Roads & Maritime

Operational Noise Management Report

Woolgoolga to Glenugie, Pacific Highway upgrade

October 2015

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GLOSSARY OF ACOUSTIC TERMS

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph below, are here defined.

Maximum Noise Level (L_{Amax}) – The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

L_{A1} – The L_{A1} level is the noise level which is exceeded for 1 per cent of the sample period. During the sample period, the noise level is below the L_{A1} level for 99 per cent of the time.

L_{A10} – The L_{A10} level is the noise level which is exceeded for 10 per cent of the sample period. During the sample period, the noise level is below the L_{A10} level for 90 per cent of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.

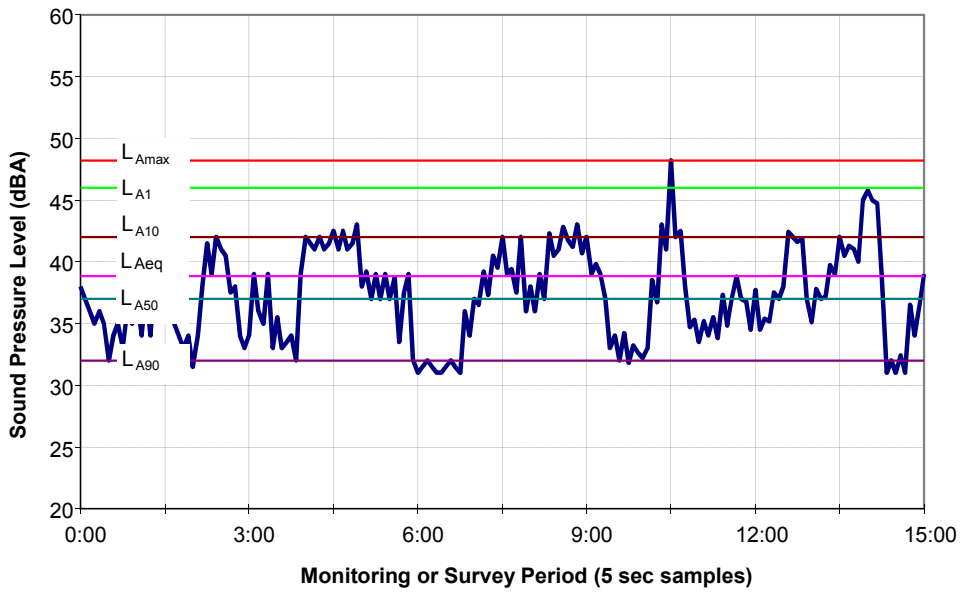
L_{A90} – The L_{A90} level is the noise level which is exceeded for 90 per cent of the sample period. During the sample period, the noise level is below the L_{A90} level for 10 per cent of the time. This measure is commonly referred to as the background noise level.

L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

ABL – The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night time) for each day. It is determined by calculating the 10th percentile (lowest 10th percent) background level (L_{A90}) for each period.

RBL – The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period – daytime, evening and night time.

Typical Graph of Sound Pressure Level vs Time



1 INTRODUCTION

The NSW Roads and Maritime Services (Roads and Maritime) propose to upgrade approximately 30 kilometres of the Pacific Highway between Woolgoolga and Glenugie in northern New South Wales.

The Arup Parsons Brinckerhoff Joint Venture (APBJV) has been appointed by Roads and Maritime to undertake detailed design of the Woolgoolga to Glenugie Pacific Highway Upgrade Project (W2G, 'the Upgrade') and Wilkinson Murray Pty Limited (WM) has been commissioned to undertake the detailed design operational noise assessment.

This report has been prepared to form part of the 100 per cent detailed design documentation for the Upgrade. It details the extent of potential operational noise impacts at nearby receivers and requirements for mitigation measures where relevant.

Potential noise impacts have been assessed in accordance with the requirements of Sections 4.14.5 & 4.14.6 of the *Professional Services Contract – Description of Services [Contract number: 11.2544.2618*, *Version 2.5.2 W2G 2, dated 8 May 2011]* – referred to herein as the Detailed Design Brief.

Consistent with the requirements of the Detailed Design Brief, potential noise impacts have been assessed against road traffic noise criteria recommended by the NSW Government's *Road Noise Policy (RNP)* and mitigation requirements have been guided by the *RTA Environmental Noise Management Manual (ENMM)*.

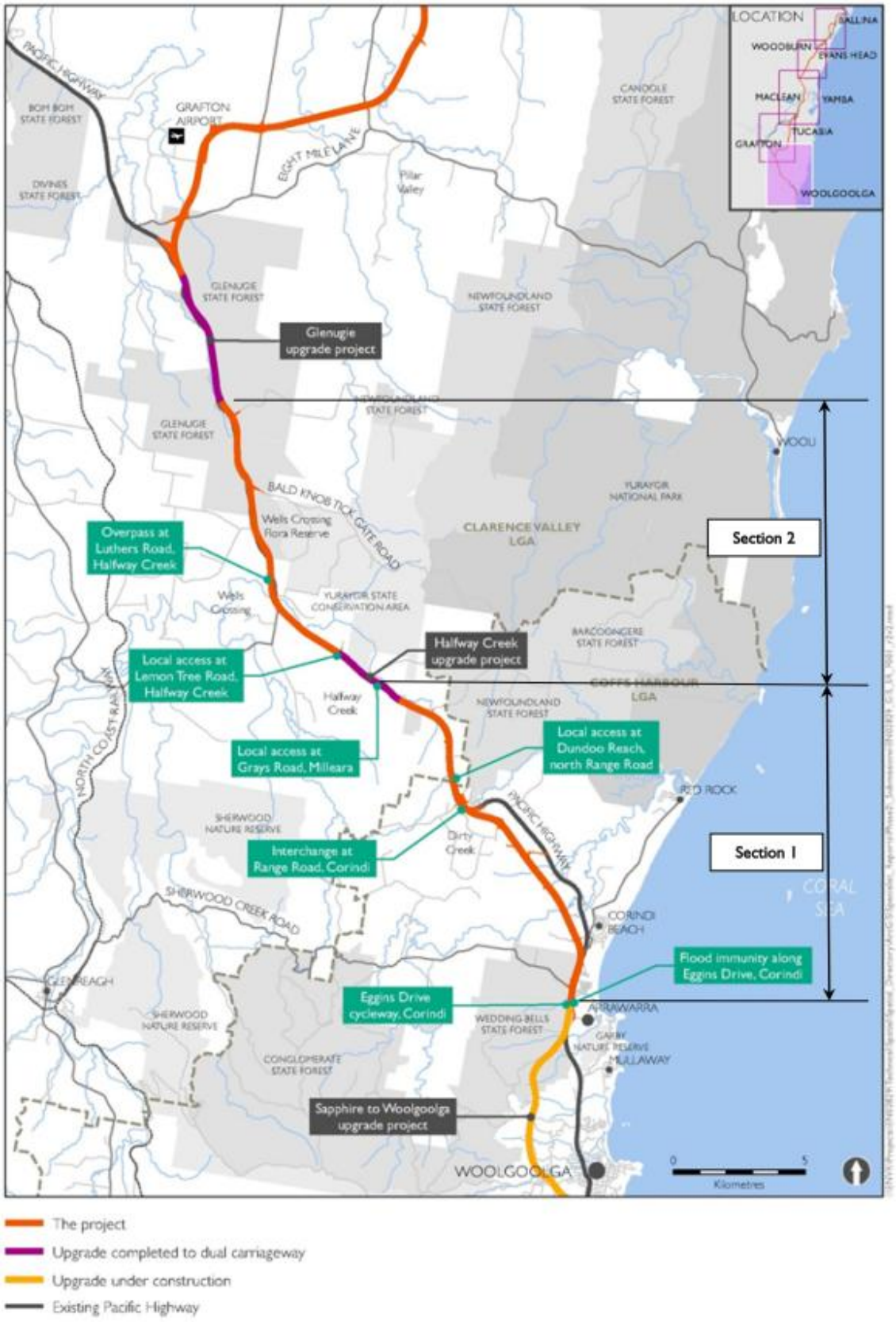
The Upgrade forms part of the 155 kilometre Woolgoolga to Ballina Upgrade Project (W2B) proposed by Roads and Maritime. The W2B project is divided into 11 nominal sections, with Sections 1 and 2 at the southern extent of the W2B alignment forming the Upgrade between Woolgoolga and Glenugie. Figure 1-1 shows the extent of the Upgrade design alignment (i.e. Sections 1 and 2 of the W2B alignment).

The W2B concept design noise assessment was undertaken by Sinclair Knight Merz (SKM) on behalf of the Woolgoolga to Ballina Planning Alliance (WBPA). Details of this study are included in the Noise & Vibration Assessment *(Woolgoolga to Ballina – Upgrading the Pacific Highway Working Paper: Noise & Vibration Assessment)* and Volumes 7A/B of the Environmental Impact Statement (EIS) prepared for the upgrade (*Pacific Highway Upgrade Woolgoolga to Ballina, December 2012*).

The approved concept design and modelling input data have been further refined since issue of the EIS, resulting in some differences in modelling outputs. The following sections of this report address the 100 per cent detailed design assessment and results. The differences between the 100 per cent detailed design results and the EIS results are discussed in Section 10.

The recently proposed Arrawarra rest area, which would be located to the south of the W2G Upgrade has additionally been considered. This is discussed in Section 11.

Figure 1-1: Proposed W2G alignment – identifying Sections 1 & 2



1.1 Minister's conditions of approval

The Minister's Conditions of Approval (MCoA) granted by the Minister for Planning on 24 June 2014 for the Woolgoolga to Ballina Pacific Highway Upgrade includes the following Condition (D11) with respect to operational noise.

> *D11. The Applicant shall prepare a review of the operational noise mitigation measures proposed to be implemented for the SSI, within six months of commencing construction, unless otherwise agreed by the Secretary. The review shall be prepared in consultation with the EPA, to the satisfaction of the Secretary. The review may be submitted in stages to suit the staged construction of the SSI and shall:*
>
> *(a) confirm the operational noise predictions of the SSI based on detailed design.*
>
> *This operational noise assessment shall be based on an appropriately calibrated noise model (which has incorporated additional noise monitoring, where necessary for calibration purposes);*
>
> *(b) review the suitability of the operational noise mitigation measures identified in the documents listed in condition A2. The review shall take into account the detailed design of the SSI and, where feasible and reasonable, and where necessary, refine the proposed measures with the objective of meeting the criteria outlined in the NSW Road Noise Policy (Department of Environment, Climate Change and Water, 2011), based on the operational noise performance of the SSI predicted under (a) above; and*
>
> *(c) where necessary, investigate additional feasible and reasonable noise mitigation measures to achieve the criteria outlined in the NSW Road Noise Policy (DECCW, 2011).*

Table 1-1 identifies the relevant sections of this report where the matters outlined under Condition D11 are addressed.

Table 1-1: MCoA requirements for detailed design operational noise review

Item	Details	Addressed In
D11	*The Applicant shall prepare a review of the operational noise mitigation measures proposed to be implemented for the SSI, within six months of commencing construction, unless otherwise agreed by the Secretary. The review shall be prepared in consultation with the EPA, to the satisfaction of the Secretary. The review may be submitted in stages to suit the staged construction of the SSI and shall:*	This report provides an operational noise assessment based on the detailed design requirements which are set out in Section 3. With consideration to the findings of this detailed design assessment a review of the operational noise mitigation measures, proposed by the EIS is provided in Section 10. This detailed design assessment and operational noise mitigation review has been undertaken in advance of the construction phase, to allow for mitigation measured to be established, where required, prior to construction.

