure 3 shows an example of an A3 summary paper illustrating mitigation options.
FIGURE 3: EXAMPLE OF NOISE MITIGATION OPTIONS SUMMARY PAPER

Option 1: porous asphalt surface
Option 2: 2m barrier at edge of SH1 (278m long)
Option 3: 3m barrier at edge of SH1 (278m long)
Option 4: 2m barrier on property boundary (270m long)
Option 5: as Option 2 but with acrylic barrier

Option 1: Building modification for Category C PPFs
Option 2: Option 2 at edge of SH1 (278m long)
Option 5: as Option 5 at SH1 (278m long)
3 The project acoustics specialist should calculate the benefit cost ratio for each mitigation option using the spreadsheet template available on the HIP. The relative merits should be added to the assessment area summary paper.

4 The project acoustics specialist should prepare an assessment matrix for each assessment area using the template on the HIP. The acoustics specialist should fill in the assessment for the acoustics criteria and then circulate the matrices with the options summary papers to the project team. For each assessment criteria the matrices include a seven-point qualitative rating from triple-plus to triple-minus. Early trials proved that a quantitative scoring system could not correctly balance the different criteria in the matrix, as the appropriate weightings change in each discipline. The template allows the assessment criteria to be customised so that they are relevant to the specific project and location. As a minimum the criteria should cover the factors listed in section 6.3 of NZS 6806.

5 All relevant project team members should complete the matrix. The key responses in addition to those from the acoustics specialists will usually be from the safety, landscape/visual and urban design specialists. Although all other disciplines are important in determining the preferred noise mitigation. The Transport Agency Network Manager should contribute to the matrix to ensure operation and maintenance issues are adequately considered.
6. The responses to the matrices should be collated and reviewed by the project manager, planner and acoustics specialist. If the choice of noise mitigation options is clear-cut on the basis of the assessment matrices then these may be selected as the noise mitigation solution. For simple projects it is envisaged that this will often be the case. For large, complex and high-risk projects it will usually be necessary to hold one or more noise mitigation workshops to review the matrices before determining the preferred noise mitigation.

7. If necessary, hold a noise mitigation workshop. Precirculate the completed assessment matrices to all attendees. Attendees may include:
   - facilitator
   - Transport Agency project staff
   - consultant team: acoustics, planning, social, consultation, roading, structures, visual/landscape, urban design, construction, ecology, stormwater
   - Transport Agency national office: acoustics, urban design
   - Transport Agency regional office: planning, maintenance (regional maintenance staff are critical contributors as the long-term performance of the mitigation depends on practicable maintenance)
   - acoustics advisors from the council (observer only – as NZS 6806 is a process rather than performance based standard, it is beneficial for the regulatory authority’s acoustics advisor to be able to witness the process so that they can verify it was correctly implemented).

Not all of these people will be needed for every noise mitigation workshop, and the appropriate attendees should be determined by the Transport Agency project manager.

8. Ideally the noise mitigation will be determined by consensus at the noise mitigation workshop. In many cases, minor variants to mitigation options will need to be remodelled following the workshop and reviewed by specific workshop participants. If consensus cannot be achieved then a suitably qualified expert with a holistic view, such as a planner or an environmental specialist, is responsible for balancing the different considerations and selecting the preferred option.
**NOISE MITIGATION WORKSHOPS**

To give effect to the process detailed on the previous pages, a noise mitigation workshop needs to be well planned and organised. This should include the following:

- The acoustics specialist should complete the noise modelling and prepare a summary paper and draft assessment matrix for each area at least one month before the workshop.
- All team members should complete their parts of the assessment matrices at least two weeks before the workshop.
- Complete assessment matrices with collated responses should be circulated at least one week before the workshop.
- The room used for the workshop should be configured for a round-table discussion, with a projection screen to display the options being discussed.
- The workshop should be led by a facilitator/integrator with a holistic view.
- The preferred noise mitigation options and selection rationale should be documented and circulated.
- Any subsequent alterations to the noise mitigation should be reviewed and confirmed by the relevant team members.

**STAKEHOLDER ENGAGEMENT**

Stakeholder input is required in the noise mitigation assessment process, including from those people living adjacent to proposed barriers. Ideally, community opinions will be known when completing assessment matrices and prior to any noise mitigation workshop. Otherwise, the selected options should remain subject to confirmation following community consultation after the workshop.

It is important to note that significant design development will still occur after the consenting process has been completed. Therefore it is essential to establish the community desires and expectations, but not constrain engineering development.

A clear record of community input into the design is required and should be included in the Technical assessment report.
6 DETAILED MITIGATION OPTIONS

INTRODUCTION
NZS 6806 provides a process for determining appropriate mitigation; however the standard does not address how mitigation is developed as a design progresses through to construction.

While the overall layout of the construction design will remain broadly in accordance with the information presented in the Notices of Requirement, the vertical and horizontal alignments of traffic lanes will almost certainly move within the designation, as a result of design development and refinement.

