DD Report | Appendix B

Noise Assessment

Department of Transport and Main Roads

Sumners Road Interchange Upgrade

Detailed Noise Modelling

260330-TN-0022

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Job number 260330

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Contents

Appendices

1 Introduction

The Sumners Road Interchange Upgrade Project (SRIU) has progressed to the detailed design phase, requiring a detailed road traffic noise assessment in accordance with the TMR Code of Practice Volume 1 (CoPV1).

The SRIU is located at the intersection between Sumners Road and the Centenary Motorway. The interchange upgrade involves the replacement of the current double-roundabout configuration with separate carriageways, the construction of a new overpass over the Centenary Motorway, and the construction of a pedestrian tunnel under Sumners Road.

A plan view of the project extent is shown in Figure 1.

Figure 1: Overall Site Extent (Upgraded Alignment Overlaid in Red)

This report assesses road traffic noise from state controlled roads to all sensitive receivers in the vicinity of the interchange upgrade against compliance criteria provided in the CoPV1.

2 Existing Noise Environment

2.1 Noise Survey

A noise survey was conducted in May 2018 to determine the existing noise environment in the vicinity of the Sumners Road Interchange Upgrade Project. The purpose of the noise survey was to measure existing road traffic noise levels for use in calibrating the noise model for the project.

The noise survey was conducted by specialist acoustics staff from Arup and was conducted in general accordance with the procedures given in CoPv1 as well as Australian Standard AS2702 (1984) *Acoustics – methods for the measurement of road traffic noise* and AS1055.1 (1997) *Acoustics – description and measurement of environmental noise. Part 1: General procedures*.

All noise loggers and sound level meters were checked for calibration before and after measurements using a Brüel and Kjær Type 4231 calibrator. No significant drift in calibration occurred over the measurement period. All noise measurement equipment used by Arup in performing these services holds current calibration certification, available on request.

The noise survey consisted of the following measurements:

- Unattended and attended noise measurements at the following locations:
  - 34 Leopard Tree Crescent, Sinnamon Park
  - 19 Melody Street, Jamboree Heights
  - 35 Melody Street, Jamboree Heights

2.1.1 Noise Monitoring Locations

2.1.1.1 Logger 1 (34 Leopard Tree Crescent)

An ARL Ngara noise logger (serial number 8780E5) was set up approximately 1m from the south-western façade of 34 Leopard Tree Crescent, facing the Centenary Motorway Southbound off-ramp, as shown in Figure 2.

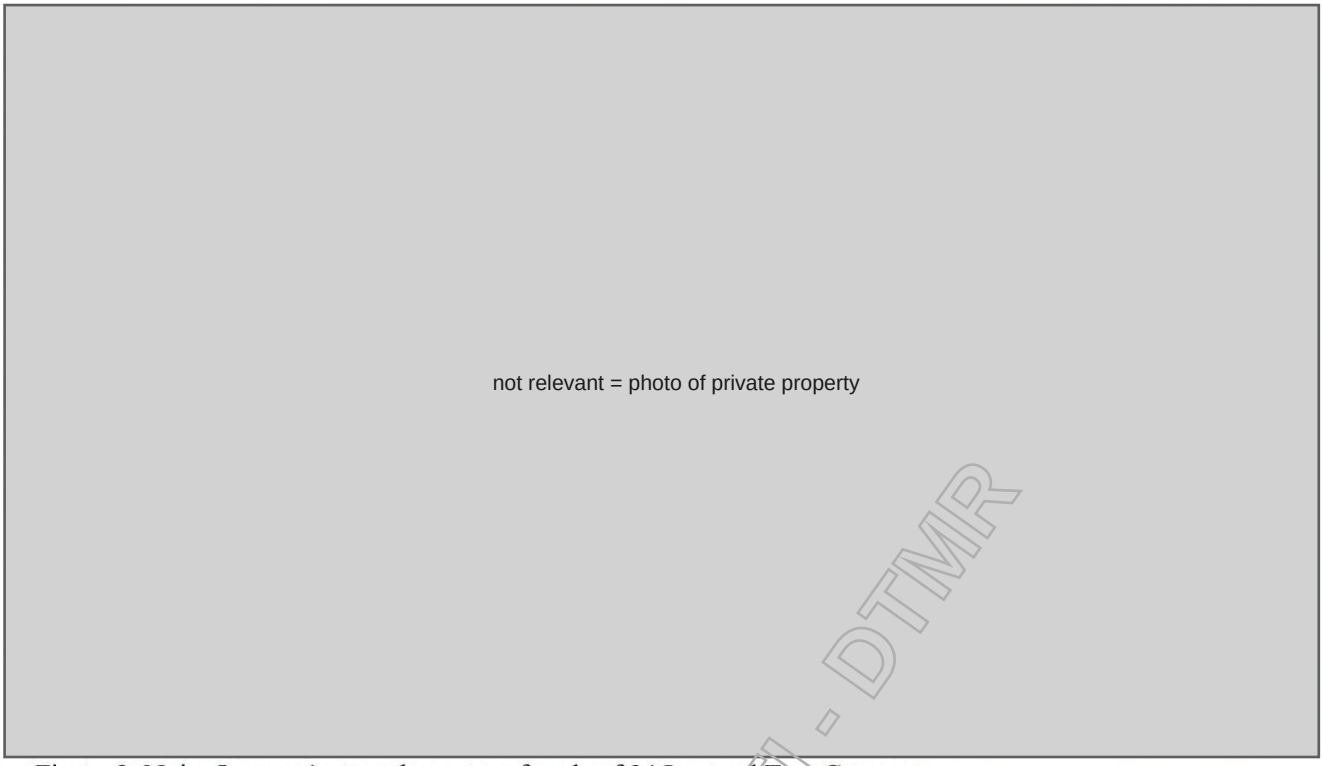


Figure 2: Noise Logger 1 at south-western facade of 34 Leopard Tree Crescent

The noise logger measured continuously from Monday 14 May 2018 to Monday 21 May 2018. The data from the Ngara logger was processed using a 1-hour time period to obtain the $L_{A10,1hr}$ noise levels, from which the $L_{A10,18hr}$ noise level for road traffic noise assessment may be calculated.

The measurement location was partially screened from the Centenary Motorway main carriageway and southbound off-ramp by a noise barrier which ends immediately before this property.

2.1.1.2 Logger 2 (19 Melody Street)

An ARL Ngara noise logger (serial number 8780D0) was set up approximately 1m from the south-eastern façade of 19 Melody Street, facing the eastern roundabout of Sumners Road.

A Davis Vantage Vue weather station was also set up in the vicinity of the noise logger, as shown in Figure 3.

Figure 3: Noise Logger 2 and weather station at south-western façade of 19 Melody Street

The noise logger measured continuously from Monday 14 May 2018 to Monday 21 May 2018. The data from the Ngara logger was processed using a 1-hour time period to obtain the $L_{A10,1hr}$ noise levels, from which the $L_{A10,18hr}$ noise level for road traffic noise assessment may be calculated.

2.1.1.3 Logger 3 (35 Melody Street)

An ARL Ngara noise logger (serial number 8780D1) was set up approximately 1m from the eastern façade of 35 Melody Street, facing the northbound on-ramp and carriageway of the Centenary Motorway, as shown in Figure 4.

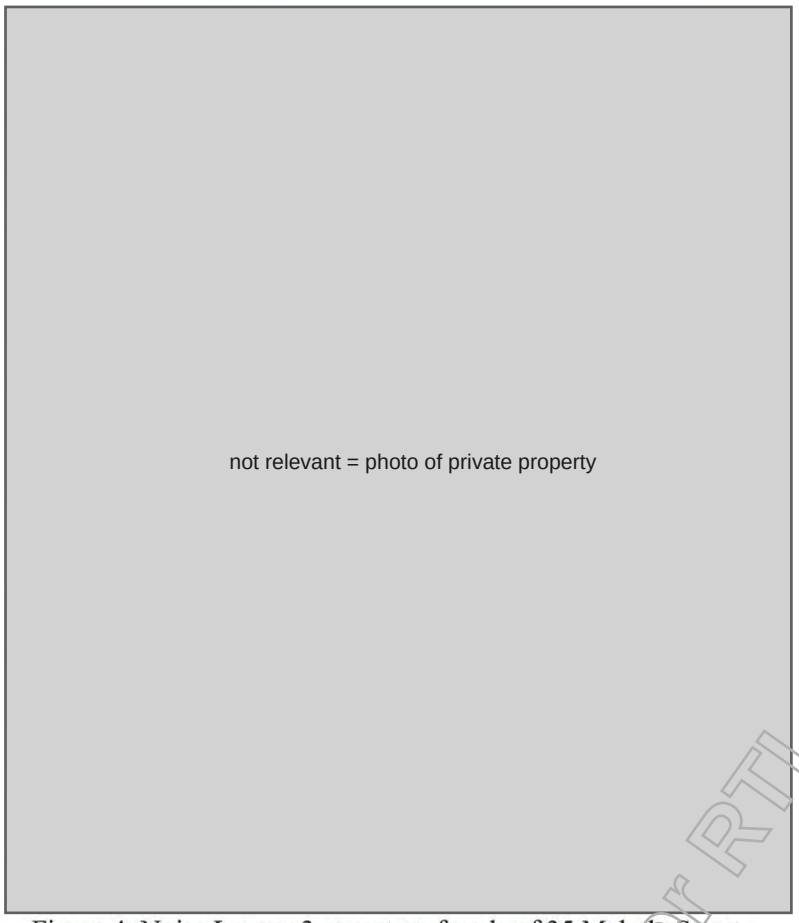


Figure 4: Noise Logger 3 at eastern facade of 35 Melody Street

The noise logger measured continuously from Monday 14 May 2018 to Monday 21 May 2018. The data from the Ngara logger was processed using a 1-hour time period to obtain the $L_{A10,1hr}$ noise levels, from which the $L_{A10,18hr}$ noise level for road traffic noise assessment may be calculated.

2.1.2 Measured Noise Levels

Measured $L_{A10,1hr}$ noise levels on each day were used to derive the existing $L_{A10,18hr}$ noise levels using the arithmetic average of the measured $L_{A10,1hr}$ noise levels between 6am and midnight for each site for calibration of the noise model. Noise level graphs for each logger over the entire measurement period can be found in Appendix B. The derived $L_{A10,18hr}$ noise levels for each property are summarised in Table 1 below.

Table 1: Summary of Derived $L_{A10,18hr}$ Noise Levels, SRIU Measurements, dB re 20 µPa

Property	**$L_{A10,18hr}$ (dB)**
34 Leopard Tree Crescent	not relevant
19 Melody Street	65
35 Melody Street	not relevant

3 Noise Criteria

Road traffic noise criteria for road transport noise from State-controlled roads in Queensland are contained in Volume 1 of the TMR Code of Practice for Transport Noise Management (the CoPv1).

Volume 1 of the Code of Practice contains traffic noise criteria which apply to noise from State-controlled roads only. Criteria are given for three receiver categories (residences, sensitive educational/community/health buildings, and outdoor passive recreational areas) for new roads, upgrades of existing roads, existing roads (no roadworks) and Exposure of Second Row of Buildings.

The applicable categories for SRIU upgrade works are:

- Upgrade of Existing Road
  [road segments upgraded as part of the SRIU upgrade project]
- Existing Road (No Roadworks)
  [all other State-controlled road segments, including the Centenary Motorway itself]

The noise criteria for these categories are numerically identical:

- A façade-corrected level of 68 dB $L_{A10,18hr}$[1] at residences
- A façade-corrected level of 65 dB $L_{A10,1hr}$ at community buildings

[1] between 6 am and 12 midnight

4 Traffic Noise Modelling

A traffic noise model of the SRIU project and the surrounding road network has been built using the SoundPLAN 7.4 noise modelling program, as detailed in this section.

The Calculation of Road Traffic Noise (CoRTN) 1988 noise model[2] has been implemented in SoundPLAN. CoRTN is TMR's preferred model for predicting road traffic noise and has been validated for QLD conditions, as discussed in more detail in Section 4.1.4.

4.1 Noise Model Inputs

The SoundPLAN noise model has been developed using inputs from several sources, including:

- Building outline shape files provided by TMR – buildings_region.shx
- Existing noise barrier shape files provided by TMR – barriers_polyline.shx
- The proposed road alignment (including concrete barriers), terrain data and traffic volumes provided by the Arup project design team – SRUI_DES_STRS_3D_Z56.dxf.

Given that the design of the interchange Project does not include any upgrade of the Centenary Motorway mainline, the alignment of the existing Centenary Motorway was obtained by overlaying road strings onto the surveyed terrain data.

Noise model input data such as noise barriers and buildings provided to Arup by others has been verified through a combination of inspection during the noise survey and through the use of Google Street view.

4.1.1 Road Segments

Road segments which have been modelled in the study area include:

- Sumners Road east and west lanes, including new separated bridge design
- Centenary Motorway north and south carriageways
- All on-ramps and off-ramps between the Centenary Motorway and Sumners Road
- Westcombe Street

All road segments have been modelled as single lane roads.

4.1.2 Buildings

Digitised buildings have been added to the SoundPLAN acoustic model by attaching to the terrain at mean terrain height for the building. Digitised building outlines were provided by TMR as DXF polylines. Building heights have been obtained from site surveys.

4.1.3 Traffic Volumes

The traffic volumes were obtained from Arup Technical Note 04 (TN0004) – *18 Hour Traffic Volumes for Noise Modelling* (refer to Appendix E in this report). Table 4 and Table 5 in TN0004 provide the 18-hour traffic flows and the proportion of heavy vehicles (%HV) for a 10-hour period,

2 Her Majesty's Stationery Office (1988) *Calculation of Road Traffic Noise*

respectively. As noted in TN0004, in absence of any other data to derive traffic profile specific to heavy vehicles, the percentage of heavy vehicles shown in Table 3 were assumed to apply to the 18-hour traffic volumes.

Link IDs for the project are shown in Figure 5. 1-hour traffic volumes were obtained using a conversion factor of 0.1 from the 18 hour volumes.