Item	Details	Addressed In
(a)	*confirm the operational noise predictions of the SSI based on detailed design.* *This operational noise assessment shall be based on an appropriately calibrated noise model (which has incorporated additional noise monitoring, where necessary for calibration purposes);*	This report provides an operational noise assessment based on the detailed design requirements which are set out in Section 3. A calibrated noise model forms the basis of this operational noise assessment. This is described in Section 6. Model calibration is discussed in Section 7. The noise monitoring undertaken for calibration purposed in discussed in Section 5.
(b)	*review the suitability of the operational noise mitigation measures identified in the documents listed in condition A2. The review shall take into account the detailed design of the SSI and, where feasible and reasonable, and where necessary, refine the proposed measures with the objective of meeting the criteria outlined in the NSW Road Noise Policy (Department of Environment, Climate Change and Water, 2011), based on the operational noise performance of the SSI predicted under (a) above; and*	This report provides an operational noise assessment based on the detailed design requirements which are set out in Section 3. With consideration to the findings of this detailed design assessment a review of the operational noise mitigation measures, proposed by the EIS is provided in Section 10. Feasible and reasonable mitigation measures based on the detailed design operational noise modelling results are detailed Sections 8 and 9. These are provided with the objective of meeting the criteria outlined in the NSW Road Noise Policy.
(c)	*where necessary, investigate additional feasible and reasonable noise mitigation measures to achieve the criteria outlined in the NSW Road Noise Policy (DECCW, 2011).*	With consideration to the findings of this detailed design assessment a review of the operational noise mitigation measures, proposed by the EIS is provided in Section 10. Feasible and reasonable mitigation measures based on the detailed design operational noise modelling results are detailed Sections 8 and 9. These are provided with the objective of meeting the criteria outlined in the NSW Road Noise Policy.

2 SITE DESCRIPTION

As shown in Figure 1-1 the proposed W2G upgrade is mainly located within the existing corridor, with one deviation (bypass) in Section 1. The route of the bypass section has been selected based on prior evaluation of a range of corridor and route options.

The W2G project comprises the provision of dual carriageways connecting the Sapphire to Woolgoolga upgrade (currently under construction) at the southern end of the project and the completed Glenugie upgrade to the north.

The dual carriageways will be median separated with controlled access to allow vehicles to travel continuously at the posted speed limit of 110 km/h.

2.1 Section 1 (Woolgoolga to Halfway Creek)[1]

Section 1 (Woolgoolga to Halfway Creek) is approximately 17 kilometres long, extending from Arrawarra Beach Road, Arrawarra (about 6 kilometres north of Woolgoolga) to the northern end of the completed Halfway Creek Upgrade at Lemon Tree Road, Halfway Creek. It passes through and near to the communities of Arrawarra, Corindi Beach, Casson's Creek and Dirty Creek.

From just south of Corindi Beach the project corridor bypasses the existing highway to the west, rejoining the existing highway again to the north of Dirty Creek. From here the project follows the existing highway through the completed Halfway Creek Upgrade.

The section of the bypassed existing highway will be retained as a local road.

2.2 Section 2 (Halfway Creek to Glenugie)

Section 2 (Halfway Creek to Glenugie) is around 12 kilometres long, extending from the northern end of the Halfway Creek upgrade at Lemon Tree Road to the southern end of the Glenugie upgrade at Franklins Road.

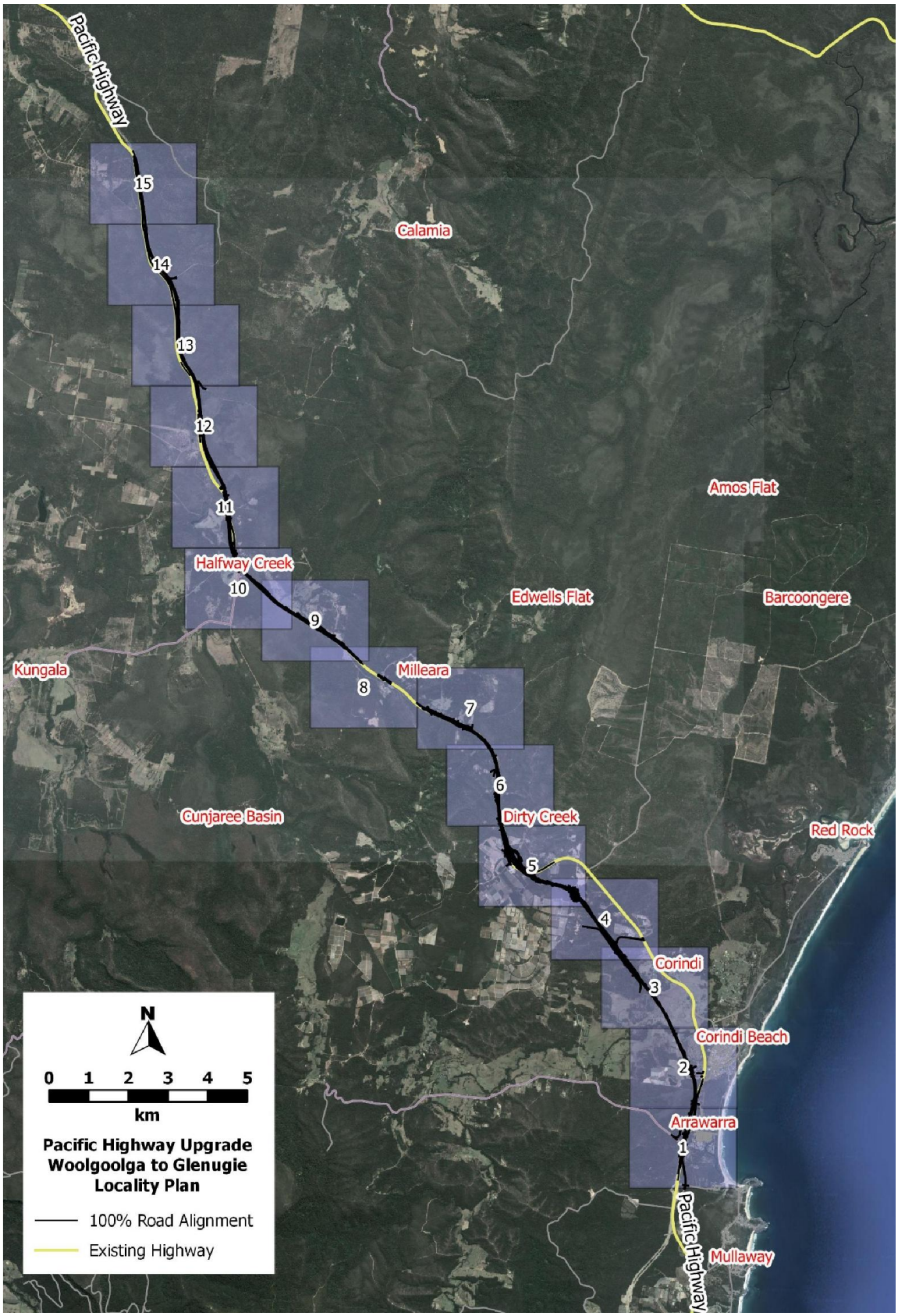
Within Section 2, the proposed upgrade closely follows the existing highway through the Yuraygir Nature Reserve and the Glenugie State Forest, where the upgrade ends.

2.3 Sensitive receivers

This study assesses potential traffic noise impacts at sensitive receivers located within 600 m from the proposed upgrade, considering both the redeveloped and new road sections. For the purpose of graphical presentation, the alignment has been divided into 15 subsections as identified in Figure 2-1. The 15 individual locality plans are provided in Appendix A.

[1] Based on a Roads and Maritime request, the Sapphire to Woolgoolga project design for the Arrawarra Rest Area prepared by SMEC/AECOM has been included within the construction documentation for this project. However, no design or assessment associated with that component of work has been undertaken.

Figure 2-1: Locality master plan (refer Appendix A for individual plans)



The receiver information has been provided by the APBJV and has been taken to be complete and without error. It should be noted that ground truthing to confirm all structures as dwellings has not been undertaken as part of this assessment. This is only of material significance, however, for receivers identified by this assessment as requiring mitigation (as discussed in Section 8).

A total of 413 residential receivers located within 600 metres of the alignment have been identified. These are shown graphically in Appendix A and labelled using the same naming convention applied by the EIS noise study. It should be noted that the EIS reported 416 residential receivers. Three of these (Receivers 79, 162 and 259) have, however, been identified as duplications and have, therefore, been disregarded.

As shown in the figures, there are concentrated residential receivers within the southern parts of the project corridor, located within the Arrawarra and Corindi Beach areas, and to the north of Corindi Beach, residential receivers generally comprise scattered rural dwellings.

Over the northern extent of the project corridor, there are few receivers within 600 metres of the route and these are generally scattered between the towns of Halfway Creek and Wells Crossing.

There are also several commercial and industrial receivers within the Arrawarra/Corindi Beach vicinities, though in accordance with the detailed design brief, these are not subject to assessment and have therefore not been considered by this assessment.

2.4 Existing traffic noise exposure to sensitive receivers

The degree to which residences located nearby the project corridor currently experience road traffic noise is largely dependent on their setback distance from the existing Pacific Highway, intervening terrain and shielding provided by other intervening buildings.

As the upgrade will be located within the existing corridor from the southern extent until Corindi Beach, noise sensitive receivers to be potentially affected by the upgraded highway along this section of the project corridor already experience traffic noise as part of the existing environment.

From Corindi Beach (where the project corridor will deviate to the west of the existing highway) to just north of Dirty Creek (where the project corridor will rejoin the existing route), the project corridor passes through rural areas that are up to approximately 600 metres from the current highway corridor. Receivers in these areas currently experience only distant traffic noise influences, therefore the project would be expected to result in increased traffic noise to these receivers.

For a number of receivers located between the existing and new road sections, the new road section will change the direction in which traffic noise travels to residential properties. That is, a different facade of the residence (and possibly different rooms within the residence) will become exposed to traffic noise. Conversely, the existing exposed facade will be exposed to significantly less noise, as the old Pacific Highway route is to become a local service road with minor traffic flows.

From where the project will rejoin the existing highway north of Dirty Creek the upgrade will be located within the existing corridor, passing through the Halfway Creek Section, then closely following (with only minor deviations) the existing highway through the Yuraygir Nature Reserve and the Glenugie State Forest, where the project ends at the Glenugie upgrade. Receivers along this part of the route experience existing traffic noise.

3 REQUIREMENTS OF THE DETAILED DESIGN BRIEF

3.1 Noise mitigation and noise modelling requirements

Section 4.14.5 of the detailed design brief addresses noise mitigation and noise modelling requirements, as follows:

(a) Notwithstanding the requirements of Practice Note ii of ENMM, noise mitigation measures are not required at commercial or industrial premises.

(b) Further to any other requirements of the Environmental Documents in relation to noise mitigation measures, the PSC must design and provide at-road operational noise mitigation measures:

(i) notwithstanding and so as not to be constrained by any financial, costing, feasibility or other constraints on types of mitigation identified in the ENMM; and

(ii) to maintain operational noise levels of 60 dB(A) / 55dB(A) LAeq 15hr (day) or less and 55dB(A) / 50dB (A) LAeq9hr (night) or less, for the years of opening and ten years after opening for redeveloped / new roads respectively as appropriate.

(c) At-road operational noise mitigation measures must be contained within the project boundary and existing road reserves. At-road noise mitigation barriers must be provided, as a minimum, at the locations, lengths and heights detailed in the environmental documents.