Intersection forms are also likely to be developed, and it may be reversed which road passes over another or how they connect. This is particularly the case in Design and Construct tenders, where changes resulting in cost savings are encouraged.

Changes are also likely to noise barriers to accommodate stormwater design and other construction requirements.

The Transport Agency’s model designation conditions (section 8) address this by having two distinct sets of mitigation designs:

• Selected Options, being the preferred mitigation developed during the consenting phase, as confirmed in the designation; and
• Detailed Mitigation Options, which is the fully detailed design, with all practical issues addressed.

The Selected Options must be used as the starting point.

CHANGES IN NOISE LEVEL

The model conditions require that noise mitigation is reconsidered if any PPF changes from Category A in the Selected Options to Category B or C, or if a Category B PPF changes to Category C.

Changes in noise levels may arise from changes to the road geometries and surrounding earthworks. For example, if a road that was in cut during for the Selected Options is now at grade, and therefore the screening provided by the cutting is no longer present.

As increases in noise levels are permitted up to the category boundaries, it is important to not overstate the accuracy of predicted noise levels for the Selected Options in the Technical assessment report. Predicted noise levels for the Selected Options are not de facto noise limits, and there is no requirement to assess the effects of any increase within the same category for the Detailed Mitigation Options.

Where an increase in NZS 6806 category occurs, Council approval is sometimes required. This approval may form part of the Outline Plan process, if a waiver has not been granted. As with the initial assessment, PPFs in Category B (or C) may be acceptable, and the best practicable option may be to not provide mitigation. A multi-disciplinary assessment is required to support this decision.

CHANGES IN FORM OF MITIGATION

In some instances, the Selected Options may no longer be practicable to implement. This may be where a noise bund was selected, but a noise wall is now required due to space constraints.

When evaluating the acceptability of alternate options, the reasons for selecting the original mitigation needs to be understood. For example, if an earth bund was selected in preference to a concrete or timber noise wall, this may have been because a noise wall would be out of character for the area and have unacceptable visual effects.

In other areas, a bund may have been selected purely because there was surplus fill in the area, and a noise wall would also be acceptable.

In these cases, a planner must reassess the best practicable option. This will require input from other specialists such as landscape / urban design.

For this reason, the rationale behind the Selected Options must be clearly documented.

NOISE MITIGATION PLAN

The Noise Mitigation Plan (NMP) is the design report prepared by the contractor that demonstrates compliance with designation conditions and other requirements set out in P40.

The NMP is required to be prepared by an acoustics specialist and is required to address:

• Noise criteria
• Noise modelling
• Noise barriers
• Low-noise road surfaces
• Building-modification
• Post-construction review.

A NMP template is available on the HIP.

APPROVALS

Changes to mitigation are either approved by a suitably qualified planner approved by the Council or directly by the Council, depending on the change.

In addition to these checks, the Transport Agency requires the contractor to provide a ‘producer statement’, which is a certificate signed by a Chartered Professional Engineer verifying the noise mitigation design conforms to all applicable requirements, including independent peer review.

The Transport Agency monitors the contractor’s compliance with the Principal’s Requirements and designation conditions. In addition to normal contract management processes, the Agency uses a national database (CSVue) which records all individual designation conditions and requires evidence to be submitted to demonstrate compliance with each condition before it is marked as compliant. This is in addition to any monitoring of the conditions conducted by the Council.
Since the introduction of NZS 6806 in 2010, the Transport Agency has used the standard for several large projects that have been brought before boards of inquiry. These projects include:

- Waterview Connection (2010)
- Transmission Gully (2011)
- Mackays to Peka Peka (2012)
- Peka Peka to North Otaki (2012)
- Christchurch Southern Motorway 2 (2013)
- Basin Reserve Bridge (2014)
- Puhoi to Warkworth (2014)

Individual boards expressed a number of concerns about components of the assessment, particularly for the Waterview Connection and Transmission Gully. The approach of NZS 6806 is considerably different to the previous Transit Guidelines, and this level of scrutiny was expected. In all cases, the boards accepted NZS 6806 and the main elements of the proposed conditions.

Some concerns were specific to projects, while others aspects are related to the implementation of the standard. The Transport Agency has progressively changed the way projects are assessed and in particular how information is presented, which is reflected in this guide revision.

Some of the concerns stated by the Boards of Inquiry for the Waterview Connection and Transmission Gully were:

- Category A or B PPFs could be exposed to indoor noise levels that exceed 40 dB LAeq(24hr) or are higher than Category C PPFs
- a perception that NZS 6806 requires a rigid development of noise mitigation
- a perceived imbalance between the importance of economic and social well-being of the community, and the health and social well-being of directly affected persons
- NZS 6806 does not provide a set test or methodology but offers guidance and recommendations
- Night-time criteria should be different from day-time criteria
- NZS 6806 does not address all matters relevant to a decision under the RMA.