Table 2: 18-hour Traffic Volumes for the Sumners Road Interchange road network (Table 4 of TN0004)

Intersection	Link ID	Approach	2016 AADT	2017 10-Hour	2017 18-Hour	2021 18-Hour	2031 18-Hour
Eastern Terminal Intersection	1	Southbound Off-Ramp	-	5,503	8,088	9,192	12,656
	2	Southbound On-Ramp	-	7,123	10,469	10,894	12,033
	3	Monier Road EB	-	4,189	6,157	6,407	7,077
	4	Monier Road WB	-	3,924	5,767	5,942	6,403
	5	Westcombe Street NB	-	4,993	7,338	7,866	9,356
	6	Westcombe Street SB	-	5,481	8,055	9,424	13,949
	7	Sumners Road EB	-	10,698	15,723	18,393	27,227
Western Terminal Intersection	8	Northbound Off-Ramp	-	9,245	13,587	14,027	15,191
	9	Northbound On-Ramp	-	4,527	6,653	7,230	8,900
	10	Sumners Road WB	-	8,289	12,182	13,605	17,932
	11	Sumners Road (W) EB	-	9,741	14,316	14,780	16,006
	12	Sumners Road (W) WB	-	12,102	17,786	18,878	21,908
Centenary Mainline	13	Northbound	47,168	-	47,629	55,934	83,595
	14	Southbound	46,965	-	47,811	58,004	94,034

Figure 5: SRIU site plan showing Link IDs

Table 3: Heavy vehicle percentages (Table 5 of TN0004)

Intersection	Link ID's	Link	10 Hour %
Western Terminal Intersection	9	North	8%
	7,10	East	5%
	8	South	9%
	11,12	West	6%
Eastern Terminal Intersection	1,2	North	5%
	3,4	East	4%
	5,6	South	6%
	7,10	West	5%
Centenary Mainline	13	Northbound	9%*
	14	Southbound	7%*

*Heavy vehicle percentages for the Centenary Motorway mainline were obtained from existing traffic counts provided by TMR.

4.1.4 Pavement and Calibration Factors

As required by the DTM CoP Volume 1, pavement correction factors have been applied based on the road surface type:

- Dense-graded asphalt [DGA] +0 dB(A)
- Stone-mastic Asphalt [SMA] -1 dB(A)

In addition, the following site-specific calibration factors have been applied to correct the UK-derived CoRTN to QLD conditions:

- DGA sites -1.7 dB(A) [façade-corrected sites]
  -0.7 dB(A) [free-field sites]

4.1.5 Traffic Speed

Speed limits around the site are taken as the posted speed limit for each road, as obtained from site surveys. These speed limits are as follows:

- Sumners Road Main Section (Both directions): 60 km/h
- Centenary Motorway (Both directions): 100 km/h
- Centenary Motorway Southbound off-ramp: 60 km/h
- Centenary Motorway Southbound off-ramp: 70 km/h
- Centenary Motorway on-ramps (both directions): 80 km/h

4.2 Calibration of Model

The noise model has been calibrated by comparing the calculated noise levels from the CoRTN model in SoundPLAN against the measured traffic noise levels summarised in Section 2.1.2.

Table 4 summarises the existing 2018 measured noise levels and the calculated 2018 noise levels from the SoundPLAN model rounded to 1 decimal place in accordance with the CoP.

Table 4: Calculated vs Measured Noise Levels for Existing 2018 Conditions, dB re 20 µPa

Location	Measurement Conditions	Measured Noise Level ($L_{A10,18hr}$)	Calculated Noise Level ($L_{A10,18hr}$)	Difference (Calculated-Measured)
19 Melody Street	Façade	64.8 dB	65.3 dB	+0.5 dB
34 Leopard Tree Crescent	Façade	not relevant		
35 Melody Street	Façade	not relevant		

The overall average difference between measured and calculated data is +2.0 dB(A) for $L_{A10,18hr}$ which is within the required level of tolerance to be considered calibrated by the CoP.

5 Predicted Future Noise Levels

5.1 Future Road Network

The Sumners Road Interchange Upgrade project involves the replacement of the existing single overpass bridge by two separated bridges, as well of the modification of existing roundabouts to signalised intersections, and the construction of a new cycleway underpass under Sumners Road.

The upgraded road layout for the project is shown below in Figure 6, overlaid over aerial imagery of the existing site. Zoomed-in layouts for the western intersection and eastern intersection are shown in Figure 7 and Figure 8.

Figure 6: Upgraded Road Network - Overall Site Extent

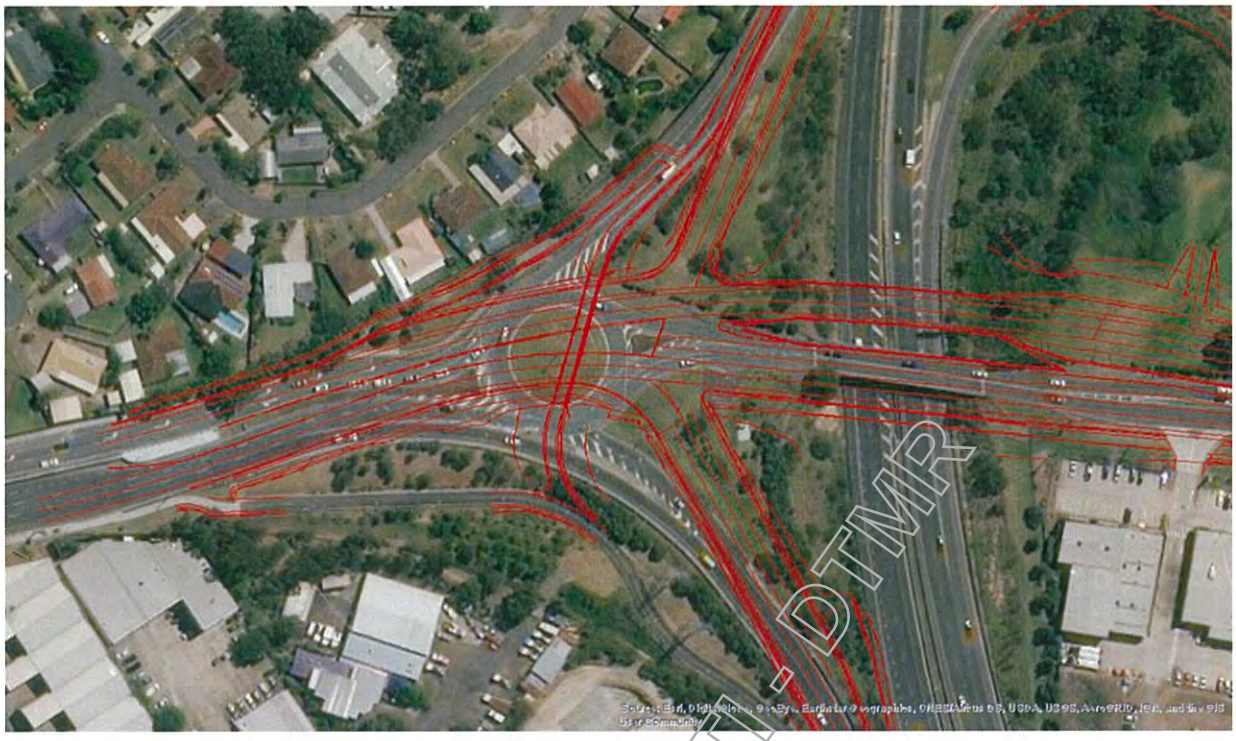


Figure 7: Upgraded Road Network - West Intersection and Cycleway Underpass

Figure 8: Upgraded Road Network - East Intersection

5.2 Project Study Area

The acoustic study area for the Sumners Road Interchange Upgrade has been defined to be the area likely to result in significant changes to noise levels as a result of the upgrade, which corresponds to

receivers within the extents of the upgraded road network as shown in Figure 1. The extents of the study area are further shown on each of the Noise contour maps provided in Appendix D.

The road traffic noise assessment has been conducted for two road scenarios:

- All roads – includes Sumners Road, Centenary Motorway, and all connecting on-ramps and off-ramps
- Sumners Road only – Only Sumners Road, on-ramps and off-ramps to the Centenary Motorway, excludes Centenary Motorway

For the purposes of this road traffic noise assessment, mitigation options have only been considered in locations where exceedances are predicted due to the Sumners Road Interchange Upgrade – i.e. for receivers where noise levels are predicted to exceed criteria due to changed road alignment including traffic growth associated with the design year.

It is understood that TMR is in process of planning a Centenary Motorway Upgrade Project which will involve widening of the Centenary Motorway. Noise mitigation for receivers which are experiencing exceedances due to the Centenary Motorway itself has been assumed to be provided as part of the future Centenary Motorway Upgrade Project.

Both the SRIU only and All roads scenarios have been considered to establish whether noise mitigation requirements at any given receiver would likely be triggered by both Projects, effectively leading to a need for greater noise mitigation than either Project would require in isolation.

This study identifies that there are no properties at which this would occur and hence noise mitigation has been developed on the basis of SRIU noise mitigation requirements only.

5.3 Opening Year Traffic Noise Levels (2021)

2021 traffic noise levels have been predicted using the developed SoundPLAN model with the detailed design road alignment for the upgraded Sumners Road Interchange, using traffic volumes provided in Section 4.1.3. The results of the 2021 opening year traffic predicted noise levels incorporating noise mitigation for the design provide a quantifiable assessment against which post construction noise monitoring could be undertaken if necessary upon opening of the Project upgrades.

A table of predicted noise levels at sensitive receivers is presented in Appendix C1. Noise contour plots of predicted 2021 noise levels are presented in Appendix D.

The upgraded Sumners Road Interchange design lies closely within the existing road corridor, meaning that most of the predicted changes in noise level are due to the increased traffic volumes.

A number of properties along Melody Drive, Solo Place, Dove Tree Crescent and Leopard Tree Crescent are predicted to exceed the $L_{A10,18hr}$ criteria for road traffic noise as defined by the CoPv1.

Some other properties are also predicted to exceed criteria, however these exceedances are attributable to the Centenary Motorway itself, rather than the upgraded interchange. As such, these receivers are deemed to be outside of the study area for the project.

5.4 Design Year – 10 Years After Opening Year Traffic Noise Levels (2031)

2031 traffic noise levels have been predicted using the developed SoundPLAN model with the detailed design road alignment for the upgraded Sumners Road Interchange, using traffic volumes provided in Section 4.1.3.

A table of predicted noise levels at sensitive receivers is presented in Appendix C2. Noise contour plots of predicted 2031 noise levels are presented in Appendix D.

As with the 2021 traffic year case, the upgraded Sumners Road Interchange design is mostly bounded by the existing road corridor. As a result, the majority of predicted exceedances in the 2031 traffic year are due to increased traffic flows through the road network.

Residences on the following streets within the project study area are predicted to exceed the road traffic noise criteria provided in the CoPv1 for the 'All Roads' case: Leopard Tree Crescent, Andaman Street, Arosa Street, Dove Tree Crescent, and Melody Place.

Details of specific properties predicted to be in exceedance of the CoPv1 criteria are provided in Section 5.5.

5.5 Noise Mitigation

The noise modelling has identified properties that exceed the criteria from the CoPv1 for existing/upgraded roads and will require provision of noise barriers as identified in the noise assessment Appendix or provision of Property Treatment should a noise barrier prove undesirable by TMR.

The preliminary need for noise mitigation has been confirmed, the location, height and length of potential noise barriers has been identified for two scenarios:

- Scenario 1 - Sumners Road Interchange Upgrade Only (The Project)
- Scenario 2 – All roads including Centenary Motorway

The assessment of the "Sumners Road Interchange Upgrade Only" scenario identifies the predicted 2031 traffic noise levels and mitigation requirements associated with this Project.

The inclusion of the Centenary Motorway in the "All Roads" scenario has been modelled as two lanes in each direction with traffic volumes predicted for 2031. This provided a reasonable indication of future noise levels and mitigation requirement that maybe expected including the Sumners Road Interchange Upgrade and the separate Centenary Motorway Upgrade Project.

This presents an opportunity for TMR to consider a cost effective solution to provide any new noise noise barriers in locations required for the Sumners Road Interchange Upgrade, but built to meet the likely future requirements of any potential Centenary Motorway Upgrade Projects in conjunction. This approach would avoid the need to upgrade the barriers constructed for this Project at a later stage to account for Centenary Motorway Upgrades.

It should be noted that it has not been possible to confirm that all facades of the identified noise sensitive properties are noise sensitive i.e. it may be that some facades only contain bathrooms, kitchens, and other non-sensitive uses, however, all properties have been confirmed as noise sensitive and the facades facing the Project noise sensitive spaces.

5.5.1 Scenario 1 – Sumners Road Intersection Upgrade Only

The residential properties (within the Project extent of works) that would require mitigation are:

- 15 Melody Street
- 17 Melody Street
- 19 Melody Street
- 6 Solo Place

The noise mitigation requirements for the above properties are provided in Table 5 below:

Table 5: Residential noise mitigation requirements

Property Address	Noise Barrier Description
15, 17, 19 Melody Street 6 Solo Place	From: X: 493930, Y: 6951654 to X: 493794, Y: 6951600 Total Length: 145m 2m in height

It should be noted that the proposed noise barrier ends at the boundary of 3 and 5 Solo Place rather than the boundary of 5 and 6 Solo Place. Whilst this may seem counterintuitive given that 5 Solo Place is not predicted to experience a noise impact, extension of the barrier along the property boundary of 5 Solo Place is required to achieve compliance with noise criteria at 6 Solo Place.

Further, the boundary between 3 and 5 Solo Place demarks the extent of the Project which necessarily defines the zone in which a noise barrier may be provided under the Project.

There are exceedances at two other residential properties; 3 Solo Place and 19 Intrepid Street.

However, as described above these properties are outside of the extent of works area and therefore noise mitigation has not been designed.

It should also be noted that two of the three community buildings are expected to experience exceedances of the 65 $L_{10(1h)}$ criteria; Westside Church of Christ and the day-care centre of 15/17 Intrepid Street. Both these receivers are outside of the extent of works area and therefore noise mitigation has not been designed.

5.5.2 Scenario 2 – All Roads

The residential properties that would require mitigation are for the all roads scenario (within the Project area) are:

- 15 Melody Street
- 17 Melody Street
- 19 Melody Street
- 6 Solo Place

The noise mitigation requirements for this scenario are shown in Table 6.

Table 6: Residential noise mitigation requirements, "All Roads" Scenario

Property Address	Noise Barrier Description
15, 17, 19 Melody Street 6 Solo Place	From: X: 493930, Y: 6951654 to X: 493794, Y: 6951600 Total Length: 145m 2m in height

It should be noted that the proposed noise barrier ends at the boundary of 3 and 5 Solo Place rather than the boundary of 5 and 6 Solo Place. Whilst this may seem counterintuitive given that 5 Solo Place is not predicted to experience a noise impact, extension of the barrier along the property boundary of 5 Solo Place is required to achieve compliance with noise criteria at 6 Solo Place.

