Detailed Design Operational Noise Assessment Summary

Centenary Bridge Upgrade

April 2022

Australian Government

BUILDING OUR FUTURE

Queensland Government

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Executive Summary

This report is based on ‘Detailed Design Operational Noise Assessment’ (May 2020) for the Centenary Bridge Upgrade. Findings of these noise reports have been de-identified to protect personal information as required by the *Information Privacy Act 2009*.

This assessment included monitoring of the surrounding residential and commercial areas of the project footprint to enable modelling of both current and further predicted motorway noise levels. A post-construction noise assessment will be completed to confirm predictions after the works have been completed and actual changes to the surrounds have been made.

The assessment was done based on the assumption that the upgrade works would be completed by 2023. This report summarises the operational noise assessment expected upon completion of the project.

As the Centenary Motorway is a state-controlled road, the assessment was carried out in general accordance with TMR’s *Transport Noise Management Code of Practice Volume 1 – Road Traffic Noise,* dated November 2013 (CoP V1).

Pre-construction noise levels were measured at six dwellings across the project in July and August 2019. The average difference between the measured and calculated road traffic noise levels, across all six measurements sites was within the ± two decibel (dB) tolerance as required by the CoP V1.

Both the 2023 and 2033 road traffic noise environment from access-controlled roads, associated with the project, were modelled.

The replacement and upgrade of the existing timber barriers to the north-east of the project are excluded from the current project scope as these barriers are not impacted by the project's construction footprint. Installing barriers to the north-west of the project was deemed to be impracticable due to structural limitations associated with the necessary height and location of potential barriers. TMR will be in discussion with relevant property owners to discuss proposed treatments, if any, noting that the recommended noise treatment are subject to the results of post-construction noise monitoring.

1. Introduction

1.1 Background

Noise assessment was undertaken to determine the impact of the duplication of the Centenary Bridge, stage 1 of the Centenary Motorway (the motorway) Upgrade. When this assessment was undertaken, it was based on the assumption that the upgrade is completed by 2023.

This report summarises the Operational Noise Impact Assessment for the detailed design phase of the project. As the motorway is a state-controlled road, the assessment was carried out in general accordance with TMR's *Transport Noise Management Code of Practice Volume 1 – Road Traffic Noise,* dated November 2013 (CoP V1).

The following assessment boundary was adopted, which is consistent with the works proposed along the Centenary Motorway:

- 350 metres to the north (CH 11,454) at Kenmore Road overpass.
- 550 metres to the south (CH 10,457) south of Pillow Talk at 190A Sinnamon Road, Jindalee.
- To the east and west by approximately 300 metres from the edge line of the upgraded road.

The detailed design stage of the project consists of one design option for the proposed upgrade (construction of a new three-lane northbound bridge and rehabilitation of the existing bridges to three-lanes southbound). This report only addresses the future operational noise impact and noise treatments to dwellings adjacent to the project.

1.2 Scope and Limitations

The scope of this report comprises:

- Verification of the road traffic noise model of the 2019 Centenary Bridge against the measured 2019 pre-construction road traffic noise levels and site conditions.
- Prediction of 2033 (10 years after proposed opening) road traffic noise levels, as well as 2023 year of proposed opening road traffic noise levels.
- Discussions of suitable noise mitigation treatments to achieve road traffic noise compliance with the CoP V1 noise criteria.

The limitations of the assessment are:

- Only traffic noise emissions from access-controlled sections of state-controlled roads have been considered in this assessment. The noise contributions from local (Council-controlled) roads have been excluded.
- Only noise-sensitive receptors which were present at the time of this assessment are assessed in relation to operational noise.
- The traffic noise impacts to the DFO Shopping Centre and other commercial-use buildings are excluded from this assessment.
- Construction noise and vibration impacts are excluded from the current assessment.
- Modelled existing barrier heights were determined using surveyed barrier/terrain data.
- The replacement and upgrade of the existing timber barriers to the north-east of the project are excluded from the project scope.
- The advice contained herein is specifically related to acoustical issues.