(d) The PSC must undertake noise modelling on the design of the upgrade to predict the opening and ten years after opening noise contours. The noise modelling must:

(i) use the following 85th percentile traffic speeds for all vehicles:

Main Carriageways; 15hr 7am – 10pm (day)	*115 km/h*
Main Carriageways; 9hr 10pm – 7am (night)	*120 km/h*
Local Roads, (including Service Road and Access Roads) and Ramps	*Posted Traffic Speed*

(ii) use the traffic volumes for the year of opening and ten years after opening;

(iii) apply three source heights: 0.5m for exhausts / engines and car / truck tyre noise; 1.5m for truck engines; and 3.6m for truck exhausts;

(iv) use pavement corrections of "+3dB(A)" for concrete, "0 dB(A)" for dense graded asphalt and "-2dB(A)" for stone mastic asphalt and open grade asphalt;

(v) adopt receiver heights at 1.5m and 4.5m above ground level for single and double story premises respectively;

(vi) adopt a ground absorption factor of 60%, except for over water where the absorption factor must be 0%;

(vii) adopt an angle increment = 1.0 degree; reflection depth = 0; number of reflections = 0; maximal search radius = 2.500;

(viii) adopt a grid space = 20; height above ground = 1.5m; grid interpretation field size = 9 x 9; grid interpretation min / max 2.0dB(A); grid interpolation difference = 0.1dB(A);

(ix) use calibration adjustment/s determined by comparing the measured existing noise levels with the predicted noise levels modelled using the concurrently collected traffic and noise data (i.e. calibration adjustment = monitored noise levels – modelled noise levels);

(x) use a risk allowance/s of at least one standard deviation for the data set obtained by comparing the measured existing noise levels with the noise levels modelled using the concurrently collected traffic and noise data (i.e. risk allowance = 1 x standard deviation);

(xi) include a +2.5dB(A) facade reflection.

(e) The PSC must design and provide at-road noise mitigation operational noise mitigation measures to comply with ENMM at any other noise-sensitive receivers (where the term 'noise-sensitive receiver' is as defined in ENMM) including those that have been constructed or have been granted development approval by the relevant Authority under the provisions of the Environmental Planning and Assessment Act 1979 prior to project approval and NSW Road Noise Policy, March 2011,

(f) Pavement wearing surfaces must be designed to produce noise levels and tonal characteristics that contribute to achieving compliance with the noise level requirements of the environmental documents. Low noise pavements must be provided as a minimum in accordance with the environmental documents.

(g) Bridge joints must be designed, selected and installed to reduce vehicle noise impacts.

(h) The design of all noise attenuation measures (eg walls, mounds and pavement treatments etc.) shall include the design and specification of the architectural and structural features of the wall components including but not limited to:

a) Footings

b) Piers

c) Panels/block work

d) Artwork/motifs

e) Posts

f) Attachments to structures (retaining walls and bridges, if required)

g) Treatment of walls in all non-typical cases including ends, openings, gates etc.

The structural requirements of noise barrier design from Section 4.5 Bridgeworks and other structures must be incorporated into the design.

The urban design requirements of noise barrier design from Section 4.10 Urban design must be agreed with in consultation with RMS and must be incorporated into the design of the noise barriers.

Where noise mounds are specified the design shall include heights, lengths, cross-sectional detail, material requirements, drainage and landscaping requirements. The design is also to ensure the stability of mounds used for attenuation purposes.

3.2 Reporting requirements

Section 4.14.6 of the detailed design brief provides a list of requirements with which the Operational Noise Management Report (ONMR) must comply. These are identified below, cross-referenced against the relevant section of the ONMR that addresses each requirement.

Table 3-1: Detailed design brief requirements

Reference	Relevant Condition	Refer to Report Section
4.14.6(a)	*a description of the prevailing ambient noise environment;*	Section 5
4.14.6(b)	*the results of noise modelling and proposed mitigations required by this brief;*	Results and mitigation required are discussed in Section 8. Operational Noise Assessment for Free Flowing Traffic and the results of noise modelling are presented in Appendices D & E.
4.14.6(c)	*The results of all field survey and noise monitoring required to calibrate the modelling required by this Brief. As a minimum, noise monitoring must include those sensitive receivers which have been identified and monitored in the environmental documents;*	Section 5.1.2 and Section 7
4.14.6(d)	*details on the noise-sensitive receivers and noise monitoring locations, including distances to the nearest roads where roads are located close to the noise monitors;*	Appendices A & B
4.14.6(e)	*a site plan showing the noise-sensitive receivers and noise monitoring locations;*	Appendices A & B
4.14.6(f)	*aerial photographs showing the noise-sensitive receivers and noise monitoring locations;*	Appendix B
4.14.6(g)	*details on the positioning of noise loggers at each noise monitoring location, including photographs of the noise logger in its monitoring position;*	GPS coordinates are shown in Table 5-1 in Section 5. Photographs of the noise loggers in-situ are shown in Appendix B.
4.14.6(h)	*charts and a summary table of measured and / or computed noise modelling parameters, including the L_{Amax}, L_{A10}, L_{Aeq} and L_{A90}, at 15-minute intervals for each 24-hour period of the noise monitoring survey;*	Appendix C

Reference	Relevant Condition	Refer to Report Section
4.14.6(i)	*a table summarising the noise parameters measured;*	Section 5 and Appendix B
4.14.6(j)	*tabulations of average annual daily traffic (AADT) predictions for the day and night time periods;*	Section 6
4.14.6(k)	*summaries of the computational algorithms used in the noise model and justification for their selection, the location of noise-sensitive receivers and how the modelling parameters were addressed;*	Section 6
4.14.6(k(i))	*summaries of the calibration adjustment/s determined by comparing the Contractor's measured existing noise levels with the predicted noise levels modelled using the Contractors concurrently collected traffic and noise data (i.e. calibration adjustment = monitored noise levels – modelled noise levels);*	Section 7
4.14.6(k(ii))	*summaries of the risk allowances applied to the noise model to reduce design and operational risks and improve modelling confidence limits;*	Section 7
4.14.6(k(iii))	*a table summarising the relevant noise modelling parameters computed at the monitoring locations and comparisons with the design noise objectives and requirements of the Environmental Documents and this Brief;*	Section 7; and Table 7-1:
4.14.6(k(iv))	*sensitivity and statistical analysis of key data in order to estimate confidence interval and reliability;*	Section 7
4.14.6(k(v))	*well presented noise contour maps for years 2016 and 2026 detailing the L_{Aeq}(9hr) Night and L_{Aeq}(15hr) Day and identifying all noise-sensitive receiver locations. The contour maps must be presented for intervals of not greater than 5 dB(A) and extend out to 45 dB(A);*	Appendix E (Note, contours are shown for distances of up to 1 km from the corridor. The 45 dBA contour is partially shown, but not included in its entirety, given the substantial setback distance required to include it. APBJV has provided its prior approval of the adequacy this).
4.14.6(k(vi))	*an assessment of maximum noise levels to evaluate sleep disturbance impacts and determination of mitigation options;*	Section 8.3

Reference	Relevant Condition	Refer to Report Section
4.14.6(k(vii))	*details on all noise-sensitive receivers that are predicted to exceed the base criteria and allowance criteria for 10 years after opening noting the different requirements for the separate projects in Section 4.14.5(e);*	Appendix D
4.14.6(k(viii))	*identification of noise-sensitive receivers predicted to have noise levels, for 10 years after opening, at an acute noise level or above;*	Appendix D
4.14.6(k(ix))	*Not withstanding the minimum noise mitigation requirements in the Environmental Documents, identify need for additional noise walls, including increased heights, lengths or new locations that comply with the requirements of Practice Note IV of the ENMM; and*	Noise walls are not required
4.14.6(k(x))	*identification of all at-road operational noise mitigation measures.*	Low noise pavement details provided in Table 6-1 and discussed further in Section 10.2.1 and Appendix H.

4 SUMMARY OF TRAFFIC NOISE CRITERIA

4.1 Relevant traffic noise criteria

Consistent with the requirements of the detailed design brief, Table 4-1 sets out the applicable road traffic noise base criteria recommended by the NSW Environmental Protection Agency (EPA) *Road Noise Policy* (*RNP*, 2011) for new and redeveloped roads.

Table 4-1: Road traffic noise base criteria

Road Category	Type of Proposal / Land Use	Noise Criteria	
		Day 7am – 10pm	Night Time 10pm - 7am
Freeway / Arterial / Sub-Arterial Roads	Existing Residences affected by noise from new freeway / arterial / sub-arterial road corridors	$L_{Aeq,15\ hour}$ 55 dBA	$L_{Aeq,9\ hour}$ 50 dBA
	Existing Residences affected by noise from redevelopment of existing freeway / arterial / sub-arterial roads	$L_{Aeq,15\ hour}$ 60 dBA	$L_{Aeq,9\ hour}$ 55 dBA

Additionally, the *ENMM* identifies receivers exposed to traffic noise levels greater than or equal to $L_{Aeq,15\ hour}$ 65 dBA and $L_{Aeq,9\ hour}$ 60 dBA as 'acutely affected'. The *ENMM* identifies the requirement for a detailed assessment of noise mitigation for acutely affected receivers.

Furthermore, the *RNP* recommends mitigation to be considered where a new or redeveloped road has potential to generate a relative increase in total traffic noise of more than 12 dB.

A summary of the criteria considered for this assessment is provided in Table 4-2.

Table 4-2: Summary of relevant criteria

Type of Proposal / Land Use	Daytime Noise Criteria $L_{Aeq,15\ hour}$ (7am – 10pm)			Night Time Noise Criteria $L_{Aeq,9\ hour}$ (10pm – 7am)		
	Base Criterion	Acute Criterion	Relative Increase Criterion	Base Criterion	Acute Criterion	Relative Increase Criterion
Existing Residences affected by noise from new freeway / arterial / sub-arterial road corridors	55 dBA	65 dBA	Existing + 12 dB	50 dBA	60 dBA	Existing + 12 dB
Existing Residences affected by noise from redevelopment of existing freeway / arterial sub-arterial roads	60 dBA	65 dBA	Existing + 12 dB	55 dBA	60 dBA	Existing + 12 dB

The criteria set out above apply to the predicted noise level at opening of the project and at a time 10 years after opening of the project (design year), which in this case is year 2026.

Practice Note (I) of the *ENMM* describes the circumstances under which the 'new freeway' and 'redevelopment of an existing freeway' criteria apply. By application of this practice note, the bypass section between Corindi Beach and Dirty Creek would be classified as a '*new freeway/arterial road',* whilst the remaining sections would be classified as '*redevelopment of existing freeway/arterial road'.*

On this basis, it is noted that the redeveloped road criteria applies to most receivers as the project largely occupies the existing corridor. For those receivers in the vicinity of the new bypass, the new road criteria are applicable.

The relevant operational base criteria for the proposed upgrade are presented for each receiver within the traffic noise prediction tables (included in Appendices D1 and D2).

Practice Note (IV) of the *ENMM* provides further discussion of situations where provision of additional controls would be considered "feasible and reasonable":

- For 'new freeways or arterial roads' it is generally not considered reasonable to take action to reduce noise levels to the base noise levels if the noise levels with the proposal, ten years after project opening, are predicted to be:
  - within 2 dB of 'existing' noise levels
  - no more than 2 dB above the noise criteria set out in the *RNP*

- For road 'redevelopments' where existing noise levels already exceed the base noise levels, it is generally not considered reasonable to apply additional treatments (after opportunities for noise control have been incorporated into the road design) if predicted design year noise levels:

  - do not exceed 'existing' noise levels by more than 2 dB
  - will not be 'acute' (i.e. do not exceed 65 dBA $L_{Aeq,15h}$ and 60 dBA $L_{Aeq,9h}$)

4.2 Guidelines for assessing maximum noise levels

The potential for sleep disturbance varies between studies, however, it is largely recognised that the maximum noise level of an event, in addition to the number of occurrences and duration of the events, as well as the emergence above background or ambient noise levels are key factors. Not all people are affected to the same degree or by the same noise exposure. Findings from studies of sleep disturbance measured by an awakening, change in sleep state or awakening-effects reflect the considerable variation in the population's response to noise.