Further, the boundary between 3 and 5 Solo Place demarks the extent of the Project which necessarily defines the zone in which a noise barrier may be provided under the Project.

There are also predicted exceedances at the following residential properties. However, because these are due to noise from the Centenary Motorway and not the Sumners Road Interchange Upgrade project, mitigation has not been considered for these properties and has been assumed to be provided as part of the Centenary Motorway Upgrade Project:

- 29. 31, 35, 38 and 41 Andaman Street
- 18 Arosa Street
- 19, 27, 29, 31, 43, 45, 47, 51 Dove Crescent
- 28 Ebrill Street
- 19, 21 Intrepid Street
- 30, 32, 34 36, 38, 40, 48, 50, 52 and 56 Leopard Tree Crescent
- 31, 35, 37 Melody Street
- 3 Solo Place

30, 32, 34 and 36 Leopard Street as well as 31, 35 and 37 Melody Street are within the extent of the Sumners Road Interchange Upgrade works. The predicted exceedances for these residences are attributable to the Centenary Motorway only and therefore noise mitigation has not been designed for these residences. All other residences are outside of the extent of Sumners Road Interchange Upgrade works and are therefore considered to be outside the study area for the SRIU project. Therefore, it is expected that noise mitigation for these properties would be provided as part of the future Centenary Motorway Upgrade Project.

It should also be noted that two of the three community buildings are expected to experience exceedances of the 65 $L_{10(1h)}$ criteria; Westside Church of Christ and the day-care centre of 15/17 Intrepid Street. Both these receivers are outside of the extent of works area and therefore noise mitigation has not been designed for these residences. These properties are located beyond the Project extents on Sumners Road and are therefore outside of the study area.

5.5.3 Recommended Noise Mitigation

The mitigation requirements for the eligible residential properties within the Sumners Road Interchange Upgrade Project extents are the same for both assessment years and consideration of future road traffic noise from the upgraded Centenary Motorway has no effect on mitigation requirements for compliance with the CoP Noise criteria at properties impacted by the SRIU Project.

Therefore, there is no opportunity to save on noise barrier costs cumulatively between the Sumners Road Interchange Upgrade Project and the Centenary Motorway upgrade Project by building noise barriers accounting for both Projects in the zones required for the Sumners Road Interchange Upgrade Project.

Consequentially it is recommended that the noise mitigation for the Sumners Road Interchange Upgrade Project as identified in Section 5.5.1 and confirmed below is installed under the Sumners Road Interchange Upgrade Project.

For the purposes of this assessment mitigation has been defined and modelled as the minimum necessary barrier height within the project extents.

Whilst technically this is not in accordance with the MRTS15 requirement to provide barrier height transitions and step downs at barrier ends, the TMR Project Manager has advised that new mitigation will be provided as a continuous 2m high noise barrier as described in Table 7 in place of existing property fences and in common with existing property fences, the new noise barrier will abut the existing 3.36m high noise barrier without height transition contrary to the MRTS15 definitions. This is considered reasonable as the proposed noise barrier is only marginally taller than the existing property fence connecting to the 3.36m high existing noise barrier and as such is comparable to the existing situation aesthetically.

Table 7: Sumners Road Interchange Upgrade noise mitigation requirements

Property Address	Noise Barrier Description
15, 17, 19 Melody Street 6 Solo Place	From: X: 493930, Y: 6951654 to X: 493794, Y: 6951600 Total Length: 145m 2m in height

It should also be noted that whilst there are predicted exceedances of noise criteria along Sumners Road beyond 5 Solo Place and that 5 Solo Place is not predicted to be impacted without noise mitigation, the proposed noise barrier ends at the boundary of 3 and 5 Solo Place rather than the boundary of 5 and 6 Solo Place.

Whilst this may seem counterintuitive given that 5 Solo Place is not predicted to experience a noise impact, extension of the barrier along the property boundary of 5 Solo Place is required to achieve compliance with noise criteria at 6 Solo Place.

Further, the boundary between 3 and 5 Solo Place demarks the extent of the Project which necessarily defines the zone in which a noise barrier may be provided under the Project.

It should be noted that the existing noise barrier extending along the northbound on ramp to the Centenary Motorway is generally in a reasonable state of repair with clear evidence of previous maintenance being undertaken in places to repair patches. There are isolated signs of weakness in the existing barrier along the on-ramp which will require monitoring for further degradation and potential future maintenance should significant deterioration occur.

6 Conclusions and Recommendations

Road traffic noise levels from the proposed Sumners Road Interchange Upgrade project have been assessed against the requirements of the TMR Code of Practice for Transport Noise Management.

Calibration of the existing 2018 noise model has been conducted against logger noise measurements and agreement has been found within the level of tolerance required by the CoPv1.

Significant increases in road traffic noise levels are predicted to occur between the current 2018 traffic year, and the 2031 10-year horizon traffic year. However, the majority of these increases in noise level are due to the predicted background increase in traffic volumes for the 2031 traffic year, and are largely not attributable to the changes to the layout of the interchange.

Noise levels for the 'Sumners Road Only' case has been assessed against the requirements of the CoPv1, and noise mitigation measures have been specified accordingly. Exceedances attributable to the SRIU project have been predicted to occur at some residences along Melody Street and Solo Place. A single noise barrier, specified in Table 7, has been designed to achieve compliance at these residences.

A number of non-compliances at other residences have been predicted for the 2031 traffic year.

These exceedances are predicted to either occur outside the defined study area along Sumners Road or result from traffic noise from the Centenary Motorway itself, rather than from the upgraded SRIU intersection in the vicinity of Leopard Crescent and Dove Tree Crescent.

As such, noise mitigation has not been considered for these properties as part of the SRIU project and it has been assumed that noise mitigation for these properties would be considered by Brisbane City Council for the properties along Sumners Road and as part of the planned Centenary Motorway Upgrade Project for properties on Leopard Crescent and Dove Tree Crescent.

Appendix A

Glossary of Acoustic Terminology

A1 Glossary of Acoustic Terminology

Ambient Noise Level

The ambient noise level is the overall noise level measured at a location from multiple noise sources. When assessing noise from a particular development, the ambient noise level is defined as the remaining noise level in the absence of the specific noise source being investigated. For example, if a fan located on a city building is being investigated, the ambient noise level is the noise level from all other sources without the fan running. This would include sources such as traffic, birds, people talking and other nearby fans on other buildings.

Background Noise Level

The background noise level is the noise level that is generally present at a location at all or most times. Although the background noise may change over the course of a day, over shorter time periods (e.g. 15 minutes) the background noise is almost-constant. Examples of background noise sources include steady traffic (e.g. motorways or arterial roads), constant mechanical or electrical plant and some natural noise sources such as wind, foliage, water and insects.

Assessment Background Level (ABL)

A single-number figure used to characterise the background noise levels from a single day of a noise survey. ABL is derived from the measured noise levels for the day, evening or night time period of a single day of background measurements. The ABL is calculated to be the tenth percentile of the background L_{A90} noise levels – i.e. the measured background noise is above the ABL 90% of the time.

Rating Background Level (RBL / min$L_{A90,1hour}$)

A single-number figure used to characterise the background noise levels from a complete noise survey. The RBL for a day, evening or night time period for the overall survey is calculated from the individual Assessment Background Levels (ABL) for each day of the measurement period, and is numerically equal to the median (middle value) of the ABL values for the days in the noise survey. This parameter is denoted RBL in NSW, and min$L_{A90,1hour}$ in QLD.

Decibel

The decibel scale is a logarithmic scale which is used to measure sound and vibration levels. Human hearing is not linear and involves hearing over a large range of sound pressure levels, which would be unwieldy if presented on a linear scale. Therefore a logarithmic scale, the decibel (dB) scale, is used to describe sound levels.

An increase of approximately 10 dB corresponds to a subjective doubling of the loudness of a noise. The minimum increase or decrease in noise level that can be noticed is typically 2 to 3 dB.

dB(A)

dB(A) denotes a single-number sound pressure level that includes a frequency weighting ("A-weighting") to reflect the subjective loudness of the sound level.

The frequency of a sound affects its perceived loudness. Human hearing is less sensitive at low and very high frequencies, and so the A-weighting is used to account for this effect. An A-weighted decibel level is written as dB(A).

Some typical dB(A) levels are shown below.

Sound Pressure Level dB(A)	Example
130	Human threshold of pain
120	Jet aircraft take-off at 100 m
110	Chain saw at 1 m
100	Inside nightclub
90	Heavy trucks at 5 m
80	Kerbside of busy street
70	Loud stereo in living room
60	Office or restaurant with people present
50	Domestic fan heater at 1m
40	Living room (without TV, stereo, etc)
30	Background noise in a theatre
20	Remote rural area on still night
10	Acoustic laboratory test chamber
0	Threshold of hearing

L_1

The L_1 statistical level is often used to represent the maximum level of a sound level that varies with time.

Mathematically, the L_1 level is the sound level exceeded for 1% of the measurement duration. As an example, 87 dB $L_{A1,15min}$ is a sound level of 87 dB(A) or higher for 1% of the 15 minute measurement period.

L_{10}

The L_{10} statistical level is often used as the "average maximum" level of a sound level that varies with time.

Mathematically, the L_{10} level is the sound level exceeded for 10% of the measurement duration. L_{10} is often used for road traffic noise assessment. As an example, 63 dB $L_{A10,18hr}$ is a sound level of 63 dB(A) or higher for 10% of the 18 hour measurement period between 6am and midnight.

L_{90}

The L_{90} statistical level is often used as the "average minimum" or "background" level of a sound level that varies with time.

Mathematically, L_{90} is the sound level exceeded for 90% of the measurement duration. As an example, 45 dB $L_{A90,15min}$ is a sound level of 45 dB(A) or higher for 90% of the 15 minute measurement period.

L_{eq}

The 'equivalent continuous sound level', L_{eq}, is used to describe the level of a time-varying sound or vibration measurement.

L_{eq} is often used as the "average" level for a measurement where the level is fluctuating over time. Mathematically, it is the energy-average level over a period of time (i.e. the constant sound level that contains the same sound energy as the measured level). When the dB(A) weighting is applied, the level is denoted dB L_{Aeq}. Often the measurement duration is quoted, thus $L_{Aeq,15\,min}$ represents the dB(A) weighted energy-average level of a 15 minute measurement.

L_{max}

The L_{max} statistical level can be used to describe the "absolute maximum" level of a sound or vibration level that varies with time.

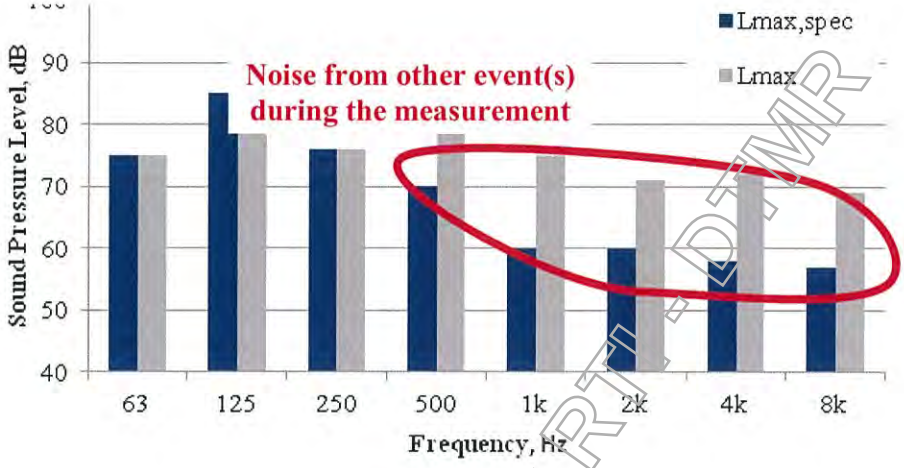
Mathematically, L_{max} is the highest value recorded during the measurement period. As an example, 94 dB L_{Amax} is a highest value of 94 dB(A) during the measurement period.

Since L_{max} is often caused by an instantaneous event, L_{max} levels often vary significantly between measurements.

$L_{max\ spec}$

$L_{max\ spec}$ is another representation of the highest noise or vibration levels during the measurement period.

$L_{max\ spec}$ is the spectrum of the event that caused the highest overall sound or vibration level during the measurement period is denoted by dB $L_{max\ spec}$. An example of the relationship between dB L_{max} and dB $L_{max\ spec}$ is shown below.



L_{max} (see definition above), when measured on an octave band or 1/3 octave band meter, is the spectrum obtained by recording the highest measured value in each band. However, the highest measured values in each band may occur at different times.

Hence, $L_{max\ spec}$ represents a real event, while L_{max} is often the mathematical addition of frequency band values from different times and often does not represent a real-world event.

Since $L_{max\ spec}$ is caused by an instantaneous event, $L_{max\ spec}$ levels often vary significantly between measurements.

Frequency

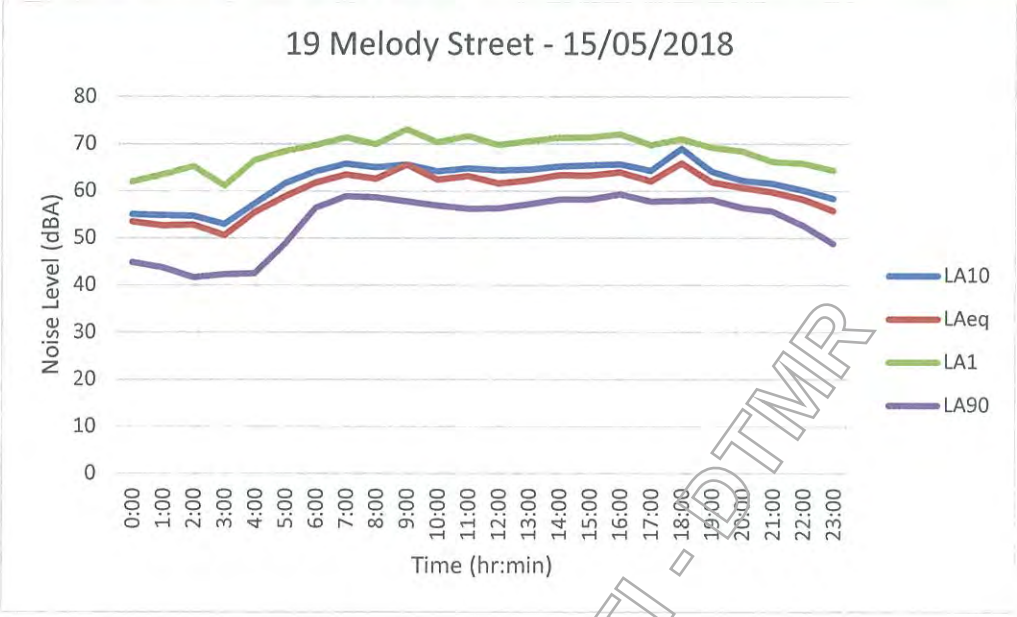
Frequency is the number of cycles per second of a sound or vibration wave. In musical terms, frequency is described as "pitch". Sounds towards the lower end of the human hearing frequency range are perceived as "bass" or "low-pitched" and sounds with a higher frequency are perceived as "treble" or "high pitched".