2. Road Traffic Noise Criteria

2.1 Sensitive Receptors

Noise-sensitive receptors defined within the CoP V1 include residential, educational, community and health buildings, and outdoor educational and passive recreational areas. Noise-sensitive receptors within the assessment boundary comprise:

- Dwellings, including:
  - Existing single, elevated and double-storey dwellings in the suburbs of Jindalee, Fig Tree Pocket and Kenmore.
- Parks (passive recreation):
  - Kooringal Drive and Amazon Place Parks.

As per the detailed design phase civil design, the northbound motorway is being shifted such that the existing Kooringal Drive park will be removed. As such, noise impacts have only been assessed at the Amazon Place Park. Some upgrades to the existing walking/cycle paths are included as part of the design.

Commercial buildings, industrial buildings and garden sheds have been excluded from assessment as these are not considered to be noise-sensitive places according to the CoP V1. Nevertheless, they have been included in the noise model to account for any acoustic reflection/shielding effects they may provide in calculations. Parks which are used for active recreation (sports) such as the Jindalee Skate Park and the Jindalee Bowls Club are not considered to be noise-sensitive according to CoP V1.

2.2 Noise Criteria

The CoP V1 noise criterion applicable to the assessment of future road traffic noise to dwellings is summarised in **Table 1** below.

Table 1 Noise criterion applied to the project

Noise Sensitive Receptor	Categories	Criteria
Existing Residences (façade corrected)	Upgrading Existing Road	68 dB(A) LA10 (18h) - average noise level measured between 6am and midnight 1.0 metre in front of most exposed façade
Outdoor Educational and Passive Recreational Areas (including Parks) (free field)	Upgrade Existing Road	63 dB(A) LA10 (12h) – average noise level measured between 6am and 6pm

CoP V1 Section 6.3.8 states the following, regarding removal or replacement of existing noise barriers:

- *Sometimes, existing noise barriers need to be removed or replaced. A community engagement strategy is required to manage community expectations regarding the permanent removal of noise barriers or temporary removal for a period prior to replacement.*
- *Any re-alignment of noise barriers involving removal or replacement of noise barriers shall not cause noise impacts on adjacent noise sensitive receptors to be measurably increased. This can be supported by road traffic noise modelling, pre and post construction measurements.*
- *The new noise barrier shall be at least the same extent and height as the existing barrier with a minimum height of 1.8 m. The noise barrier shall incorporate the design requirements detailed in Chapter 7 for greater integration with new or future road works.*

As such, dwellings located behind existing barriers being removed have been assessed against the CoP V1 requirement of no measurable increase.

No measurable increase has been defined as an increase of one dB or greater between predicted 2033 levels with and without the project noting that all modelled levels are rounded to the nearest dB, in accordance with CoP V1.

2.2.1 Noise Barrier Design Considerations

As per the CoP V1, the provision of noise barriers should consider the following factors:

- Barrier location and effectiveness
- Safety requirements
- Maintenance requirements
- Public amenity
- Fauna movements
- Horizontal and vertical alignment
- Visual amenity
- Community engagement

Additionally, the provision of noise barriers need to consider the potential safety impacts to the area by considering concepts and principles of Crime Prevention through Environmental Design (CPTED). TheCoP V1 states that:

> *The concepts and principles of Crime Prevention through Environmental Design (CPTED) shall be considered in the design arrangement and detailing of noise barriers.*
>
> *There are three main concepts which provide a broad basis for design within public spaces including road corridors:*
>
> - Crimes against people and infrastructure are less likely to occur if other people are around to intervene when the space is being used illegitimately.
> - The presence of people in adjoining buildings and spaces plays a major role if they are able to see, monitor and report what is happening in the public space.
> - Giving people safe choices about where to be and how to anticipate and respond to potential threats, improves personal safety.

These principles will be considered where applicable.

3. Pre-construction Noise Measurements

The pre-construction noise levels were measured at six dwellings across the project in July and August 2019. The results of the survey are summarised below in **Table 2**.