In relation to assessing maximum traffic noise levels, Practice Note (III) of the *ENMM* notes the following:

- *Maximum internal noise levels below 50–55 dB(A) are unlikely to cause awakening reactions*
- *One or two noise events per night with maximum internal noise levels of 65–70 dB(A) are not likely to significantly affect health and well-being*
- *At locations where road traffic is continuous rather than intermittent, the Leq(9hr) (night) target noise levels should sufficiently account for sleep disturbance impacts*
- *Where the emergence of Lmax over the ambient Leq is equal to or greater than 15 dB(A), the Leq(9hr) criteria may not sufficiently account for sleep disturbance impacts.*

With consideration to the above, for the purpose of this assessment the following guidelines have been adopted:

- Maximum noise levels external to dwellings should not exceed L_{Amax} 65 dB(A) (i.e. internal levels of L_{Amax} 50-55 considering the 10-15 dB attenuation that is typically achieved through windows partially open for ventilation).

- Maximum noise levels external to dwellings should not exceed the $L_{Aeq,9Hr}$ (or $L_{Aeq,1Hr}$) noise level by >15 dB.

5 EXISTING NOISE ENVIRONMENT

In accordance with the requirements of the detailed design brief, WM has undertaken noise monitoring within the project corridor to evaluate the existing traffic noise environment. It is not practicable to carry out monitoring of traffic noise levels at all of the identified sensitive receiver locations. Accordingly, as recommended by the *ENMM,* monitoring has been undertaken at representative locations within the study area, to broadly characterise the noise environment and to verify the traffic noise model.

It should be noted that accurate measurement of road traffic noise becomes more difficult as distance from the road increases. This is because the traffic noise contribution decreases as a function of distance from the road and as such other extraneous noise sources in the environment have a greater influence on the measured levels, despite selection of the noise monitoring locations away from obvious extraneous noise sources. Additionally, the influence of meteorological conditions on noise levels increases with distance from the source. Experience on similar projects has shown that measurements made at distances exceeding typically 200-300 metres are not suitable for road noise model calibration for these reasons.

5.1 Traffic noise monitoring

Six representative locations along the length of Pacific Highway between Woolgoolga to Glenugie were selected for noise monitoring as set out in Table 5-1.

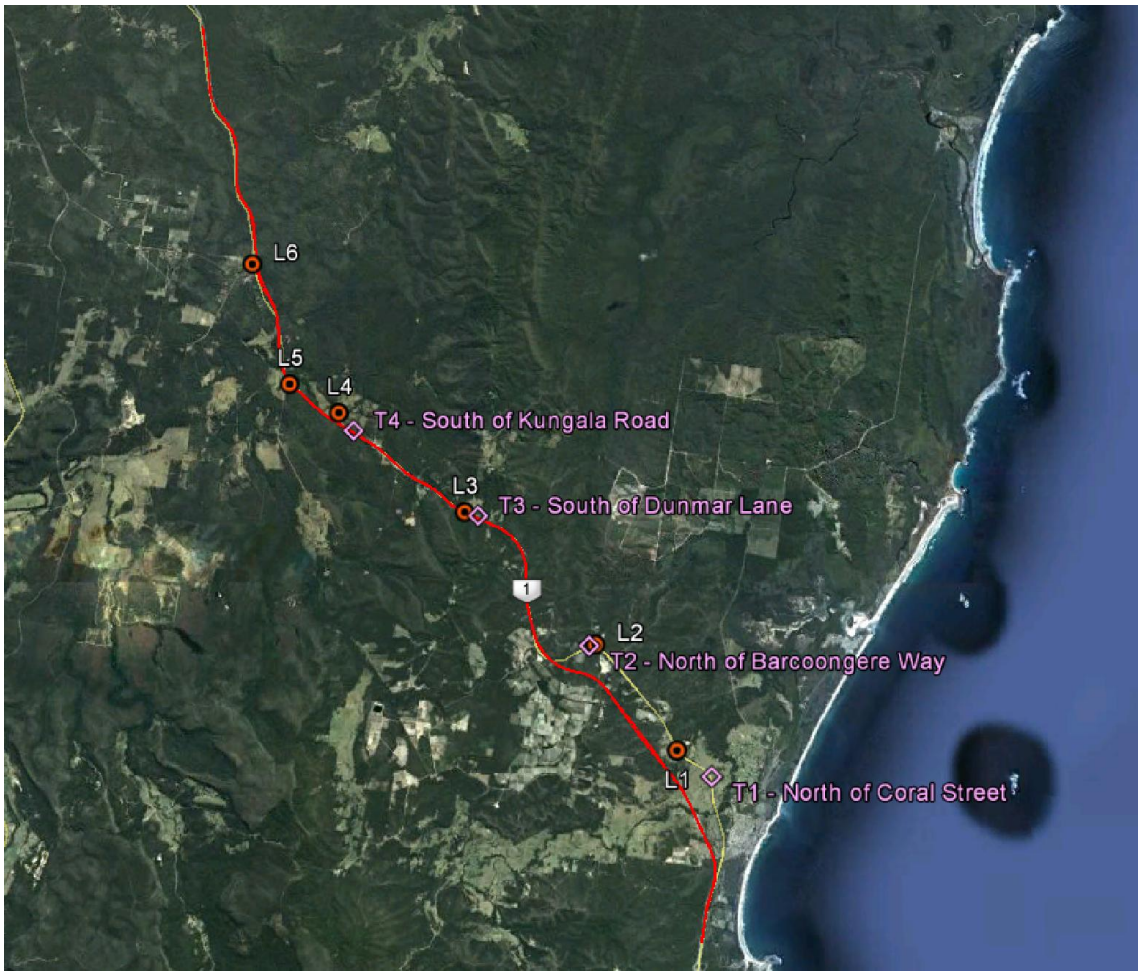
Table 5-1: Noise monitoring locations

Site	Address	GPS Coordinates	Approx. Setback Distance from the Nearside Carriageway (metres)
L1	3674 Pacific Highway, Corindi Beach	E517276, N6680086	12
L2	4028 Pacific Highway, Dirty Creek	E515123, N6682908	59
L3	11 Dunmar Lane, Halfway Creek	E511604, N6686505	16
L4	5092 Pacific Highway, Halfway Creek	E508154, N6689265	220
L5	Near Kungala Road, Halfway Creek	E506800, N6690071	23
L6	5631 Pacific Highway, Wells Crossing	E505711, N6693455	11

Unattended monitoring was conducted at these locations between Tuesday, 20 November and Friday, 30 November 2012. In addition, fully classified traffic count data were collected concurrently during the unattended noise monitoring.

Figure 5-1 identifies the unattended noise monitoring and traffic counter locations. Additionally, Appendix B provides higher resolution aerial photographs of the logger locations and in-situ photographs of the loggers.

Figure 5-1: Noise monitoring and traffic counting locations



Note: Traffic counting undertaken at T1-T4; Noise logging undertaken at L1-L6.

The noise monitoring locations were selected based on a detailed inspection of potentially affected areas, with consideration to other noise sources which may adversely influence the measurements, security issues for the noise monitoring devices and gaining permission for access from the residents/landowners.

Some free field and some façade locations were selected for monitoring. It is noted all criteria relate to façade locations and assessment is undertaken on this basis, albeit free field locations are often more appropriate for model validation.

5.1.1 Noise monitoring equipment

Equipment used for the noise measurements comprised four ARL-215 and two ARL-316 environmental noise loggers. The ARL 215 and 316 noise loggers were set to A-weighted, fast response, continuously monitoring each 15-minute period. These instruments are capable of monitoring and storing various noise level descriptors for later detailed analysis. The loggers determine L_{A1}, L_{A10}, L_{A90} and L_{Aeq} levels of the existing noise environment. The L_{A1}, L_{A10} and L_{A90} levels are the levels exceeded for 1 per cent, 10 per cent and 90 per cent of the sample time respectively. The L_{A1} is indicative of maximum noise levels due to individual noise events such as the occasional passby of a heavy vehicle. The L_{A90} level is normally taken as the background noise level. The L_{Aeq} level is the equivalent continuous sound level and has the same sound energy over the sampling period as the actual noise environment with its fluctuating sound levels. While the L_{A10} has in the past been used as a descriptor for traffic noise, the L_{Aeq} is now the standard descriptor for traffic noise in NSW.

All six loggers were placed in a position with more than 140 degrees view of the road. Four of the loggers were placed in a free field position with respect to traffic noise, whilst two were placed at 1 metre from dwelling facades. Observations made during the site survey indicate the primary noise source at the monitoring locations was road traffic on the Pacific Highway. It was noted the unattended monitoring results at all locations were not influenced by industrial noise. However, background noise levels may be influenced by other noise sources such as fauna (i.e. insects and frogs) as the distance from the road increases.

5.1.2 Noise monitoring results

All data considered to be affected by adverse weather conditions were excluded from the results. Further review of the data was performed to exclude rain and sources of extraneous noise. These sources are not always identifiable, however, discrete 15 minute measurements for which the L_{Aeq} level is significantly higher than the L_{A10} level, with an unusually high maximum level are unlikely to be controlled by 'normal' traffic noise. These measurements have therefore been excluded from the statistical analysis of the logger data. The noise results are presented in graphical form in Appendix C and summarised below in Table 5-2.

Table 5-2: Summary of measured noise levels (20-30 November 2012)

Site	Approx. Setback Distance to the Nearside Carriageway (metres)	Daytime $L_{Aeq,15hr}$ (dBA)	Night Time $L_{Aeq,9hr}$ (dBA)	Rating Background Level (RBL) (dBA)		
				Day	Evening	Night
L1	12	70	70	48	44	44
L2	59	61	61	48	43	42
L3	14	69	68	48	44	38
L4	220	53	55	43	43	42
L5	23	70	69	47	38	34
L6	11	72	72	44	43	43

6 ROAD TRAFFIC NOISE MODELLING

6.1 Methodology of assessing traffic noise impact

Detailed noise calculations have been carried out for year of opening (2016) and 10 years after opening (2026). All calculations and modelling are based on forecast traffic volumes provided by RMS. The following factors have been considered during the assessment process:

- Traffic volume and percentage of heavy vehicles for daytime and night time
- Vehicle speeds for daytime and night time
- Road surface types
- Road gradient
- Different vehicle noise emission levels and source heights
- Location of the noise sources on the highway
- Topographical information along and surrounding the entire project corridor
- Shielding from mounds, landforms and buildings
- Land use (types of noise sensitive receivers) surrounding the project
- Receiver locations.