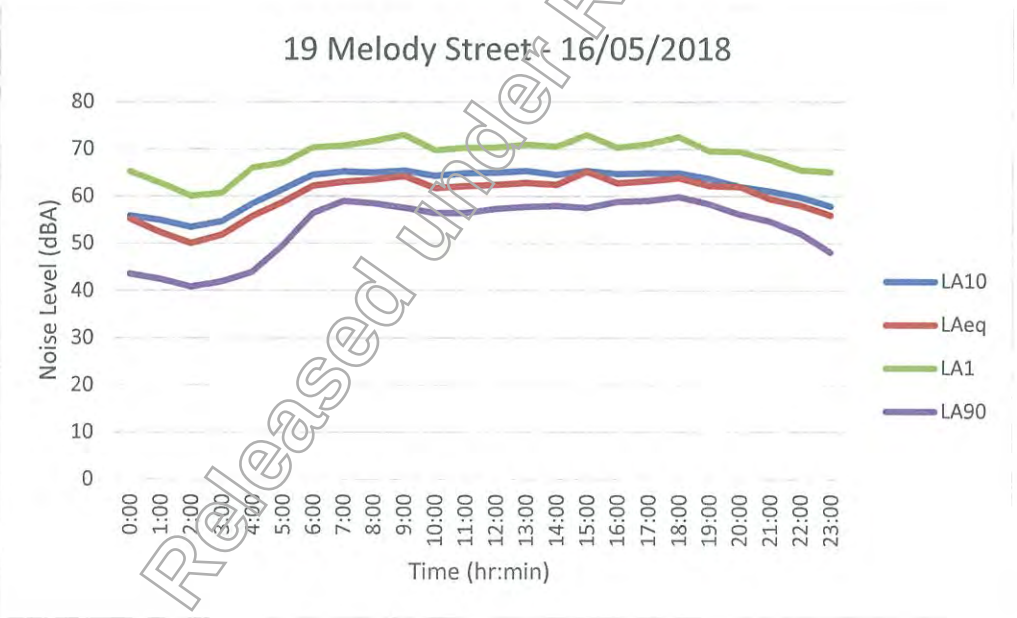
Appendix B

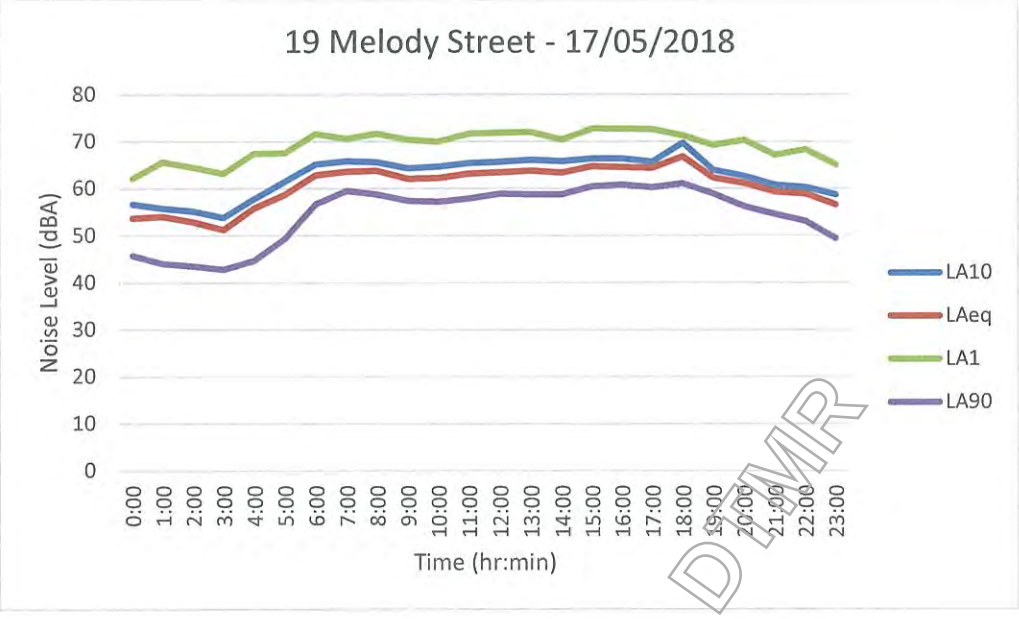
Noise Survey Data

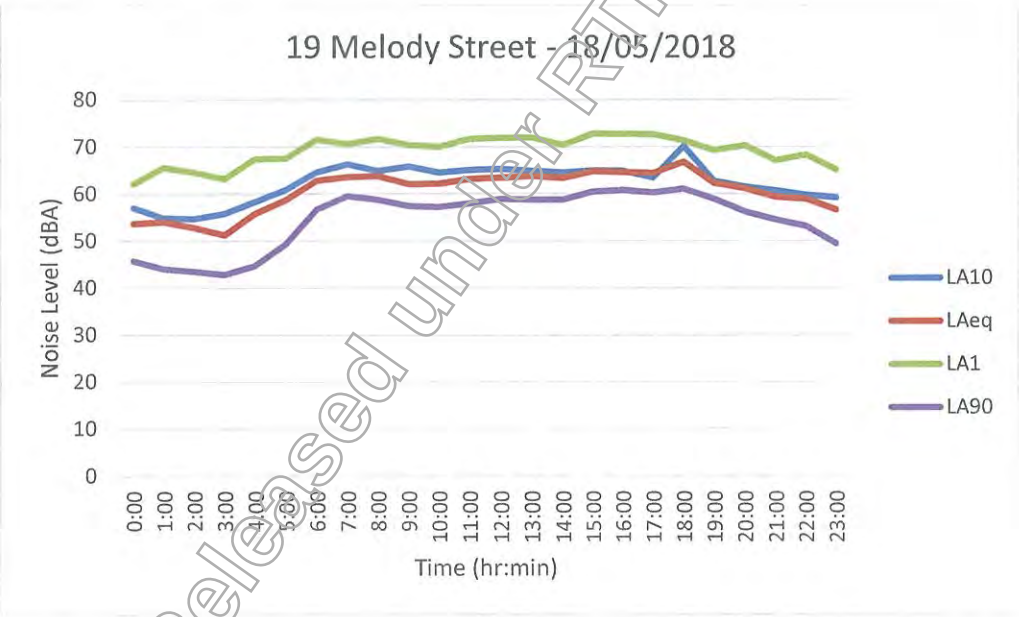
Pages 29 through 30 redacted for the following reasons:
- -
not relevant - detailed noise data of out of scope property

B2 Logger 2 – 19 Melody Street









Pages 33 through 34 redacted for the following reasons:
- -
not relevant - detailed noise data of out of scope property

Appendix C

Calculated Road Traffic Noise Levels

C1 Design Year Calculated Road Traffic Noise Levels (2021)

Floor	Address	Façade	Sumners Road Only		All Roads	
			Unmitigated	Mitigated	Unmitigated	Mitigated

not relevant - detailed noise data of out of scope properties

Pages 37 through 39 redacted for the following reasons:
- -
not relevant - detailed noise data of out of scope properties

1ST FLOOR	not relevant - detailed noise data of out of scope properties					
GROUND FLOOR						
GROUND FLOOR						
GROUND FLOOR						
GROUND FLOOR						
GROUND FLOOR	10 Melody Street	SW	49.6	49.3	53	52.9
GROUND FLOOR	11 Melody Street	SE	64	58.5	65.3	60.9
GROUND FLOOR	12 Melody Street	SE	52.5	51.9	57.6	57.4
GROUND FLOOR	14 Melody Street	S	55	54	58.2	57.6
GROUND FLOOR	15 Melody Street	S	68.4	61.6	69	63
GROUND FLOOR	17 Melody Street	SE	69.5	62.2	70.1	63.7
GROUND FLOOR	19 Melody Street	SE	70	62.8	70.7	64.4
GROUND FLOOR	not relevant - detailed noise data of out of scope properties					
GROUND FLOOR						
GROUND FLOOR						
GROUND FLOOR						
GROUND FLOOR						
1ST FLOOR						
GROUND FLOOR						
GROUND FLOOR						
GROUND FLOOR						
GROUND FLOOR						
1ST FLOOR						
GROUND FLOOR						
1ST FLOOR						
GROUND FLOOR						
1ST FLOOR						
GROUND FLOOR						

Page 41 redacted for the following reason:
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not relevant - detailed noise data of out of scope properties

C2 Design Year – 10 Years After Opening Year Calculated Road Traffic Noise Levels (2031)

Floor	Address	Façade	Sumners Road Only		All Roads	
			Unmitigated	Mitigated	Unmitigated	Mitigated

not relevant - detailed noise data of out of scope properties

Pages 43 through 45 redacted for the following reasons:
- -
not relevant - detailed noise data of out of scope properties

GROUND FLOOR	not relevant - detailed noise data of out of scope properties					
GROUND FLOOR						
GROUND FLOOR						
GROUND FLOOR	11 Melody Street	SE	64	58.5	65.9	61.8
GROUND FLOOR	12 Melody Street	SE	52.8	51.9	59	58.9
GROUND FLOOR	14 Melody Street	S	55.1	54	59.4	58.8
GROUND FLOOR	15 Melody Street	S	68.5	61.6	69.4	63.7
GROUND FLOOR	17 Melody Street	SE	69.7	62.2	70.6	64.4
GROUND FLOOR	19 Melody Street	SE	70.2	62.8	71.2	65.2
GROUND FLOOR	not relevant - detailed noise data of out of scope properties					
GROUND FLOOR						
GROUND FLOOR						
GROUND FLOOR						
GROUND FLOOR						
1ST FLOOR						
GROUND FLOOR						
GROUND FLOOR						
GROUND FLOOR						
GROUND FLOOR						
1ST FLOOR						
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1ST FLOOR						
GROUND FLOOR						
1ST FLOOR						
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GROUND FLOOR						
GROUND FLOOR						
GROUND FLOOR						

Page 47 redacted for the following reason:
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not relevant - detailed noise data of out of scope properties