Table 2 Summary of Measured 2019 Traffic Noise Levels

Site ID	Measurement Period	Micro- phone position	Micro-phone height above ground level (m)	Measured, Weekday Average traffic noise level dB(A)
1	Friday 30 July 2019 to Saturday 7 August 2019	Free field – minimum 3.5m away from a hard surface	4.8	66.0
2	Friday 30 July 2019 to Saturday 7 August 2019	Free field – minimum 3.5m away from a hard surface	1.8	63.8
3	Friday 30 July 2019 to Saturday 7 August 2019	Free field – minimum 3.5m away from a hard surface	4.6	67.2
4	Friday 30 July 2019 to Saturday 7 August 2019	1.0m from Façade	4.6	77.2
5	Friday 30 July 2019 to Saturday 7 August 2019	Free field – minimum 3.5m away from a hard surface	4.6	63.6
6	Friday 30 July 2019 to Saturday 7 August 2019	Free field – minimum 3.5m away from a hard surface	4.6	65.1

A continuous weather monitoring station was deployed adjacent to the monitoring sites during the noise survey and the weather conditions were found to be within the CoP V1 requirements throughout the survey period.

The results of the noise survey are used in this assessment to verify the 2019 pre-construction Centenary Bridge traffic noise model. This is discussed further in **Section 4.2**.

4. Road Traffic Noise Modelling

4.1 Methodology

A road traffic noise model was created in SoundPLAN (Version 8.1). This noise modelling software implements the UK Department of Transport Welsh Office *Calculation of Road Traffic Noise* 1988 (CoRTN) algorithms to predict operational road traffic noise emissions.

CoRTN is the most commonly accepted algorithm for calculating road traffic noise in Australia and is recommended in the CoP V1.

The SoundPLAN model was constructed as a three-dimensional representation of the existing and future traffic noise environments surrounding the project. Input into the SoundPLAN model include ground contours, roads, noise sensitive receptors, noise barriers, and other inputs which effect road traffic noise propagation.

The SoundPLAN model was verified by comparing the calculated results from the pre-construction road traffic model of the road and surrounds and the results from the traffic noise measurements discussed in **Section 3.0**.

The verified road traffic noise model was then modified to reflect the 2033 road conditions, with the project, and used to predict the 2033 road traffic noise levels. The 2023 year of opening road traffic noise levels have also been predicted.

4.2 Noise Model Verification

The CoP V1 requires that the noise model is verified by comparing the measured and calculated noise levels at several representative locations along the project. The model is deemed to be verified if the average difference between the measured and calculated noise values is no more than ±2 dB(A).

Further, the CoP V1 states that:

- *If the average difference between existing measured and calculated noise descriptors values is positive (i.e. average measured values exceed the calculated values), then the calculated values shall be adjusted upwards by this average difference before determining the predicted values.*
- *If the average difference between existing measured and calculated noise descriptors values is negative (i.e. average calculated values exceed the measured values), then no adjustment shall be made to the calculated values before determining the predicted values.*

A comparison between calculated and measured noise levels for this project is presented in **Table 3**.

Table 3 Summary of measured and predicted 2019 road traffic noise levels

Site ID	Measured traffic noise level dB(A)	Calculated Noise Level dB(A)	Difference (Calculated minusMeasured) dB
1	66.0	66.1	+0.1
2	63.8	64.3	+0.5
3	67.2	66.8	-0.4
4	77.2	77.8	+0.6
5	63.6	65.5	+1.9
6	65.1	64.9	-0.2
Average difference across all measurement sites			**+0.4**

The average difference between the measured and calculated road traffic noise levels, across all six measurements sites was within the ± 2 dB tolerance as required by the CoP V1. As such, the noise model was verified.

In addition, as the noise average difference is positive (i.e. the average calculated values exceed the average measured values), the noise model was conservative, and no adjustment to the future noise predictions are required in accordance with the CoP V1.

This verified 2019 SoundPLAN model has subsequently been used to predict the 2023 and 2033 traffic noise impact.

5. Predicted 2023 & 2033 Road Traffic Noise Impacts

This assessment was conducted using the verified pre-construction SoundPLAN noise model (discussed in **Section 4.2**), and the future traffic volumes.