6.2 Noise modelling procedures

Noise levels from the proposed road designs were calculated using procedures based on the *CoRTN (Calculation of Road Traffic Noise)* (UK Department of Transport, 1988) prediction algorithms. The standard prediction procedures were modified in the following ways, in accordance with the detailed design brief:

- L_{Aeq} values were calculated from the L_{A10} values predicted by the *CoRTN* algorithms using the well-validated approximation $L_{Aeq,1hour} = L_{A10,1hr} - 3$ (NSW RTA, 2001). It is worth noting the predicted $L_{Aeq,1hr}$ is equivalent to the $L_{Aeq,period}$ as required by the noise criteria since the input is the "average" traffic flow over the given daytime and night time periods
- Noise source heights were set at 0.5 m for cars, 1.5 m for heavy vehicle engines and 3.6 m for heavy vehicle exhausts, representative of typical values for Australian vehicles (*Road Traffic Noise: Interim Traffic Noise Policy*, 1992)
- Noise from heavy vehicle exhausts have been set 8 dB lower than the (steady continuous) noise from the engine
- Previous research in Australia has established a negative correction to the *CoRTN* predictions of -1.7 dB for façade-corrected levels (Samuels and Saunders, 1982). Corrections for Australian conditions have been included in noise modelling for this project
- The same corrections (for a given road pavement surface) were applied to all light and heavy vehicle sources in the 3 source height model

The model was implemented using SoundPLAN software (Version 7.1), based on the 100 per cent alignment data supplied by APBJV on 1 October 2013

Percentage of absorbent ground cover was set to 60 per cent as required by the detailed design brief and applied throughout the study area. It should be noted that use of absorbent ground cover in the range of 60 per cent to 89 per cent is taken by *CoRTN* to adopt a soft ground factor of 75 per cent.

Table 6-1 summarises other variables used in the noise model.

Table 6-1: Variables used for noise modelling

Parameter	Comment
Traffic Speed	For the existing road: Weighted average (validation) and 85th percentile data (supplied by RMS); For the upgraded road: 115 km/h (Daytime) and 120 km/h (Night) on the main carriageway; and 80 km/h on service roads, 60 km/h on access roads and 80km/h on ramps.
Road Surface	+3 dB for concrete, 0 dB for dense grade asphalt (DGA) and -2 dB for stone mastic asphalt (SMA). It has been confirmed by APBJV that low noise pavement (SMA type) would be included within the Arrawarra vicinity. The low noise pavement would tie in to the Sapphire to Woolgoolga (S2W) Project at the southern extent of the alignment (ch 80 northbound and ch minus 50 southbound) and extend until chainage 1800. This has been included in the 100% design modelling.
Façade Correction	+2.5 dB in accordance with *CoRTN; and* -1.7 dB for ARRB's Australian condition correction at 1 m from façade conditions and -0.7 dB for free-field conditions.
Traffic Volume	Traffic counting data provided by RMS for the existing road; and Volume predictions provided by APBJV for the upgraded road.
Calculation Settings	Grid space of 20 m; height above ground = 1.5 m; grid interpretation field size = 9 x 9; grid interpretation min/max = 2 dB; grid interpretation difference = 0.1 dB; angle increment = 1 degree; reflection depth = 0; number of reflections = 0; and maximal search radius = 7000 m.
Receivers	1.5 m and 4.5 m above existing ground level for single and double storey premises respectively.
Buildings	4.5 m and 6 m above maximum terrain height of building footprint for single and double storey premises respectively.

6.3 Modelling scenarios

The following scenarios were modelled under both daytime and night time conditions.

- Existing Road – Current noise levels were calculated based on traffic counts obtained during the traffic survey undertaken concurrently with noise monitoring (supplied by Roads and Maritime). This was used to validate the noise model by comparing predicted levels with those measured at corresponding noise logger locations
- Year of Opening (2016) 'Build Option' – Noise levels were predicted based on forecast traffic counts assuming the project proceeds (supplied by APBJV)
- Year of Opening (2016) 'No Build Option' – Noise levels were predicted based on forecast traffic counts that would be expected to occur due to general traffic growth assuming the project does not proceed (supplied by APBJV)
- Design Year (2026) 'Build Option' – Noise levels were predicted based on forecast traffic counts (supplied by APBJV). Results are compared with existing results and baseline criteria
- Design Year (2026) 'No Build Option' – Noise levels were predicted based on forecast traffic counts that would be expected to occur due to general traffic growth assuming the project does not proceed (supplied by APBJV).

6.4 Traffic data

Traffic inputs were provided by Roads and Maritime (Existing scenarios) and APBJV (Future scenarios) and are categorised as being associated with the main carriageway, ramps or local roads for the existing road as well as the year of opening, 2016, and 10 years after opening in 2026.

Traffic volumes and 85th percentile speeds based on the fully classified traffic counting data collected concurrently with the noise measurements were used to calibrate the noise model. These are shown in Table 6-2: below.

Table 6-2: Existing traffic (daily average counts, 20-30 November 2012)

Location	Direction	Day (7am to 10pm)		Night (10pm to 7am)		85th Percentile Speed	
		Light	Heavy	Light	Heavy	Day	Night
T1- South of Coral Street	Northbound	3356	648	423	397	96	99
	Southbound	3465	829	308	292	102	105
T2- North of Barcoongere Way	Northbound	3288	623	407	395	100	102
	Southbound	3411	764	301	289	100	102
T3- South of Dunmar Lane	Northbound	3074	494	414	298	105	105
	Southbound	3062	673	320	285	101	101
T4- South of Kungala Road	Northbound	3059	593	294	386	104	105
	Southbound	3047	685	326	281	101	102

This traffic count data is discussed in Section 7, which address calibration of the noise model.

The traffic volumes for "No Build" option provided by APBJV, for the existing Pacific Highway are summarised below, with 2016 volumes set out in Table 6-3: and 2026 volumes in Table 6-4: .

The traffic volumes for "Build" option provided by APBJV, for the main carriageway, ramps and local roads are summarised below, with 2016 volumes set out in Table 6-5: and 2026 volumes in Table 6-6: .

Table 6-3: Predicted traffic volumes – No build option year 2016

Year 2016	Direction	Day, 15hr		Night, 9hr	
		Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles
Main Carriageway					
S Point of Model to	NB	3015	810	291	406
Coral Street	SB	3373	929	281	275
Coral Street to	NB	2755	812	244	406
Range Road	SB	3112	934	246	277
Range Road to	NB	2784	818	247	410
McPhillips Road	SB	3144	942	249	279
McPhillips Road to	NB	2813	825	250	413
Kungala Road	SB	3175	950	252	281
Kungala Road to	NB	2811	826	249	413
Parker Road	SB	3148	968	245	287
Parker Road to	NB	2800	824	248	413
Franklins Road	SB	3151	979	244	290
Franklins Road to	NB	2790	823	246	412
Eight Mile Lane	SB	3155	990	242	293

Table 6-4: Predicted traffic volumes – No build option year 2026

Year 2026	Direction	Day, 15hr		Night, 9hr	
		Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles
Main Carriageway					
S Point of Model to	NB	3403	1063	282	532
Coral Street	SB	3724	1055	343	528
Coral Street to	NB	3006	1034	219	518
Range Road	SB	3327	1026	280	514
Range Road to	NB	3135	1072	230	537
McPhillips Road	SB	3471	1065	293	534
McPhillips Road to	NB	3165	1081	233	541
Kungala Road	SB	3503	1073	297	538

Year 2026	Direction	Day, 15hr		Night, 9hr	
		Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles
Kungala Road to	NB	3214	1078	242	540
Parker Road	SB	3558	1096	299	549
Parker Road to	NB	3275	1089	250	546
Franklins Road	SB	3587	1115	299	559
Franklins Road to	NB	3137	1079	228	541
Eight Mile Lane	SB	3465	1119	275	560

Table 6-5: Predicted traffic volumes – Build option year 2016

Year 2016	Direction	Day, 15hr		Night, 9hr	
		Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles
Main Carriageway					
S Point of Model to	NB	3015	810	291	406
Coral Street	SB	3307	802	347	402
Coral Street to	NB	2669	789	235	395
Range Road	SB	2961	781	291	391
Range Road to	NB	2784	818	247	410
McPhillips Road	SB	3089	814	304	407
McPhillips Road to	NB	2813	825	250	413
Kungala Road	SB	3120	820	307	411
Kungala Road to	NB	2860	824	259	412
Parker Road	SB	3171	838	311	420
Parker Road to	NB	2915	830	267	416
Franklins Road	SB	3198	852	311	426
Franklins Road to	NB	2790	823	246	412
Eight Mile Lane	SB	3087	855	290	428
Interchange					
Coral Street to Range	NB	86	23	9	11
Road (E ramps)	SB	97	26	9	13
Range Road (overpass)	Overall	118	29	12	15
Range Road (W off-ramp)	NB	118	29	12	15
Range Road (W on-ramp)	NB	118	29	12	15
Range Road (E off-ramp)	SB	128	33	13	16
Range Road (E on-ramp)	SB	0	0	0	0
Range Road /	NB	115	29	12	15
New Highway Merge	SB	0	0	0	0

Table 6-6: Predicted traffic volumes – Build option year 2026

Year 2026	Direction	Day, 15hr		Night, 9hr	
		Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles
Main Carriageway					
S Point of Model to	NB	3403	1063	282	532
Coral Street	SB	3724	1055	343	528
Coral Street to	NB	3006	1034	219	518
Range Road	SB	3327	1026	280	514
Range Road to	NB	3135	1072	230	537
McPhillips Road	SB	3471	1065	293	534
McPhillips Road to	NB	3165	1081	233	541
Kungala Road	SB	3503	1073	297	538
Kungala Road to	NB	3214	1078	242	540
Parker Road	SB	3558	1096	299	549
Parker Road to	NB	3275	1089	250	546
Franklins Road	SB	3587	1115	299	559
Franklins Road to	NB	3137	1079	228	541
Eight Mile Lane	SB	3465	1119	275	560
Interchange					
Coral Street to	NB	97	29	8	15
Range Road (E ramps)	SB	109	31	10	16
Range Road (overpass)	Overall	131	37	12	19
Range Road (W off-ramp)	NB	0	0	0	0
Range Road (W on-ramp)	NB	131	37	12	19
Range Road (E off-ramp)	SB	143	39	14	20
Range Road (E on-ramp)	SB	0	0	0	0
Range Road /	NB	129	38	11	19
New Highway Merge	SB	0	0	0	0

In addition to the vehicle volumes set out above, the northernmost 2 km of the Saphire to Woolgoolga (S2W) Upgrade and the proposed Arrawarra interchange has been included in the noise modelling. This is to ensure that the noise contribution from the S2W alignment is appropriately included in the levels predicted at the receivers located to the south of the W2G study area.

Predicted 2021 vehicle volumes on the Arrawarra interchange ramps were sourced from the noise assessment undertaken for the Saphire to Woolgoolga rest area assessment (Wilkinson Murray Report No. 00086-RA – Ver C - September 2009). These are set out in Table 6-7.

Table 6-7: Predicted Arrawarra Interchange traffic volumes – Build year 2021

Arrawarra Interchange				
Ramps	**Day, 15hr**		**Night, 9hr**	
	Light Vehicles	**Heavy Vehicles**	**Light Vehicles**	**Heavy Vehicles**
On Ramp - NB	2765	199	185	73
Off Ramp - NB	821	90	56	49
On Ramp - SB	741	104	60	32
Off Ramp - SB	2957	237	265	53

7 NOISE MODEL VALIDATION & CALIBRATION ADJUSTMENTS

To provide validation of the noise model to be used for 2016 and 2026, a model for the existing road was prepared based on the existing traffic volumes and average weighted vehicle speeds and topographic data and design strings provided by the APBJV.

Measured results are compared with model predictions at the six identified noise monitoring locations in Table 7-1: . The differences between measured and predicted values are also shown.

Agreement to within 2 dB is generally considered acceptable given the expected accuracy of standard noise modelling procedures, and also variability in traffic speeds along the whole alignment. The results are discussed below.