Appendix D

Calculated Road Traffic Noise Contours

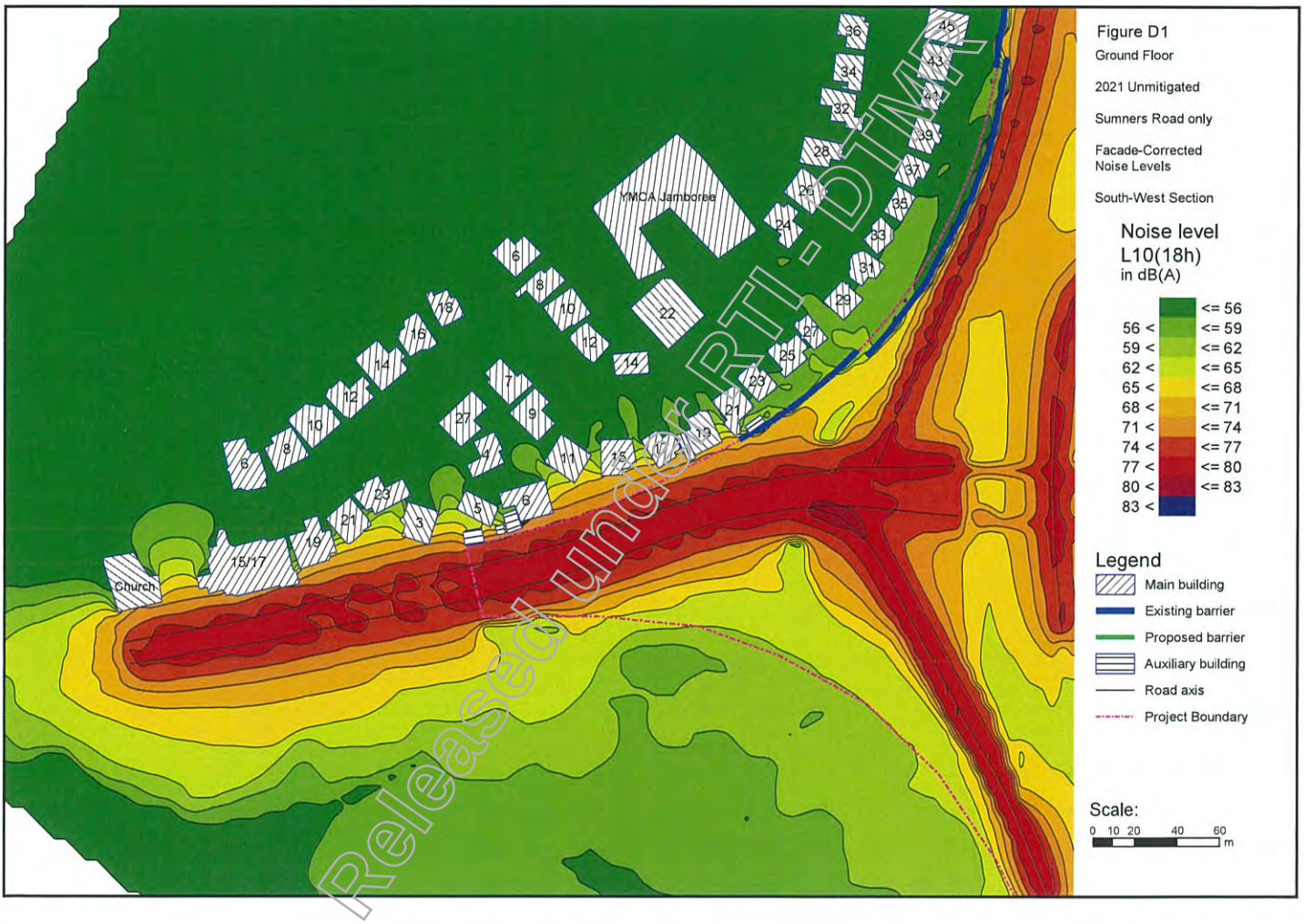
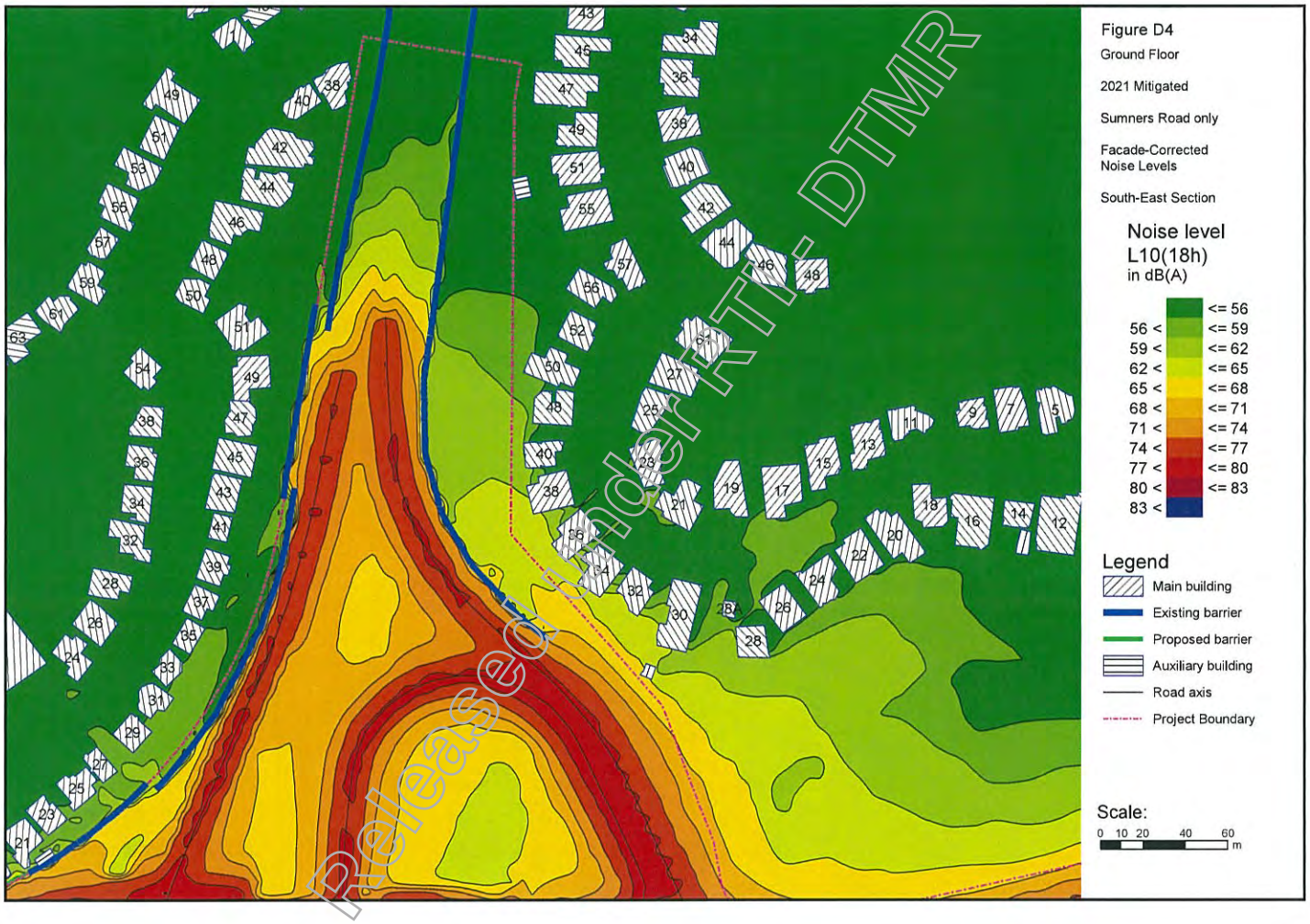
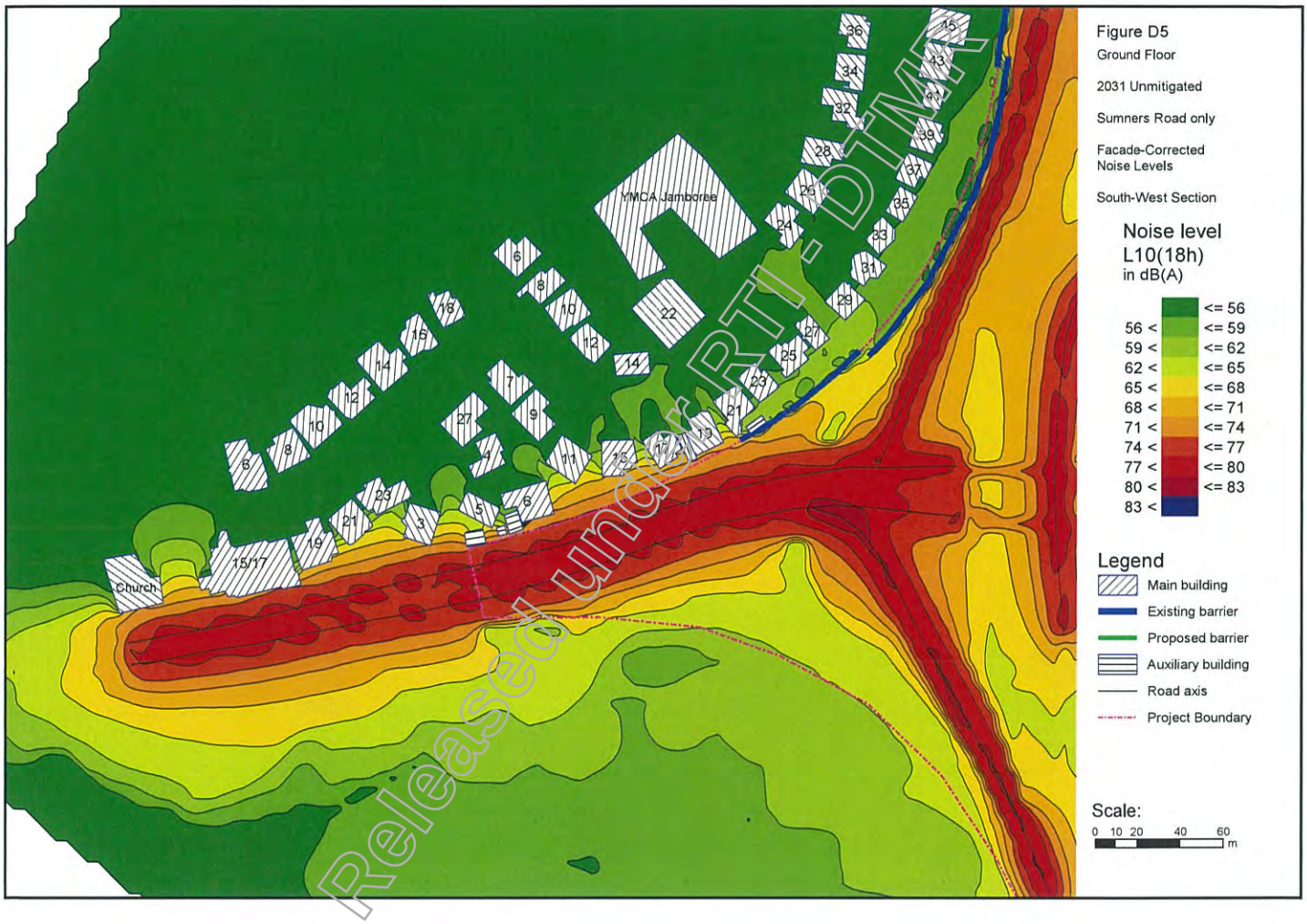
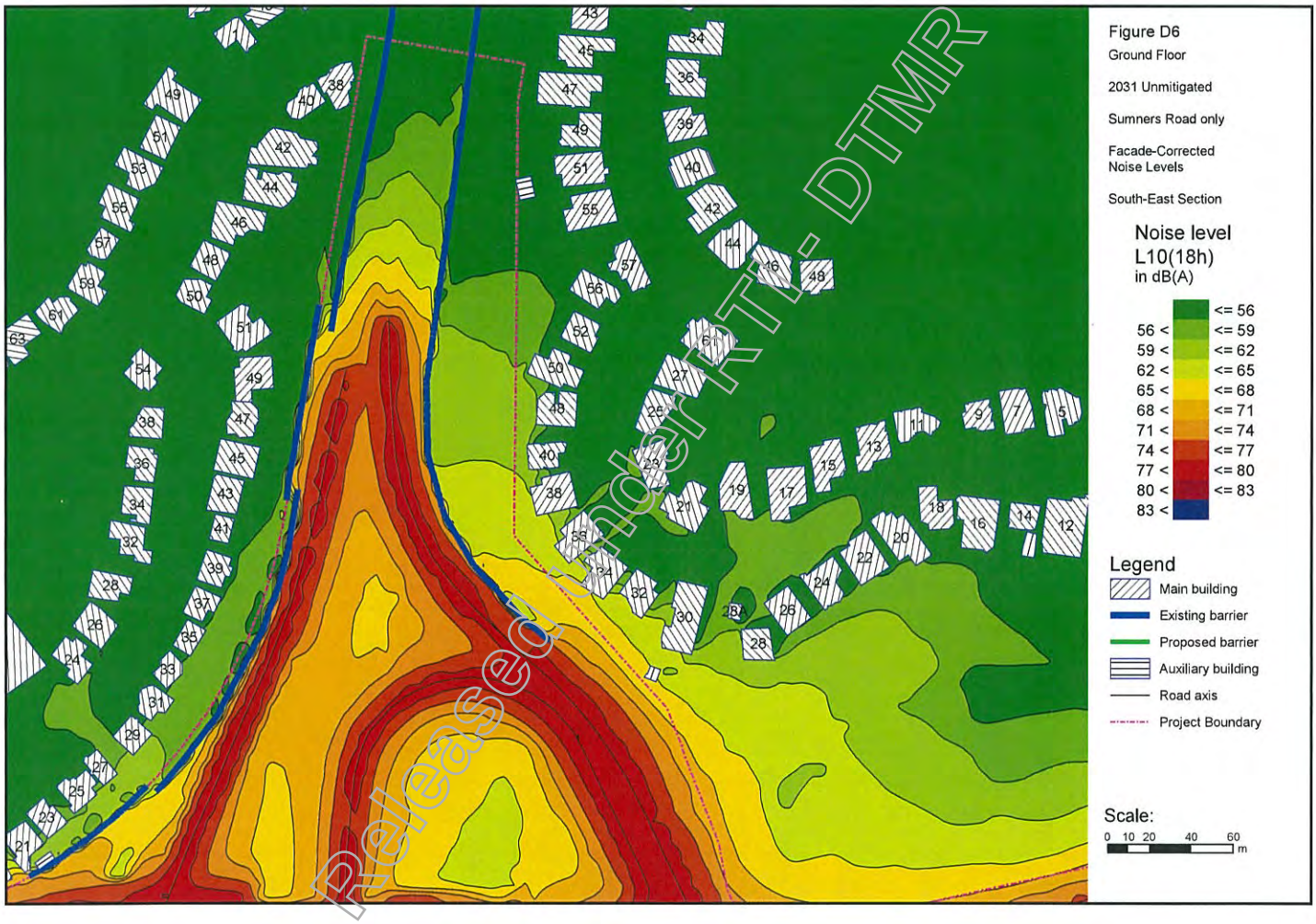
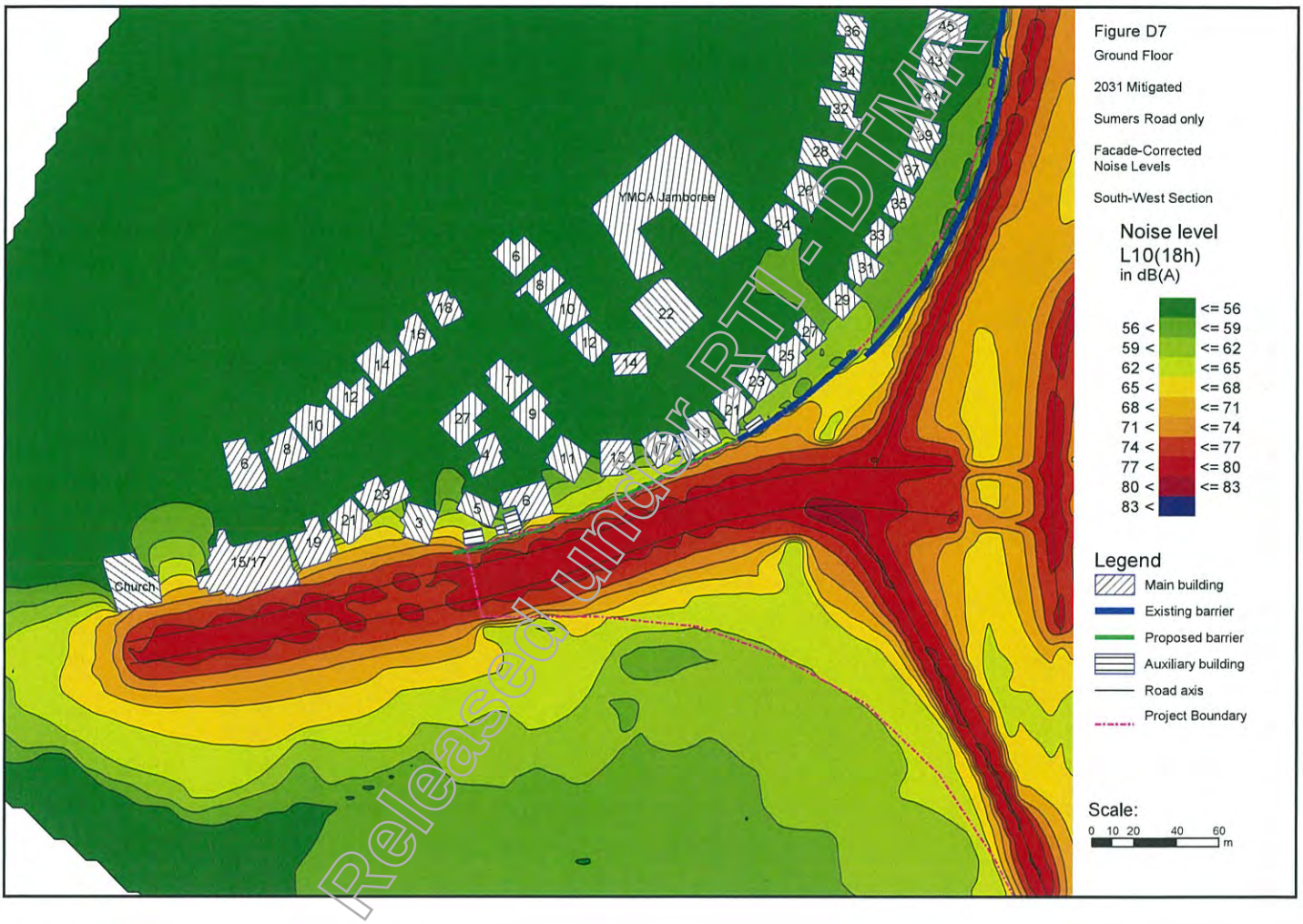