TMR requires the prediction and assessment of road traffic noise to be based on a 10-year design horizon following the completion date for the installation of the project.

Accordingly, both the 2023 (year of opening) and the 2033 scenarios have been assessed. The Noise Contour Maps showing the predicted noise levels can be found in the Appendix.

5.1 Residential Buildings

5.1.1 Upgrading Existing Road Criteria

A total of **202 dwellings** were included in the assessment.

The replacement and upgrade of the existing noise barrier between the motorway and the receptors on the north-eastern side of the motorway are excluded from the current project scope as these barriers are not impacted by the project's construction footprint.

There are three receptors predicted to exceed the noise criterion, without treatments are summarised in **Table 4**.

Table 4 Summary of dwellings with noise levels predicted to exceed the nominated criterion

Receptor ID	Floor	Without additional noise treatments	
		Predicted noise level dB(A)	Exceedance of the 68 dB(A) criterion
R12	Ground	78	10
	Upper	78	10
R25	Ground	67	N/A
	Upper	69	1
R37	Ground	74	6

5.1.2 Removal of Existing Noise Barriers Criteria

As outlined in **Section 2.2**, existing barriers to the north-west of the project are being removed to incorporate the project. Seven dwellings to the north-west have therefore been assessed against the CoP V1 section 6.3.8 requirement of no measurable increase following the removal of existing barriers, even if they are not predicted to exceed the project criteria of 68 dB(A) .

The modelled 2033 predicted noise levels with and without the project were compared in order to assess the impacts of the removal of the existing noise barriers to the north-west of the project. These results are presented in **Table 5.**

Table 5 Comparison of predicted noise levels prior to and following removal of existing noise barriers

Receptor ID	Floor	Predicted 2033 noise level with no development dB(A)	Predicted 2033 noise level with project dB(A)	Difference following removal of existing barriers dB(A)
R35	Ground	59	58	-1
R37	Ground	70	74	4
R38	Ground	66	67	1
R42	Ground	60	59	-1
R44	Ground	62	62	0
	Upper	66	65	-1
R47	Ground	62	60	-2
	Upper	63	61	-2
R49	Ground	61	61	0
	Upper	63	61	-2

The predicted noise levels following the removal of the existing barriers to the north-west of the project show predicted increases at two dwellings behind these barriers.

R37 has been predicted to exceed the 68 dB(A) criterion as per **Table 4**. Treatment of impacts to R37 is driven by exceedance ofthe 68 dB(A) criterion due to the greater magnitude of exceedance.

5.2 Passive Recreational Areas

The noise impacts at passive recreational areas are also assessed as specified in CoP V1. Upon applying the correction factors, it was found that free-field noise level to be 1.5dB(A) lower than the predicted noise levels.

The Jindalee Skate Park and Jindalee Bowls Club are not considered noise sensitive in accordance with CoP V1.

6. Recommended Noise Treatments

6.1 Rationale for Treatments

The traffic noise impact from the project is predicted to exceed the nominated noise criterion as discussed previously in **Section 5.0**. Accordingly, noise treatments are recommended to mitigate noise impacts at these receptors.

Noise barriers can be an effective method of controlling noise at sensitive receptors. A noise barrier is typically required to break the line of sight between the noise source and the building window as a minimum, in order to provide a suitable level of noise attenuation. The most acoustically effective location for noise barriers is that which maximises the sound diffraction angle over the barrier.

Effective barrier placement locations are either close to the source, close to the building, at the edge of an embankment or at the top of a road cutting, depending on the topography of the area.

6.2 Noise Barriers

6.2.1 Existing Barrier Performance

TMR have clarified that the replacement and upgrade of the existing timber barriers to the north-east of the project are excluded from the current project scope and are to remain unmodified, as these barriers are not impacted by the project's construction footprint.

Noise measurements were conducted as part of the verification process, as outlined in **Sections 3.0** and **4.0**. This was directly behind the existing timber barriers to the north-east of the project. As such, the monitoring results were able to provide an indication of the acoustic effectiveness of the existing timber barriers.