Table 7-1: Predicted and measured results based on 0.75 soft ground factor (unattended monitoring)

Location	Daytime $L_{Aeq,15hr}$			Night Time $L_{Aeq,9hr}$		
	Measured	Predicted	Difference	Measured	Predicted	Difference
L1	70.0	71.9	1.9	69.5	69.6	0.1
L2	60.8	63.3	2.5	61.2	60.9	-0.3
L3	69.2	71.0	1.8	68.2	68.8	0.6
L4	53.2	56.7	3.5	54.8	54.3	-0.5
L5	69.5	70.1	0.6	69.0	68.0	-1.0
L6	72.4	73.0	0.6	71.9	71.1	-0.8

At L4 (5092 Pacific Highway, Halfway Creek) which is located at a distance of approximately 220 metres from the existing road there is a significant discrepancy between predicted and measured daytime noise levels, but not night time noise levels. The reasons for this discrepancy cannot be determined with certainty, however, it should be noted that, at distances greater than 200 metres from the road, meteorological effects begin to have a significant influence on noise levels and additionally the *CoRTN* calculation routines are not optimised for prediction at such distances. For this reason, the results from this location have been disregarded for the purpose of model validation. It should be noted, however, that both measured and predicted levels are sufficiently low that they would not affect assessment of requirements for noise mitigation.

Table 7-1: shows that the predicted daytime noise levels are higher than the corresponding measured noise levels. Additionally, the differences between measured and predicted noise levels are generally higher during the day, while a better correlation exists for the night comparison. This is possibly due to meteorological effects to some degree. Additionally, hotter road surfaces that are present during the daytime can also lead to small reductions in tyre/road noise, which may account for some of the daytime over-prediction.

7.1.1 Sensitivity analysis

In order to determine modelling confidence limits, a sensitivity study of key parameters, including traffic speed, volume and percentage of absorbent ground, has been undertaken.

In undertaking the noise model verification process and sensitivity analysis, Wilkinson Murray has considered the implementation of *CoRTN* algorithm in SoundPLAN with soft ground factor of 60 per cent[2] and the identified 85th percentile posted speeds to be reasonable for this upgrade. Notwithstanding this, calibration adjustment(s) have been applied to improve the modelling confidence limits. These are discussed below.

7.1.2 Risk allowances

Calibration results suggest the detailed design noise model is over-predicting by:

- +1.5dB (Standard deviation = 0.8) during daytime
- -0.3dB (Standard deviation = 0.7dB) during night time.

The detailed design noise model has therefore adopted the following risk allowances:

- +0dB for daytime (no additional safety factor applied as the model over predicts by more than 1 standard deviation i.e. +1.5 - 0.8 = +0.7)
- +1dB for night time (safety factor applied as the model over predicts by less than 1 standard deviation i.e. -0.3 - 0.7 +1 = +0).

These safety factors meet the requirements of the detailed design brief.

[2] Absorbent ground cover in the range of 60% to 89% is taken by *CoRTN* to adopt a soft ground factor of 75%.

8 OPERATIONAL NOISE ASSESSMENT

8.1 Traffic noise modelling results (free flowing traffic)

Based on the modelling procedures described in Sections 6 and 7, daytime and night time traffic noise levels for the year 2016 (year of opening) and design year 2026 (10 years after opening) have been predicted at all the identified residential receiver locations. The predicted levels are set out in tabular form in Appendices D1 and D2. Additionally, day and night noise contours for years 2016 and 2026 are included in Appendices E1 and E2. Note that noise contours are subject to tolerance as the contours are based on an interpolation of noise levels carried out in a regular rectangular grid.

The receiver information provided by APBJV has been taken to be complete and without error. It should be noted that ground truthing to confirm all structures as dwellings has not been undertaken as part of this assessment. This, it should be noted, is only of material significance for receivers identified by this assessment as requiring mitigation. The IDs used to identify receivers are consistent with those applied in the EIS noise study.

Based on the noise modelling outputs, compliance with the *RNP* base criteria is expected to be readily achieved at 341 of the 415 receivers identified within the study area.

Exceedances of base criteria are predicted at 74 of the 415 receivers, of these 24 are acute exceedances. The 12 dB relative increase criterion is exceeded at 4 receivers.

8.2 Receivers identified for architectural treatment

A total of 41 receivers have been identified for consideration of mitigation, in accordance with the protocol for determining feasible and reasonable noise mitigation measures, provided by the *ENMM* (as discussed in Section 4) 374 receivers (of the 415 considered) would not require any treatment.

In accordance with the provisions of the *ENMM* Practice Notes, it is expected that architectural treatment will be implemented to those residences requiring mitigation as a consequence of low residential density negating any benefits that may be obtained from other methods.

Notwithstanding this, a cluster of seven residences (396, 399, 402, 403, 404, 415 and 419) located between the bypass (at chainage 5000 to 5250) and the existing road has been given some further consideration, with regard to 'at-road' mitigation. A cost-benefit analysis, undertaken in accordance with the provisions of the *ENMM* Practice Note IV, is provided in Appendix H. The analysis shows that treatment of these properties by the implementation of a noise barrier may be feasible, but due to the minimum insertion loss of 5dB not being achieved for the "assessed" barrier, architectural treatment is preferred.

Based on the outputs of the noise model, night time noise levels (as compared to daytime) exceed the base criteria by the highest margin and also exhibit the largest increase when comparing to existing noise levels. Mitigation measures designed to meet relevant criteria at night would therefore also meet them during the daytime.

Table 8-1 identifies the 41 receivers to be considered for mitigation. These are also identified in Appendix D2 and shown graphically in Appendix F. Depending on their orientation with respect to the alignment, the receivers would require differing minimum attenuation requirements and further to this differing minimum attenuation requirements would be required of their individual building facades. Section 9 provides further detailed guidance in this respect.

Table 8-1: Receivers identified for acoustic treatment

Receiver	Address
335	47 Kangaroo Trail Rd, Corindi Beach NSW 2456
344	1 Kangaroo Trail Rd, Corindi Beach NSW 2456
351	31 Kangaroo Trail Rd, Corindi Beach NSW 2456
386	34 Kangaroo Trail Rd, Corindi Beach NSW 2456
393	Lot5/DP828411 (3507 Pacific Highway, Corindi Beach NSW 2456)
396	21 Post Office Lane, Corindi Beach NSW 2456
399	15 Post Office Lane, Corindi Beach NSW 2456
402	18 Post Office Lane, Corindi Beach NSW 2456
403	13 Post Office Lane, Corindi Beach NSW 2456
404	20 Post Office Lane, Corindi Beach NSW 2456
415	8 Post Office Lane, Corindi Beach NSW 2456
419	10 Post Office Lane, Corindi Beach NSW 2456
431	Lot68/DP731384 (13 Alice Close, Corindi Beach NSW 2456)
432	11 Bottle Brush Drive, Corindi Beach NSW 2456
434	3723 - 3731 Pacific Highway, Corindi Beach NSW 2456
435	Lot 109 / DP752820 (3875 Pacific Highway, Corindi Beach NSW 2456)
439	17 Bonita Drive, Dirty Creek NSW 2456
446	153 Kathleen Drive, Dirty Creek NSW 2456
449	Lot 1001, Hawthorn Close, Corindi Beach NSW 2456
453	27 Flinty Road, Dirty Creek NSW 2456
455	7 Dirty Creek Road, Dirty Creek NSW 2456
476	1 Dundoo Reach, , Dirty Creek NSW 2456
481	319 Dirty Creek Road, Dirty Creek NSW 2460
495	4470 Pacific Highway,Halfway Creek NSW 2460
502	4577 Pacific Highway, Halfway Creek NSW 2460
506	17 McPhillips Road, Halfway Creek NSW 2460
510	4612 Pacific Highway, Halfway Creek NSW 2460
512	4614 Pacific Highway, Halfway Creek NSW 2460
522	4650 Pacific Highway, Halfway Creek NSW 2460
526	4644 Pacific Highway, Halfway Creek NSW 2460
529	4688 Pacific Highway, Halfway Creek NSW 2460
533	56 Grays Road, Halfway Creek NSW 2460
537	4616 - 4620 Pacific Highway, Halfway Creek NSW 2460
564	19 Grays Road, Halfway Creek NSW 2460

Receiver	Address
575	4925 Pacific Highway, Halfway Creek NSW 2460
581	4982 Pacific Highway, Halfway Creek NSW 2460
582	9 Lemon Tree Road, Halfway Creek NSW 2460
588	5062 Pacific Highway, Halfway Creek NSW 2460
597	5092 Pacific Highway, Halfway Creek NSW 2460
616	Lot411 / DP883976 (119 Pacific Highway, Halfway Creek NSW 2460)
617	Lot411 / DP883976 (24 Luthers Road, Halfway Creek NSW 2460)

8.3 Assessment of maximum noise levels

In accordance with the requirements of the detailed design brief, an assessment of maximum noise levels has been undertaken to determine the potential for noise events to cause awakenings and generate annoyance within the community.

For the purpose of assessment a maximum sound power level of 114 dBA has been considered as representative of typical maximum noise levels arising from trucks. This level has been determined as appropriate and has been applied in previous maximum noise level assessments on other Pacific Highway projects.

External noise levels have been predicted at all the identified receiver locations throughout the W2G corridor with consideration to this maximum sound power level and exposure to receivers.

Table 8-2 identifies the receiver locations where external maximum noise levels are predicted to exceed L_{Amax} 65 dBA. This is the external noise level, considered by this assessment, above which there would be potential for sleep disturbance impacts to arise without appropriate mitigation.

Table 8-2: Predicted exceedances of $L_{Amax\ 65\ dBA}$ external noise levels

Receiver	Predicted Maximum External Noise Level (L_{Amax} dBA)	Does the Predicted Maximum External Noise Level Exceed the $L_{Aeq,9Hr}$ (or $L_{Aeq,1Hr}$) Level by >15dB?
386	68	N
481	67	N
495	76	N
510	65	N
512	69	N
522	72	N
529	67	N
564	66	N
575	68	N
581	76	N
582	71	N
616	75	N

As identified in the table, the predicted maximum noise levels are not expected to exceed the L_{Aeq} noise levels that would occur due to free flowing traffic by more than 15 dB at these receivers.

Further to this, it should be noted that appropriate mitigation measures have already been nominated for the identified receivers to ensure noise from free flowing traffic would be controlled to satisfactory levels internally. The details of these mitigation measures are provided in Appendix G and are further discussed in Section 9.

This assessment has shown that meeting the $L_{Aeq,9hr}$ night target noise levels (inclusive of appropriate mitigation) would sufficiently account for sleep disturbance impact.

It should be noted that the number of maximum noise level events along the existing Pacific Highway route between Corindi Beach and Dirty Creek will be reduced by the proposed upgrade alignment as most vehicles will bypass these residences. The residences located closer to the new bypass section would experience this as a new source of noise. The new road has, however, been designed to allow for continuous flow of traffic. It is therefore expected that the need for heavy vehicles to use engine brakes would be greatly reduced from the current usage on the Pacific Highway. Similarly, to the south and north of the bypass, the provision of dual carriageways will serve to reduce the occurrence of engine braking and, in turn, the occurrence of maximum noise events.

9 ARCHITECTURAL TREATMENT DETAILS

The provision of noise mitigation in the form of architectural treatments would need to be considered on an individual basis for the receivers identified in Table 8-1, taking into account the construction of the dwellings and their noise control efficacy. Additionally, the *ENMM* notes that any such acoustic architectural treatments may be implemented only after extensive consultation with the residents and after obtaining the agreement of all affected parties, as described in Practice Note IV(b).