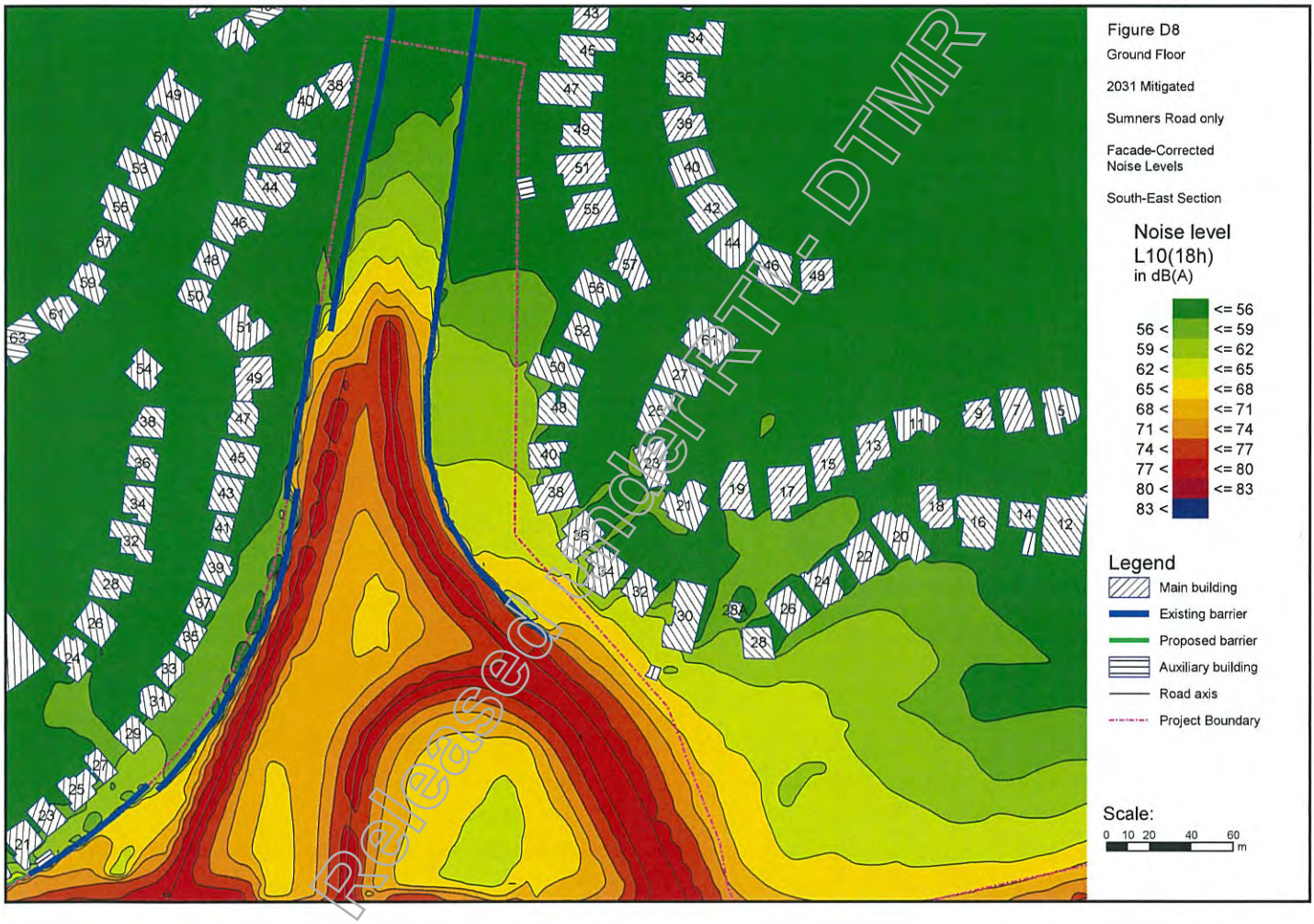

Figure D3
Ground Floor
2021 Mitigated
Sumers Road only
Facade-Corrected
Noise Levels
South-West Section
Noise level
L10(18h)
in dB(A)
<= 56
56 < <= 59
59 < <= 62
62 < <= 65
65 < <= 68
68 < <= 71
71 < <= 74
74 < <= 77
77 < <= 80
80 < <= 83
83 <
Legend
Main building
Existing barrier
Proposed barrier
Auxiliary building
Road axis
Project Boundary
Scale:
0 10 20 40 60
m
YMCA Jamboree
Church
Released under RTI - DTMR