The measured noise level of 67.2 dB(A), between Friday 31 July and Saturday 7 August 2019, is non-compliant with the CoP V1 criteria following the +2.5 dB(A) façade correction.

Inspection of the existing timber barriers highlighted some gaps/degradation where the barriers may not be performing as designed. TMR will manage the functional life of the existing timber barriers and any ongoing maintenance.

6.2.2 New Noise Barrier Practicality

Noise barriers were considered to mitigate the predicted exceedances. To achieve compliance, barriers would be required both along the upgraded bridge, as well as along the embankment of the project.

Locating very high noise barriers, with the proposed design between 5 and 5.5 metres, on the bridge creates construction difficulties and safety concerns for the project.

Barriers of this height must be designed to withstand significant wind forces. The bridge superstructure and barriers would require considerable modifications to support the steel framing required for the noise barriers. Additionally, at the ultimate limit state, as the river floods to deck level, the large area of the noise barriers increases hydraulic loads on the bridge which would exceed the capacity of the steel support frames, leading to failure of the bridge in a flood event.

The geometric location of the noise barriers results in signage at this location encroaching on the working width of the carriageway, leading to safety issues to the public.

Locating the high noise barriers on the embankment near the bridge will require high steel/concrete structures to support the barriers. The embankment falls away towards the river. As the top of the barrier must remain at the design level, the supporting structure must increase in height to match the decrease in ground levels. During flood events, this steel structure will be impacted by significant hydraulic forces, which could lead to collapse of the noise barrier structure.

The construction of noise barriers was not considered practical. No additional barriers have been proposed as part of the project, due to structural limitations of high (more than five metres) barriers in available locations.

6.2.3 Removal of Existing Noise Barriers Criteria

The CoP V1 section 6.3.8 requires that there be no measurable increase following the removal of existing barriers. Achieving no measurable increase in noise impacts to the receptor forecast to have a measurable increase in **Section 5.1.2** was determined to be impracticable. Any replacement barrier would need to be taller than five metres and be constructed into terrain at a steep gradient. The footings required to ensure that such a barrier is structurally sound would be prohibitively costly to construct.

6.2.4 Passive Recreational Areas

The noise impacts at the Amazon Place Park, which lies to the south-east of the project, have been assessed. As per CoP V1, for passive recreational areas greater than 2000 m^2, the criterion needs to be achieved across a minimum of 2000 m^2.

No mitigation has been recommended to mitigate noise impacts to the Amazon Place Park.

7. Conclusion

The operational traffic noise assessment for the Centenary Bridge Upgrade Preliminary Design was completed in accordance with the requirements of the TMR's document *Transport Noise Management Code of Practice Volume 1 – Road Traffic Noise,* dated November 2013 (CoP V1).

The replacement and upgrade of the existing timber barriers to the north-east of the project are excluded from the current project scope as these barriers are not impacted by the project's construction footprint. Installing barriers to the north-west of the project was deemed to be impracticable due to structural limitations associated with the necessary height and location of potential barriers.

The predicted future traffic noise levels indicate that some dwellings may require treatment. TMR will be in discussion with relevant property owners to discuss proposed treatments, if any, noting that the recommendations will be subject to post-construction noise monitoring

Appendix

Predicted 2023 & 2033 Road Traffic Noise Levels – Noise Contour Maps

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0 50 100 200

metres

1:3,000 (when printed at A3)

Legend

$L_{A10\ (18hr)}$

- <= 63
- 63 < <= 68
- 68 < <= 70
- 70 < <= 77
- 77 <

- Retained Existing Noise Barriers
- Future Roadside Barriers
- New Roads
- Existing Road
- Assessment Boundary
- Buildings Not Assessed

Centenary Bridge Upgrade – 2023 $L_{A10\ (18h)}$ Facade-corrected Road Traffic Noise Contours at 1.8 metres above Ground Level

PROJECT ID	60605610
CREATED BY	LAN
LAST MODIFIED	BH - 24 Apr 2020
VERSION:	2

Figure 1

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Figure 1

A3 size

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