The mitigation measures should be designed to achieve the internal noise levels that would have prevailed had the external traffic noise criteria been able to be achieved. In this respect 10 dB below the external criterion is taken as the internal noise level goal. Most buildings will achieve an internal noise level 10 dB below the external noise level with the windows open partially for ventilation, without providing additional treatment.

Where satisfactory internal noise levels would not be met through ventilating windows, keeping windows closed can be mitigation enough to achieve acceptable internal levels in some cases. By virtue of having to keep windows closed, however, it then becomes necessary to provide mechanical ventilation to the dwelling for provision of fresh air. This is required in order to comply with the Building Code of Australia (BCA). Care needs to be taken to ensure that any new ventilation system does not introduce a sound flanking transmission (leakage) path, which could offset the benefits of the other acoustical measures.

If traffic noise levels incident on the façade are substantially higher, such that closed (standard) windows do not provide satisfactory attenuation, upgrades to the other building elements of the façade are sometimes necessary. Such measures include sealing vents and upgrading glazing and door constructions in the façades exposed to the road.

It should be noted that these types of building treatments do not provide any external noise reduction benefit, but the internal noise reductions may be higher than for most external noise barrier solutions.

Whilst physical inspections of the properties would be required to determine appropriate treatment, for the purpose of this assessment the three commonly applied mitigation categories as set out below may be considered. Appendix G provides an evaluation with respect to these categories for each façade of the properties.

- Option 1 Mechanical ventilation only (where <5 dB reduction is required)

  Where external noise levels are less than 5 dB above the *RNP* 'base' criteria, the internal 'base' criteria may be achieved with windows closed. A light framed building with single glazed windows will provide a minimum noise reduction of up to 15 dB from outside to inside when windows are closed. To achieve this, mechanical ventilation or air conditioning must be provided for BCA requirements.

- Option 2 Mechanical ventilation and sealing of wall vents

  (where 5-10 dB reduction is required)

  Where external noise levels are less than 10 dB above the 'base' criteria, the internal 'base' criteria may be achieved with windows closed. A light framed building with single glazed windows will provide a minimum noise reduction of up to 20 dB from outside to inside when windows are closed and wall vents are sealed. Again, mechanical ventilation or air conditioning must be provided for BCA compliance.

- Option 3 Upgraded windows, glazing and doors

  (where >10 dB reduction is required)

  Where the predicted external noise level exceeds the 'base' criteria by significantly more than 10 dB, then upgraded windows and glazing and the provision of solid core doors will be required on the facades exposed to the proposed upgrade, in addition to mechanical ventilation or air conditioning.

It should be noted that these measures are mostly appropriate for masonry buildings. Comparable acoustic benefit may not be achieved with light framed structures, particularly those without acoustic insulation in the walls.

10 REVIEW AGAINST CONCEPT DESIGN (EIS & PIR) RESULTS

The EIS identified 416 residences within 600 metres of the W2G alignment (394 in Section 1 and 22 in Section 2). As previously noted during the detailed design assessment, three of these receivers (79, 162 and 259) were found to be duplications and were therefore disregarded. Furthermore, Appendix F of the W2B Pacific Highway Upgrade Submissions / Preferred Infrastructure Report (SPIR), submitted in November 2013, provided a revised operational noise assessment at 3 receivers (422, 584 and 597) and identified a further receiver (402) not previously assessed as part of the EIS. Since completion of the SPIR RMS identified a further receiver (404) which has not been previously assessed.

10.1 Comparison of modelling results

The approved concept design and modelling input data have been further refined since issue of the EIS, resulting in some differences in modelling outputs. Changes have arisen due to updated information with respect to traffic volume, speed, road surface description and ground absorption. A further key difference between the EIS model and the model developed during detail design pertains to the inclusion of buildings. In lieu of including individual buildings in the EIS model, the EIS assessment has applied an apparent 6-8 dB reduction (approximate) to account for the effects of acoustic shielding afforded by buildings. The detailed design model has included the individual buildings, which would be expected to improve the model accuracy.

The EIS noise and vibration study reported exceedances of base criteria at 284 receiver locations within the upgrade study area (265 in Section 1; and 19 in Section 2). Of these, 60 receivers were identified for consideration for mitigation in the form of architectural treatment (50 in Section 1; and 10 receivers in Section 2). The revised operational noise assessment in the Appendix F of the W2B SPIR identified 5 additional receivers for consideration for mitigation in the form of architectural treatment (3 in Section 1; and 2 in Section 2). Appendix D2 provides a comparison of the detailed design predictions against the concept design (EIS and SPIR) predictions for all receivers for design year 2026. A summary of the key changes with respect to the total number of receivers is shown in Table 10-1.

Table 10-1: Summary of differences between detailed design and concept design predictions

	No Build (i.e. No Upgrade) 2026		Build (i.e. With Upgrade) 2026	
	Day	**Night**	**Day**	**Night**
Change in predicted number of receivers affected by exceedance of base criteria	+35 (CD: 20; DD:55)	-92 (CD: 181; DD:89)	+2 (CD: 38; DD:40)	-210 (CD: 286; DD:74)
Change in predicted number of receivers affected by exceedance of acute criteria	+6 (CD: 4; DD:10)	+1 (CD: 15; DD:16)	+7 (CD: 6; DD:13)	-8 (CD: 32; DD:24)
Change in predicted number of receivers for which difference between 'build' and 'no build' is greater than 2 dB	n/a	n/a	-3 (CD: 16; DD:13)	-16 (CD: 33; DD:17)
Change in predicted number of receivers affected by exceedance of 12 dB relative increase criteria	n/a	n/a	-3 (CD: 7; DD:4)	-3 (CD: 7; DD:4)

10.2 Comparison of mitigation requirements – detailed design compared with concept design

10.2.1 'At-road' mitigation

The EIS indicated consideration of 'at-road' mitigation in the form of low noise pavement between chainage 200 and 1600. WM has reviewed the requirement for low noise pavement and concur with the recommendation for this treatment. Further to this recommendation, the APBJV has confirmed that for the purpose of simplifying construction the low noise pavement would be included over an extended length of the alignment. The low noise pavement will tie in to the Sapphire to Woolgoolga (S2W) Project at the southern extent of the alignment (ch 80 northbound and ch minus 50 southbound) and extend until chainage 1800. This has been included in the 100 per cent design modelling.

Beyond the Arrawarra vicinity, given the relatively sparse density of dwellings, the EIS determined the use of low noise pavements and noise barriers to mitigate noise to be impracticable, i.e. not fitting the definitions of "feasible" and/or reasonable" provided by the *ENMM* (refer to Section 4.1). WM again concurs with this finding.

Beyond the adoption of low noise pavement, as identified, this detailed design assessment has found no further requirement for 'at-road' mitigation.

10.2.2 'At-property' mitigation

The EIS reported that mitigation measures in the form of architectural treatments should be considered for a total of 60 receivers located within the W2G alignment study area. In addition to the 60 receivers identified in the EIS, Appendix F of the W2B SPIR has identified 5 additional receivers for architectural treatment. As detailed in Section 8.2, due to the modelling input differences discussed, the 100 per cent detailed design modelling results now indicate that the number of receivers to be considered for architectural treatment may be reduced to 41.

The following changes are indicated:

- Mitigation would no longer be required for 29 of the receivers indicated for treatment by the EIS and SPIR
- Mitigation would be required at 5 further receivers that were not identified by the EIS and SPIR.

Table 10-2 summarises the receivers specifically subject to altered architectural treatment requirements, with respect to the EIS results. These receiver locations are identified graphically in Appendix F.

Table 10-2: Receivers subject to altered architectural treatment requirements

Receiver ID	Easting (metres)	Northing (metres)	Mitigation
502	512223	6685978	Additionally Required
506	512573	6686316	Additionally Required
510	512258	6686378	Additionally Required
512	512171	6686391	Additionally Required
588	508493	6689043	Additionally Required
57	518091	6675626	No Longer Required
65	518098	6675641	No Longer Required
76	518101	6675653	No Longer Required
87	518105	6675666	No Longer Required
95	518114	6675685	No Longer Required
104	518122	6675700	No Longer Required
116	518134	6675718	No Longer Required
209	518160	6675921	No Longer Required
218	518154	6675931	No Longer Required
221	518142	6675934	No Longer Required
305	518258	6676310	No Longer Required
309	518260	6676318	No Longer Required
313	518284	6676333	No Longer Required
314	518264	6676334	No Longer Required
367	518344	6677718	No Longer Required
411	517186	6680065	No Longer Required
420	517151	6680118	No Longer Required

Receiver ID	Easting (metres)	Northing (metres)	Mitigation
422	517167	6680146	No Longer Required
429	516918	6680510	No Longer Required
448	515815	6681945	No Longer Required
464	514772	6682726	No Longer Required
484	512976	6684559	No Longer Required
531	511768	6686779	No Longer Required
584	508788	6688922	No Longer Required
601	507654	6689966	No Longer Required
608	507361	6690074	No Longer Required
613	507512	6690140	No Longer Required
630	506751	6691296	No Longer Required
633	506069	6691393	No Longer Required

11 ARRAWARRA REST AREA

It is proposed that a rest area for cars and heavy vehicles would be located to the east of the upgraded highway near the proposed Arrawarra interchange and immediately south of Arrawarra Beach Road. The rest area would have the capacity to service:

- 24 standard car parks (including two disabled spaces);
- 6 car and trailer parks;
- 20 truck parks (3 parallel to Eggins Drive);
- 2 bus parks; and
- 2 rv parks.

A plan of the proposed rest area is shown in Figure 11-1, with the nearest residential receivers identified in Figure 11-2.

Figure 11-1: Arrawarra rest area layout

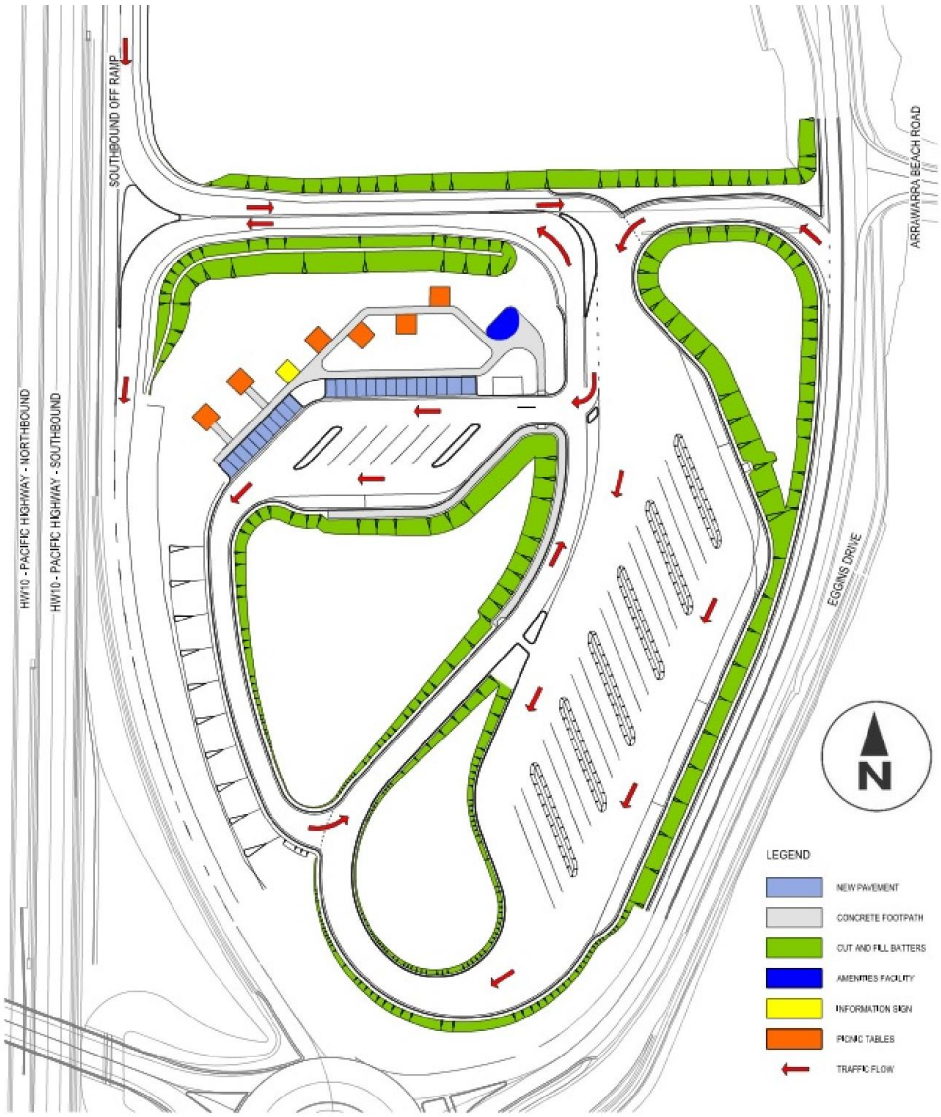


Figure 11-2: Arrawarra rest area receivers

The closest residential receivers are located in two clusters to the east and north of the proposed rest area. The closest residence to the east (R771) is located approximately 275 m from the rest area; the closest residence to the north (R450) is located approximately 600 m from the rest area.