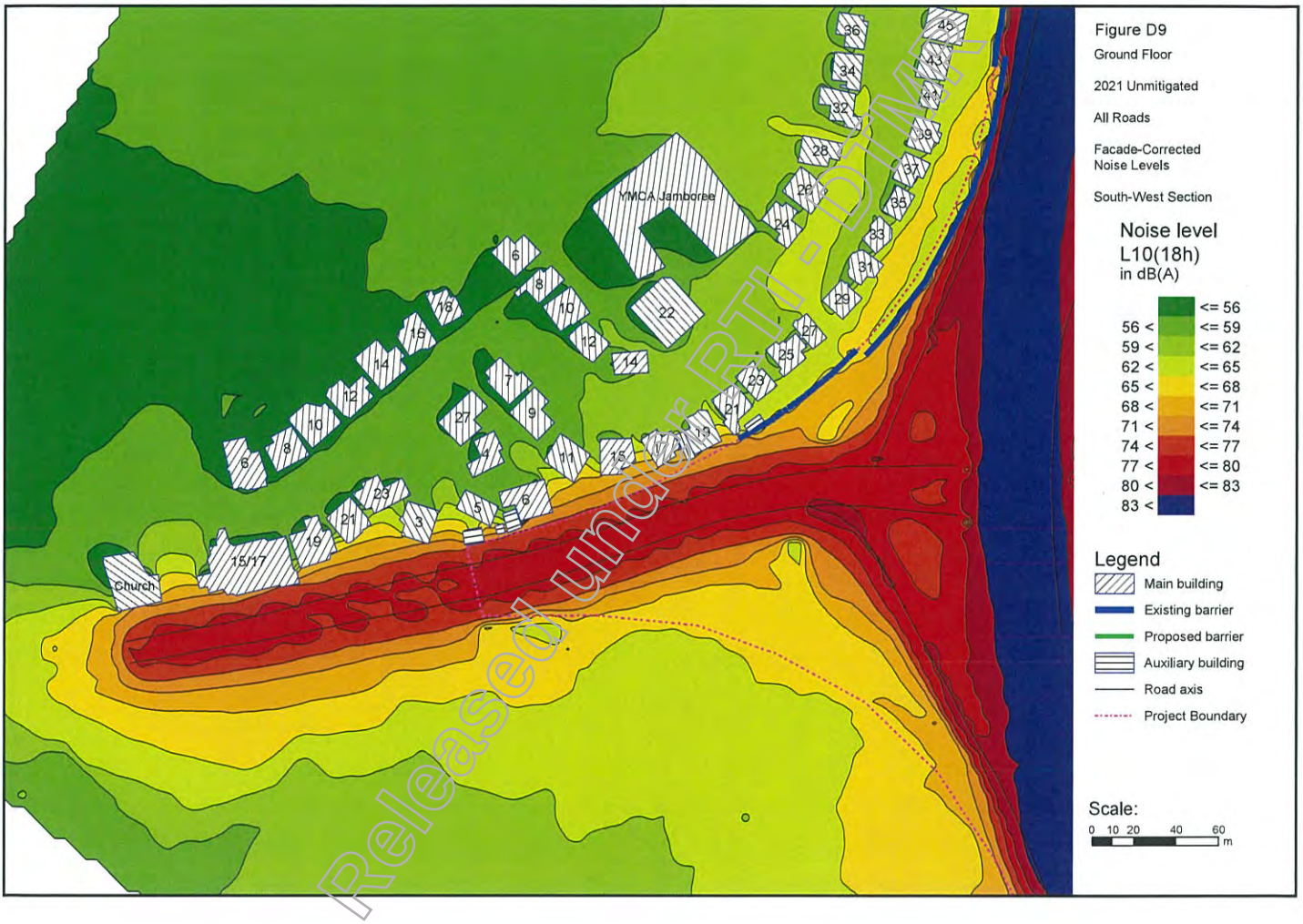


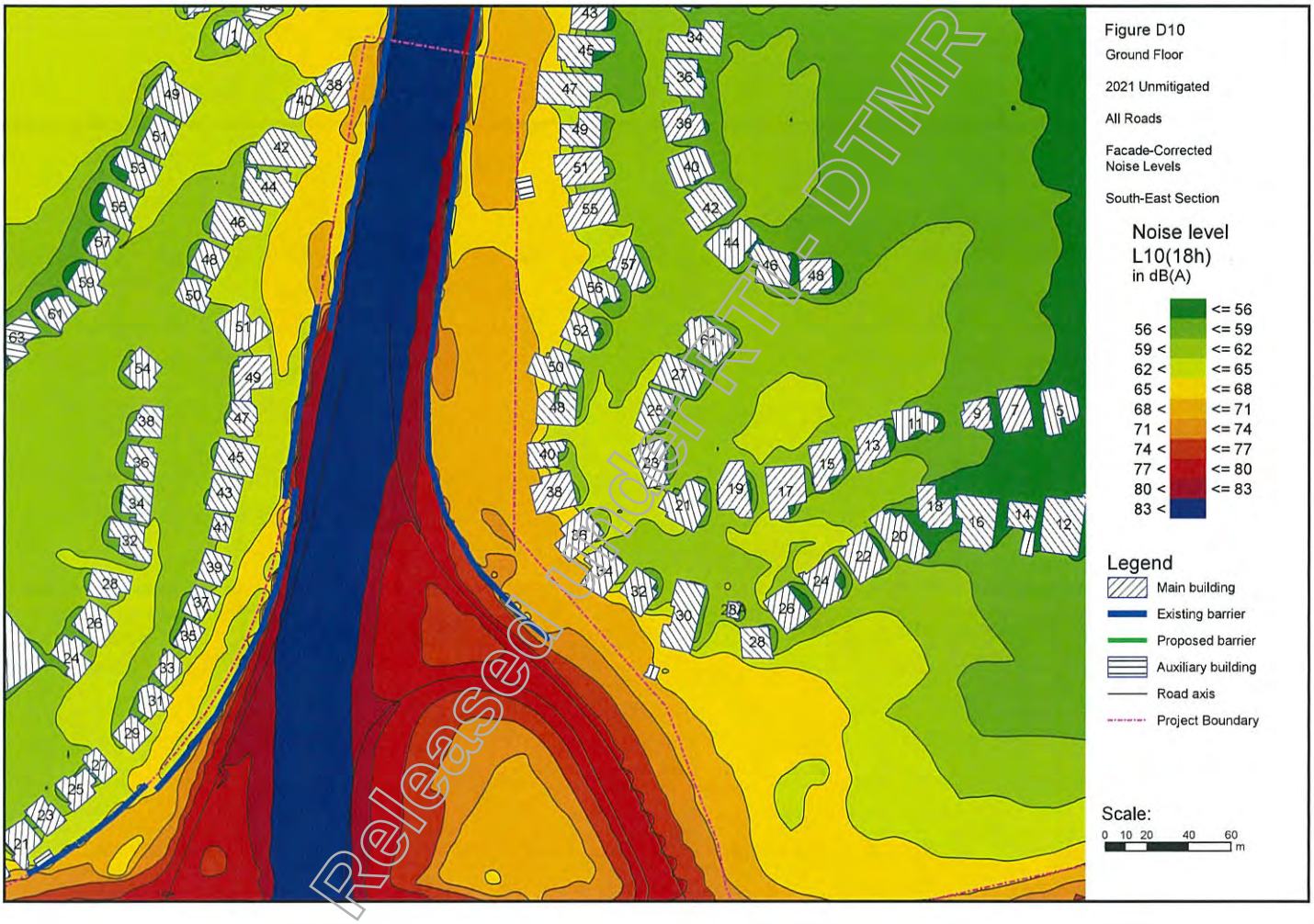


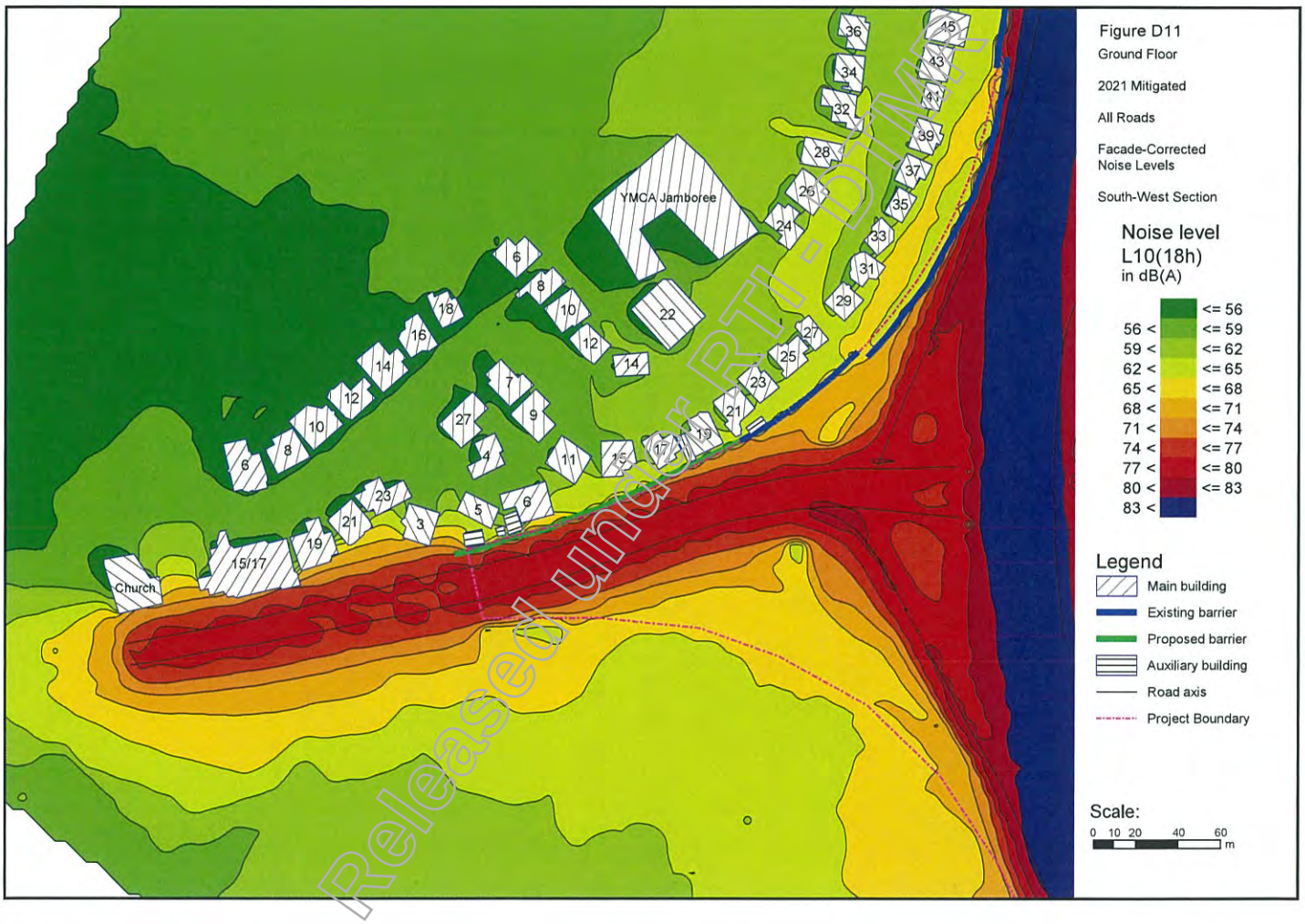


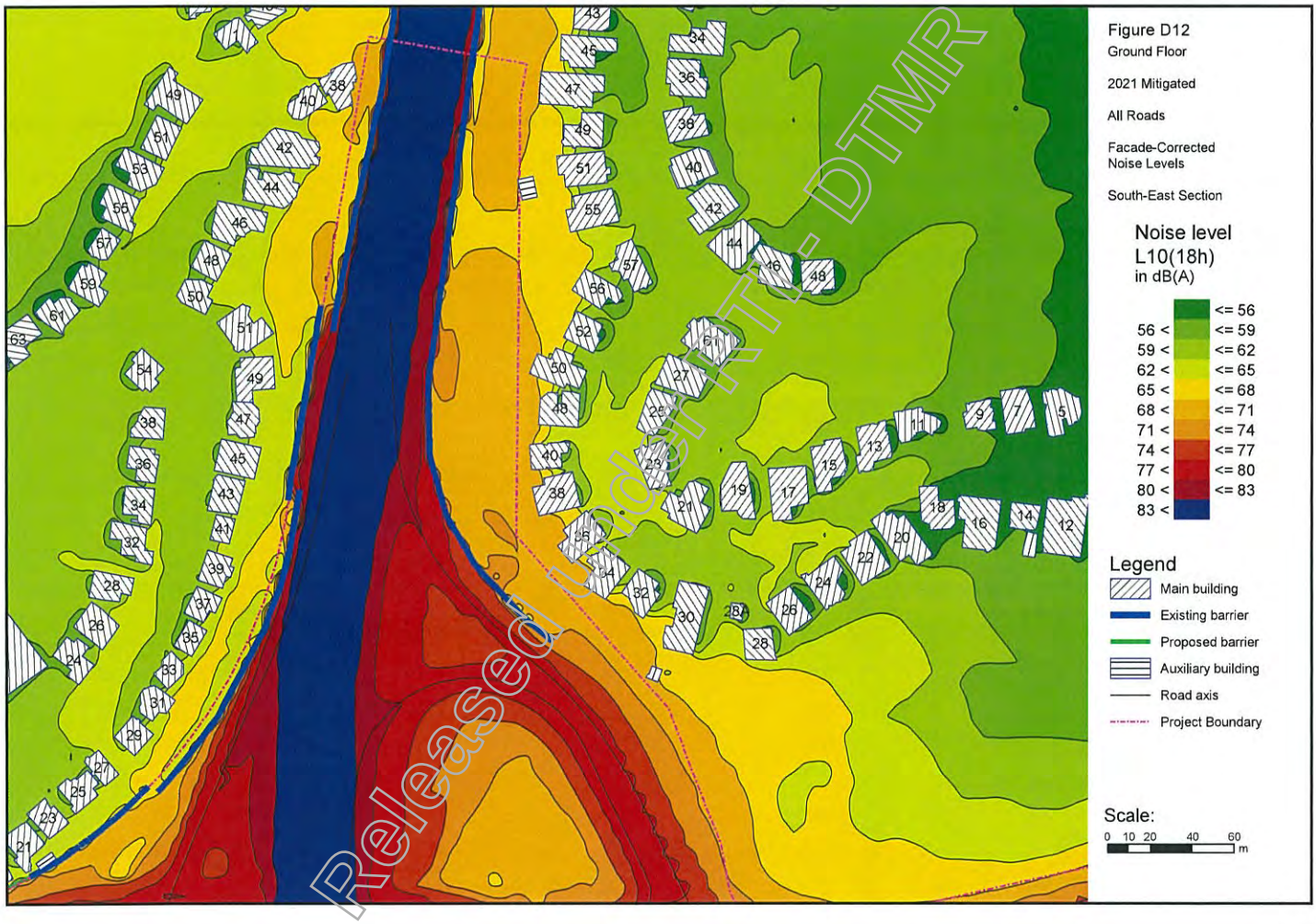


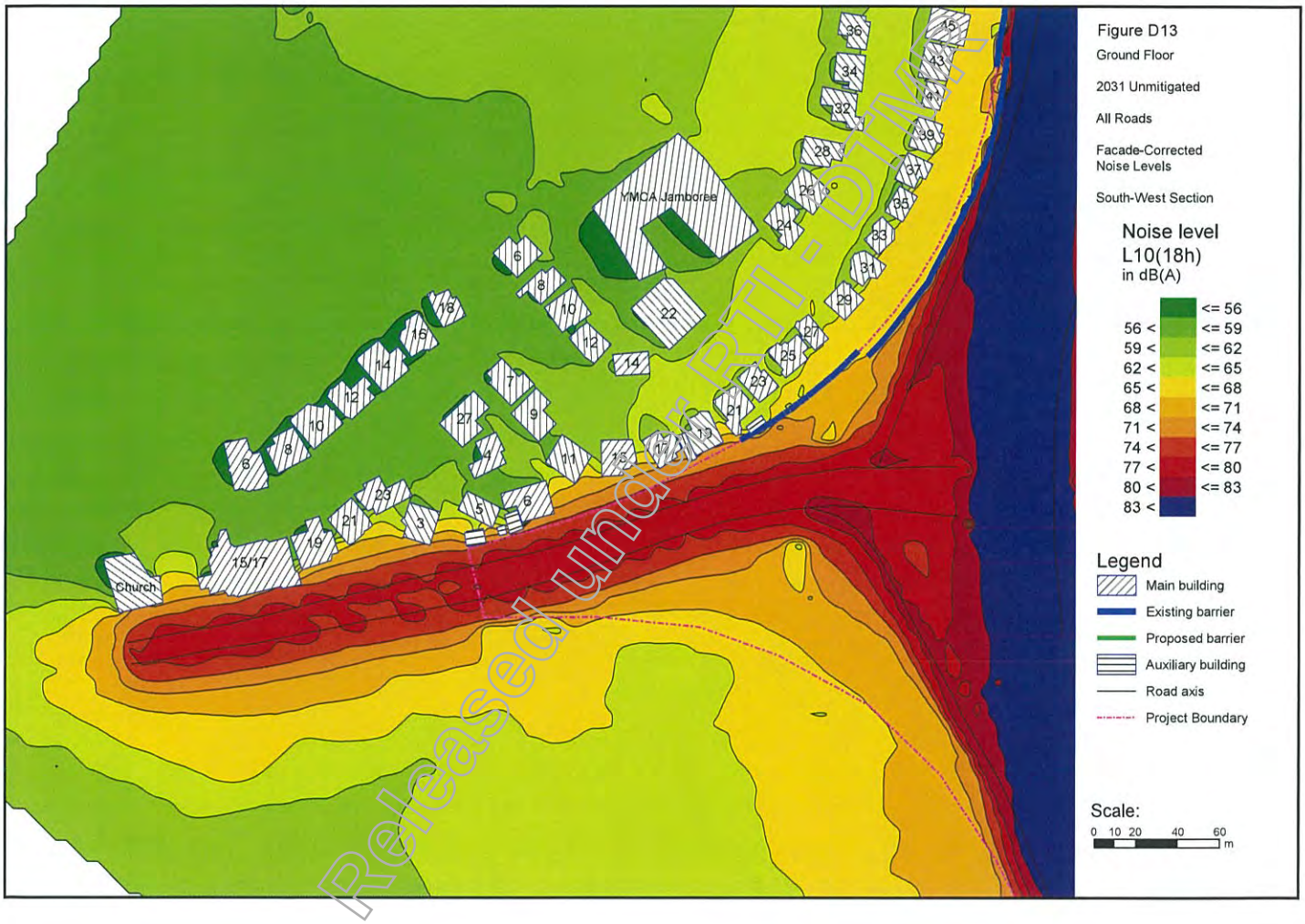












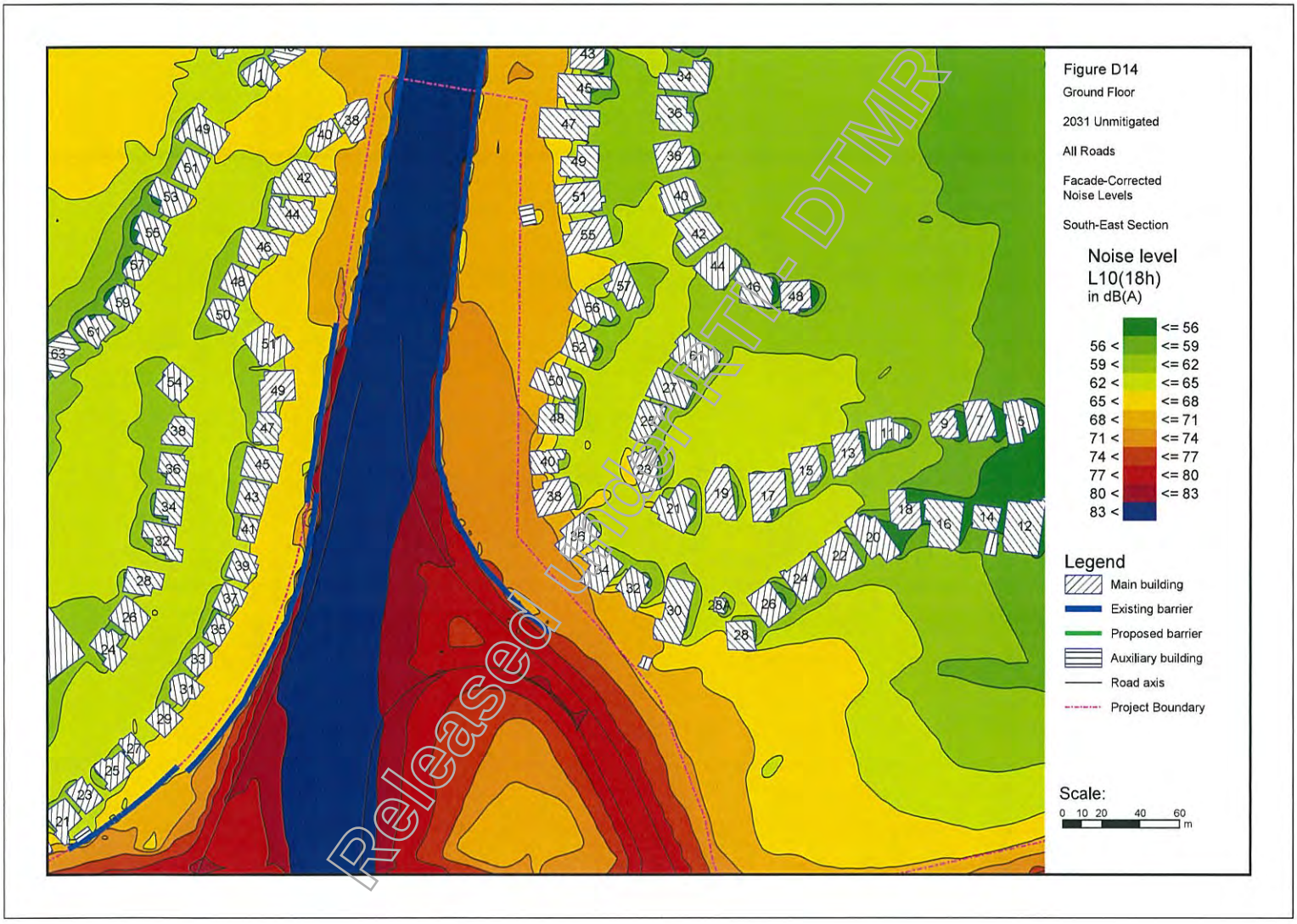
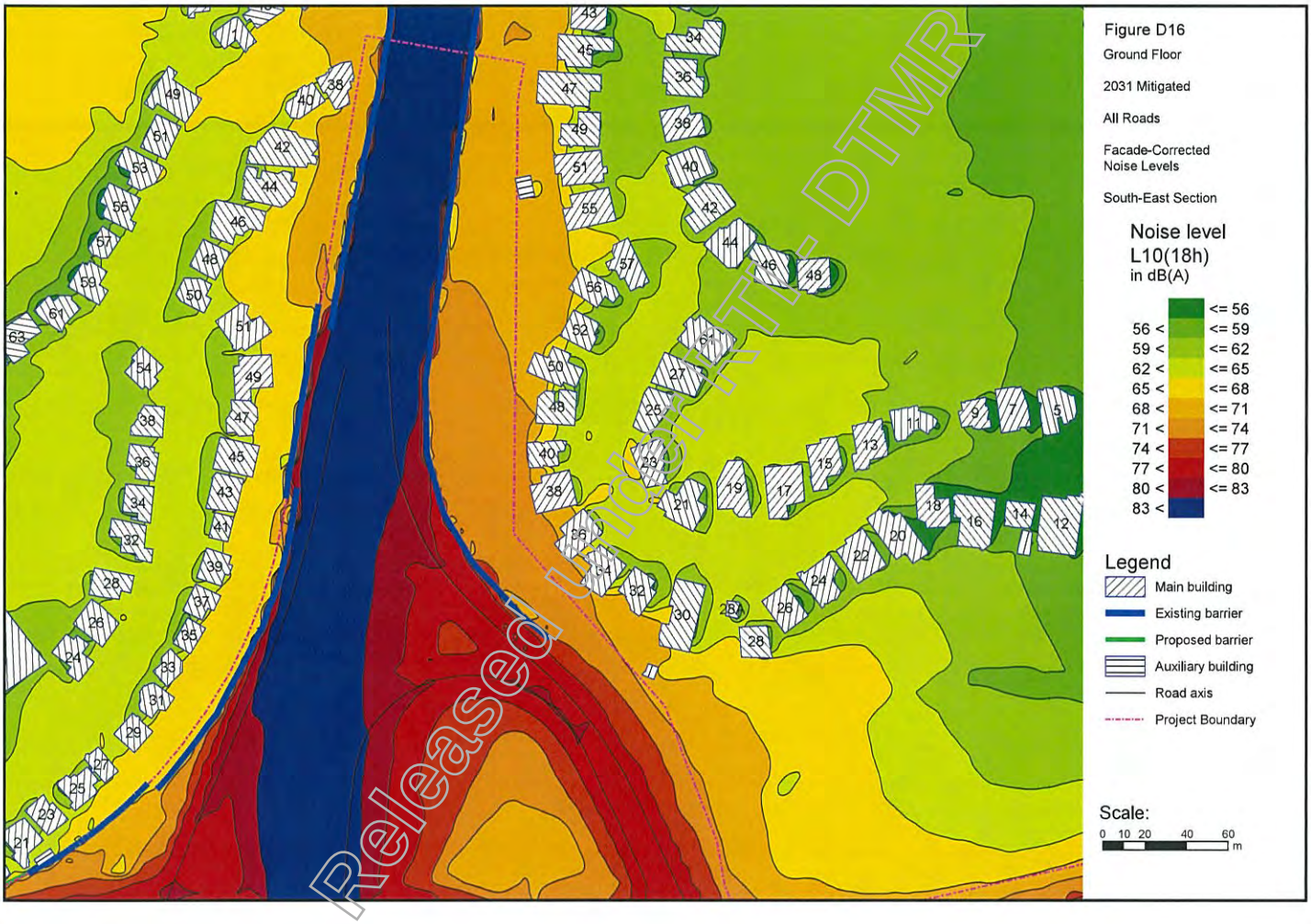