For the Waterview Connection all PPFs in specific area (Sector 9) would be eligible for building-modification if the internal road-traffic noise levels exceed 40 dB LAeq(24hr) with the windows closed due to the low existing noise levels. This was a unique circumstance as Sector 9 of the Waterview Connection involved the installation of new road with exceptionally high traffic volumes through a densely populated, residential urban area with a low existing noise environment.

The Board for Transmission Gully specified that the windows needed to be open when determining the compliance with the internal noise criterion, as required for ventilation. For future projects where the Transport Agency offers acoustic treatment of PPFs it will be designed to achieve the internal noise criterion, at the same time providing adequate ventilation.

There were concerns raised as to how NZS 6806 ensures that health and amenity of directly affected persons are balanced fairly against the social benefits of the project. It was agreed that the potential impacts of the project need to be considered in a wider context than NZS 6806. The Transmission Gully Board raised the issue that NZS 6806 does not address all matters relevant to the RMA. The Waterview Connection Board were also concerned that NZS 6806 required a rigid development of a BPO, which may not adequately manage road noise under the RMA. In both cases it was agreed that an analysis of the wider noise and environmental factors is required in order to meet the criteria specified by the RMA. Page 8 presents an overview of the other factors that need to be considered in conjunction with NZS 6806.

The lack of separate night-time and day-time noise level criteria caused some concern as NZS 6806 utilises the daily time average LAeq(24hr) whereas other international standards often utilise an average that imposes a penalty on night-time noise. The LAeq(24hr) criteria is well-understood in New Zealand as it has been used unchallenged by the Transit Guidelines for over a decade, furthermore difficulties in implementing separate day and night levels were identified.

The Transport Agency considers NZS 6806 is a robust tool to help assess what are reasonable levels of road-traffic noise, and to help determine appropriate mitigation of the noise effects of new and altered roads. NZS 6806 was subject to the usual committee process for approval of New Zealand Standards and involved a wide range of stakeholders, many with the public’s interest as their responsibility, together with science experts, who considered and weighed the available evidence and sought wider input through public submissions.
8 DESIGNATION CONDITIONS

MODEL CONDITIONS
The Transport Agency has developed model designation conditions that encapsulate the process documented in this guide. The conditions provide certainty in the noise mitigation outcome to be provided, while allowing for development during normal detailed design processes. The model conditions can be applied for all projects and should not be customised. By using a consistent national approach the Transport Agency will be able to provide better quality control with its project teams.

It is not possible to prescribe a simplistic performance standard, such as a noise limit, to the NZS 6806 process or the results of the process. The noise mitigation design is determined by following the correct process and not by achieving an absolute limit.

EXISTING DESIGNATIONS
Existing designation conditions should be reviewed for consistency with current best practice. The consenting strategy should be confirmed in the Detailed Business Case in consultation with the Environment and Urban Design Team.

Some designations may not have noise-related conditions. Mitigation for these projects should be designed using this guide, and should be consistent with the model conditions.

Where specific noise conditions exist and good environmental outcomes will be maintained, there is no need to alter the conditions. However, where existing conditions are complex, fragmented and likely to lead to a poor environmental outcomes, altering the designation should be considered.

FIGURE 4: NOISE MITIGATION (OUTLINED BY MODEL CONDITIONS)

<table>
<thead>
<tr>
<th>CONDITION</th>
<th>TIMEFRAME</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adopt Selected Options for noise mitigation from consenting phase (ON2)</td>
<td>Prior to construction</td>
<td>The form and extent of mitigation from the AEE design must be used as the starting point.</td>
</tr>
<tr>
<td>Adjust mitigation for updated alignment and earthworks design (ON3)</td>
<td>Prior to construction</td>
<td>Acoustics specialist will adjust the Selected Options as appropriate (e.g., barriers to stay on top of cuts).</td>
</tr>
<tr>
<td>Predict noise levels at PPFs at design year. Obtain approvals if Noise Categories or form of mitigation changes (ON4)</td>
<td>Prior to construction</td>
<td>If PPFs change from Category A to B, a suitably qualified person (e.g., planner) must confirm that this change constitutes the Best Practicable Option. If any PPFs change to Category C, the council must confirm the change.</td>
</tr>
<tr>
<td>Prepare Noise Mitigation Plan (NMP) detailing compliance with designation conditions and other contractual requirements (ON5)</td>
<td>Prior to construction</td>
<td>A template is available on the HIP.</td>
</tr>
<tr>
<td>Noise mitigation is to be constructed in accordance with NMP (ON6)</td>
<td>Prior to opening</td>
<td></td>
</tr>
<tr>
<td>Perform Post-construction Review to confirm noise mitigation has been installed as designed (ON7)</td>
<td>Within 12 months of opening</td>
<td>A Post-Construction Review Report must be prepared and submitted to the council.</td>
</tr>
<tr>
<td>Maintain noise mitigation (ON8)</td>
<td>Ongoing</td>
<td></td>
</tr>
</tbody>
</table>