Vehicles travelling south on the proposed upgraded highway would use the southbound off ramp to the Arrawarra Interchange, and turn left into the rest area on Arrawarra Beach Road. It is proposed that this section of Arrawarra Beach Road which is an existing public road would become a service road for the rest area. Access to Arrawarra Beach Road would then only be via the Arrawarra Interchange.

Vehicles travelling north would enter the rest area via the Arrawarra Interchange and then onto a section of the old Pacific Highway, turning left onto the proposed service road and into the rest area from the east. All vehicles would depart by rejoining the southbound off ramp of the Arrawarra Interchange.

It is proposed to construct noise walls approximately 3.5 metres in height along the northern and eastern boundaries of the proposed rest area to minimise noise impacts to the residences shown in the above figure.

11.1 Noise criteria

The NSW *RNP* requires that noise emissions from permanent facilities that support the road network are assessed against criteria established in NSW *Industrial Noise Policy* (Environment Protection Authority 2000), hereafter *INP*.

It is considered that while a truck is slowing to approach the rest area or is accelerating away, the noise is associated with a moving vehicle within the road reserve and should therefore be assessed in accordance with the *RNP*. The specific approach taken for the proposed Arrawarra rest area is therefore to assess vehicle noise on ramps that are public roads under the *RNP* and noise emanating from vehicles within the rest area that are not considered public roads under the *INP*. This would include the service road linking the southbound off ramp to the rest area.

The *INP* requires the L_{Aeq} noise level associated with the proposed operation over a typical 15-minute period at any time should not exceed the background L_{A90} noise level by more than 5 dBA.

For night time use of the rest area it is also relevant to consider the adopted sleep disturbance criteria, as discussed in Section 4.2 This requires that the typical maximum noise levels associated with noise from heavy vehicles at the rest area (engines starting/doors closing) should not exceed L_{Amax} 65 dBA, or emerge above the $L_{Aeq,9Hr}$ noise level by more than 15dBA.

During the ambient noise survey described in Section 5 there were no surveys undertaken at either of the two groups of residences identified above. However, it is likely that the ambient noise levels at those locations would be similar to levels at residences that are setback at an equivalent distance to the highway. Table 11-1 outlines the derived rating background level (RBL) based on measured ambient noise levels at such locations.

Table 11-1: Derived rating background levels at residences

Location	Distance from Highway (m)	Rating Background Levels (dBA)		
		Daytime (7.00am-6.00pm)	Evening (6.00pm-10.00pm)	Night (10.00pm-7.00am)
Eastern Residences	250	43	43	33
Northern Residences	350	45	45	35

Based on the above rating background levels, the *INP* intrusiveness criterion for each period is then shown in Table 11-2 and the sleep disturbance criteria adopted by this assessment is shown in Table 11-3: .

Table 11-2: Industrial noise policy intrusiveness criterion

Location	Industrial Noise Policy Intrusiveness Criterion ($L_{Aeq, 15\ min}$ dBA)		
	Daytime (7.00am-6.00pm)	Evening (6.00pm-10.00pm)	Night (10.00pm-7.00am)
Eastern Residences	48	48	38
Northern Residences	50	50	40

Table 11-3: Sleep arousal guideline

Location	Sleep Disturbance Criteria (L_{Amax} dBA)
Eastern Residences	65
Northern Residences	65

11.2 Predicted traffic volumes

Future predicted traffic volumes within the proposed rest area are set out in the RTA Arrawarra Rest Area Traffic Impact Assessment (*Sapphire to Woolgoolga Pacific Highway Upgrade - Rest Area Traffic Impact Assessment, dated September 2009 – Report No 1093 - Rev 4*).

Table 11-4: shows the maximum predicted number of arrivals and departures that may be expected to occur during the AM and PM peak hours for year 2031, as identified by the traffic impact assessment.

Table 11-4: Predicted peak hour vehicle movements for year 2031

Period	Light Vehicles		Heavy Vehicles	
	Arrive	Depart	Arrive	Depart
AM Peak Hour	58	58	12	12
PM Peak Hour	74	74	15	15

As shown in Table 11-4 the greatest use of the rest area may be expected during the PM peak hour.

11.3 Noise modelling procedures

For the purpose of assessment against the INP and sleep disturbance criteria detailed noise calculations have been carried out for design year (2031). All calculations and modelling are based on forecast traffic volumes provided by RMS, as set out in Table 11-4.

Given that the night-time is expected to be the most sensitive and critical in terms of compliance, assessment is focused on this period. Compliance with the night-time criteria, based on the PM peak hour vehicle movements implies compliance at all other times.

The rest area operational noise predictions were implemented using the SoundPLAN (Version 7.1) environmental noise prediction software, based on the 100 per cent design data supplied by RMS. The following factors have been considered during the assessment process:

- Traffic volumes (as set out in Table 11-4)
- Vehicle speeds of 20 km per hour within the rest area and 40 km per hour on ramps
- Road surface types
- Road gradient
- Different vehicle noise emission levels and source heights
- Location of the noise sources within the rest area
- Topographical information within and surrounding the rest area
- Shielding from landforms
- Shielding from the 3.5 m barriers proposed to be established to the north and east of the rest area, as shown in Figure 11-1
- Ground effect – Note, outside the rest area boundary the ground cover was set to 60 per cent absorbing, consistent with the operational traffic noise model
- Land use (types of noise sensitive receivers) surrounding the rest area
- Receiver locations.

For noise within the rest area the following source noise levels have been assumed at 7 metres. These are based on previous measurements of similar items and research conducted by Wilkinson Murray.

- Truck L_{Amax} (high revs) 89dBA
- Truck driving through rest area at 20 km/hr 78 dBA
- Truck start 85dBA
- Truck idle 66dBA
- Truck door close 75dBA
- Truck refrigeration unit 73dBA

11.4 Noise level predictions

Predicted $L_{Aeq,\ 15\ min}$ noise levels from both moving vehicles and vehicles at rest are outlined in Table 11-5: and compared against the adopted *INP* criteria.

With respect to vehicles at rest, this assessment has assumed that at any time up to five trucks may be idling and a further five may have on board refrigeration units continuously running. This is considered to represent a reasonable worst-case scenario with consideration to the projected vehicle volumes identified in Table 11-5.

With respect to moving vehicles it is not expected that trucks will need to use engine brakes while slowing to stop, although there will be some noise associated with trucks changing down through gears to enter the site and the air release on stopping. It is assumed that vehicles entering the rest area from the southbound ramp via the Arrawarra service road would travel at no more than 40kph and once within the rest area at no more than 20kph.

All predictions assume 3.5 m noise barriers are in place to the north and east of the rest area, as shown in Figure 11-1.

Table 11-5: Calculated rest area $L_{Aeq,\ 15\ min}$ noise levels

Location	$L_{Aeq,\ 15\ min}$ Noise Level (dBA)			
	Moving Vehicles	Vehicles at Rest	Total	Industrial Noise Policy Criterion
Northern Residences	29	29	32	40
Eastern Residences	37	32	38	38

As shown in Table 11-5: noise levels are predicted to be within *Industrial Noise Policy* criterion at all receiver locations.

Calculated L_{Amax} noise levels from both movement and vehicles at rest are shown in Table 11-6 and levels compared with the adopted sleep disturbance criterion.

Table 11-6: Calculated rest area $L_{Amax,\ 15\ min}$ noise levels

Location	Predicted L_{Amax} Noise Level (dBA)	L_{Amax} Sleep Disturbance Criterion (dBA)
Northern Residences	43	65
Eastern Residences	55	65

As shown in Table 11-6 maximum noise levels within the adopted sleep disturbance criteria are predicted. Additionally, the predicted maximum levels do not emerge above the predicted $L_{Aeq,9Hr}$ noise level by more than 15 dB. On this basis, no sleep impacts would be anticipated.

Based on the predicted noise levels and with consideration to reasonable degree of conservatism applied by this assessment, no material operational noise impacts would be expected due to the operation of the Arrawarra rest area.

12 CONCLUSION

Operational traffic noise from the proposed upgrade of Pacific Highway between Woolgoolga and Glenugie has been assessed in accordance with the requirements of the NSW Government's *Road Noise Policy (RNP)*, the RTA *Environmental Noise Management Manual (ENMM)* and environmental noise requirements, specific for Woolgoolga to Glenugie upgrade, defined in the Roads and Maritime detailed design brief.

The 100 per cent alignment design information has been provided by APBJV. The design includes low noise pavement extending from the southernmost point of the alignment to chainage 1800.

Operational noise levels have been predicted at all receiver locations within 600 metres of the upgrade alignment, as provided by APBJV; a total of 415 receiver locations have been considered. The predicted traffic noise levels have been compared against the relevant criteria, to establish the requirements for mitigation measures.

The conclusions of this assessment are as follows:

- Based on the 100 per cent alignment design provided by APBJV the operational traffic noise levels in Year 2026 would be expected to comply with the environmental noise requirements at the majority of the identified receivers (i.e. 374 out of 415) without the requirement for any mitigation.
- 41 receivers have been indicated for mitigation in the form of architectural treatment. As these are all sparsely located, mitigation in the form of barriers or additional stretches of low noise pavement would not be effective, nor considered reasonable or feasible.
- The 41 receivers indicated for architectural treatment have been summarised (as set out in Table 8-1). Architectural treatments notionally recommended to meet appropriate internal noise levels within the dwellings have additionally been provided (Appendix G), with consideration to the *ENMM* practice notes. Physical inspections of the individual properties identified for architectural treatment, with consideration to the recommendations of Practice Note IV of the *ENMM* would be required to confirm the most appropriate treatments.
- An assessment of typical maximum noise levels has identified that the architectural treatments nominated would be wholly sufficient to minimise the potential for sleep disturbance impacts.
- This assessment has additionally provided a review of the Concept Design (EIS & SPIR) noise assessment results. The differences which have arisen due to changes in the road design and noise modelling inputs have been summarised.
- An assessment of potential operational noise emissions from the Arrawarra rest area has indentified that no material operational or sleep disturbance impacts would be expected due to the operation of the rest area.