Figure D15
Ground Floor
2031 Mitigated
All Roads
Facade-Corrected
Noise Levels
South-West Section
Noise level
L10(18h)
in dB(A)
<= 56
56 < <= 59
59 < <= 62
62 < <= 65
65 < <= 68
68 < <= 71
71 < <= 74
74 < <= 77
77 < <= 80
80 < <= 83
Legend
Main building
Existing barrier
Proposed barrier
Auxiliary building
Road axis
Project Boundary
Scale:
0 10 20 40 60 m
YMCA Jamboree
Church
15/17
Released under RTI - DTMR



Appendix E

18 Hour Traffic Volumes for Noise Modelling

Technical Note

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Project title	Sumners Road Interchange Upgrade	Job number	260330-00
cc	Mark Lenske; Gavin Allan	File reference	260330-TN-0004
Prepared by	not relevant	Date	11 April 2018
Subject	18 Hour Traffic Volumes for Noise Modelling		

This Technical Note summarises the traffic data analysis undertaken to inform the noise model currently underway for the Sumners Road Interchange preliminary design. The primary focus of this analysis is to estimate 18-hour traffic volumes suitable for input into noise modelling.

The following sections of this note summarises the assumptions considered, along with traffic input data and the methodology used in the analysis.

Traffic Input Data

- Annual Volume Report (AVR) – An AVR has been provided summarising data collected from a counter located on the Centenary Motorway north of the Sumners Road interchange in 2016. Figure 1 shows the approximate location of this counter (Site 135990). This AVR includes a table with the Annual Average Daily Traffic (AADT) history, figures showing daily and weekly traffic patterns in addition to annual data for AADT figures with 1 year, 5 year and 10 year growth rates;

Figure 1: Data Collection Site Location

- 12-hour traffic count survey data – Intersection count data for 12-hour period (6am to 6pm) collected at eastern and western terminal intersections of the interchange in 2013; and
- 10-hour traffic count survey data - Intersection count data for 10-hour period (6am-10am and 3pm-7pm) collected at the interchange in 2017.

Daily Traffic Flow Profile

Based on data provided in the 2016 AVR, Figure 2 illustrates the 24-hour traffic profile on the Centenary Motorway mainline for a typical weekday.

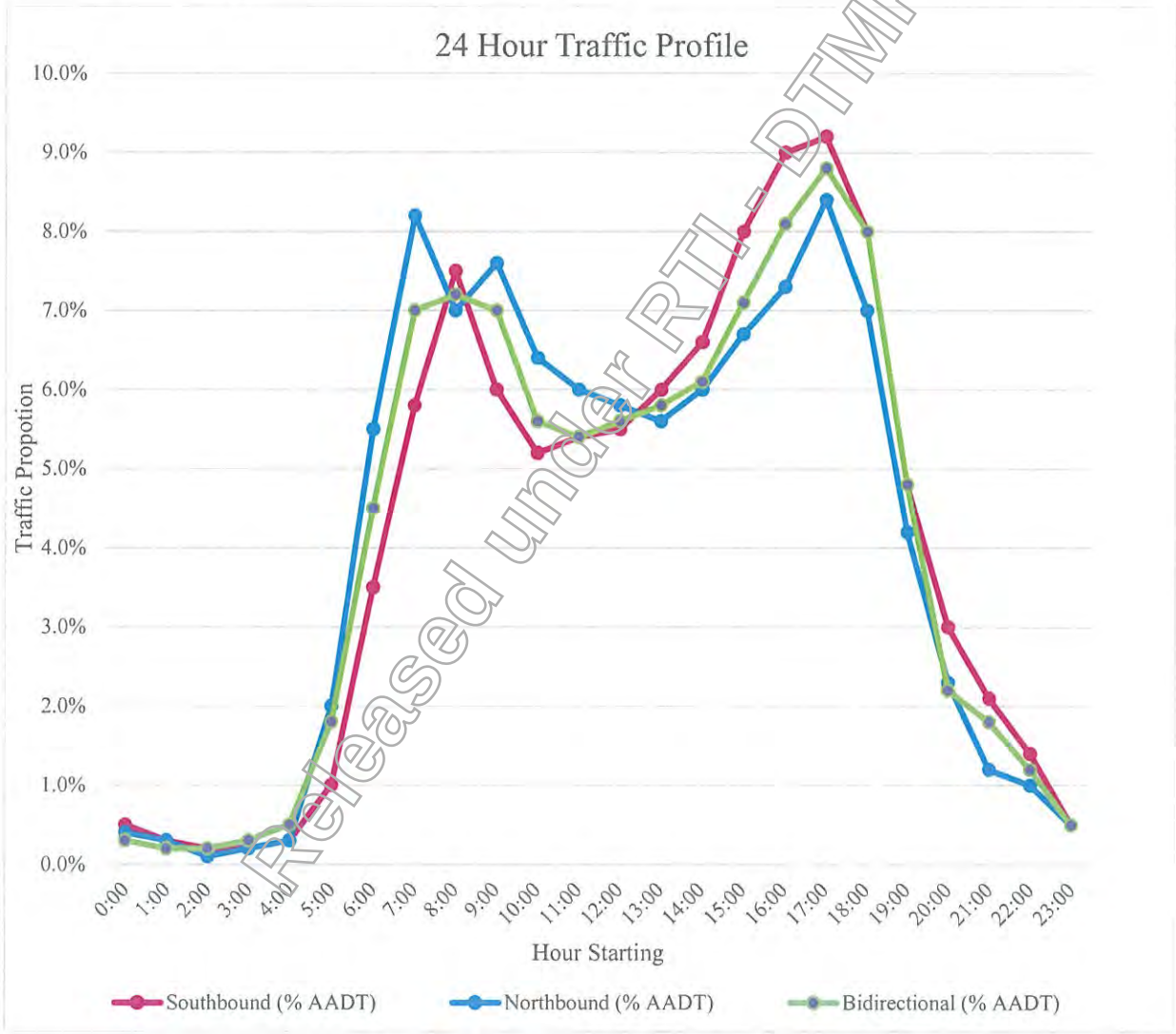

Figure 2: Daily Traffic Distributing on Centenary Motorway Mainline in Northbound and Southbound Directions

Assumptions

The following assumptions have been used to estimate 18-hour traffic volumes based on the 2017 10-hour traffic count:

- The daily traffic flow profile obtained from the AVR of the Centenary Motorway mainline was assumed to be consistent with the traffic distribution at Sumners Road interchange.
- Bidirectional hourly traffic flow profile (Green Line in Figure 2) has been used to derive factors to use in the traffic data extrapolation to derive 18-hour volumes for the distinct approaches of the Sumners Road interchange.
- For base case, the volume outputs from 10-hour traffic count surveys were factored using conversion factors calculated based on Centenary Motorway mainline traffic profile.
- Growth rates summarised in Technical Note 2 Rev B submitted to TMR on 04th Apr 2018 were incorporated forecasting 18-hour base volumes to 2021 and 2031 future scenarios.
- The proportion of heavy vehicles in the traffic flow for 10-hour period assumed to be same for the 18-hour traffic.

Methodology

In absence of 18-hour traffic count survey data, the 10-hour traffic count survey data has been factored to estimate 18-hour volumes using the following methodology:

1. The proportion of the daily (24 hour) traffic volumes that occur during the 10-hour, 12-hour and 18-hour assessment periods was determined from the AVR. For example, in this case 68% of the daily volumes occur during the 10-hour analysis period, 82% occurs during the 12-hour analysis period and 97% occurs during the 18-hour analysis period.
2. The ratio of the 18-hour traffic volumes against the 10-hour traffic volumes was calculated from the same data;
3. Using the factors determined in Step 2, the 10-hour survey data has been factored using proportions determined to estimate the anticipated 18-hour volumes at each approach of the Sumners Road Interchange;
4. The Base Case (2017) 18-hour traffic volumes were projected using compound traffic growth rates summarised in Table 1, to calculate 2021 and 2031 forecast volumes.

Growth Rates

Table 1 summarises the growth rates used to forecast Base Case 18-hour volumes to estimate 2021 and 2031 link volumes. Technical Note 002 – Rev B describes the methodology used to derive these annual compound growth rates specific to each AM and PM peak periods. These predefined rates were averaged out to calculate growth rates to use in 18-hour traffic volume projections.

Table 1: Growth Rates

Intersection	Link	Compound Annual Growth Rates		Average
		Survey Data		
		AM Peak	PM Peak	
Western terminal Intersection	North (Departure)	1.10%	3.10%	2.10%
	East (Approach)	3.00%	2.60%	2.80%
	South (Approach)	1.10%	0.50%	0.80%
	West (Approach)	0.50%	1.10%	0.80%
	West (Departure)	2.20%	0.80%	1.50%
Eastern Terminal Intersection	North (Approach)	3.70%	2.80%	3.25%
	North (Departure)	1.00%	1.00%	1.00%
	East (Approach)	1.00%	0.50%	0.75%
	East (Departure)	1.00%	1.00%	1.00%
	South (Approach)	2.00%	1.50%	1.75%
	South (Departure)	2.10%	5.90%	4.00%
	West (Approach)	0.50%	0.50%	0.50%
Centenary Mainline	Northbound	-	-	4.10%*
	Southbound	-	-	4.95%*

*Growth rates provided for last year in the AVR.

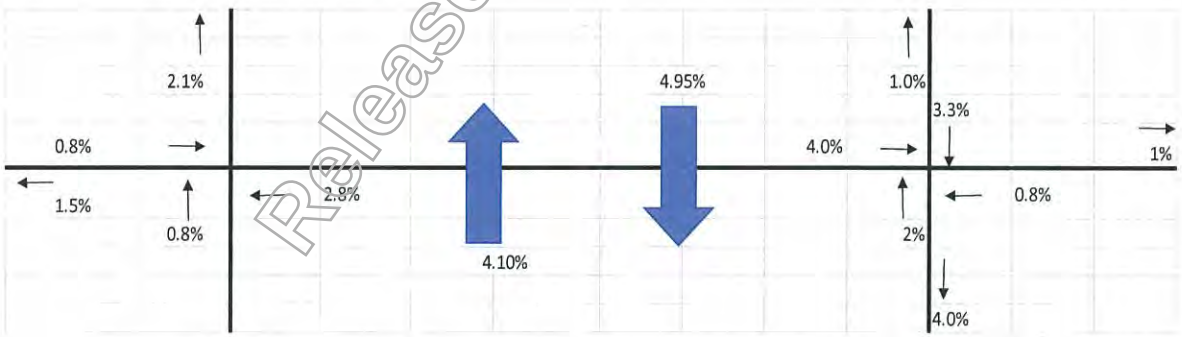

Figure 3: Growth Rates used to Estimate 2021 and 2031 Traffic Volumes

Analysis Summary

Using the 24-hour traffic profile illustrated above, Table 1 summarises the hourly traffic distributions estimated for the Centenary Motorway mainline.

Table 2: Hourly Traffic Distribution

Hour Starting	Southbound (% AADT)	Northbound (% AADT)	Bidirectional (% AADT)
0:00	0.5%	0.4%	0.3%
1:00	0.3%	0.3%	0.2%
2:00	0.2%	0.1%	0.2%
3:00	0.2%	0.2%	0.3%
4:00	0.3%	0.3%	0.5%
5:00	1.0%	2.0%	1.8%
6:00	3.5%	5.5%	4.5%
7:00	5.8%	8.2%	7.0%
8:00	7.5%	7.0%	7.2%
9:00	6.0%	7.6%	7.0%
10:00	5.2%	6.4%	5.6%
11:00	5.4%	6.0%	5.4%
12:00	5.5%	5.8%	5.6%
13:00	6.0%	5.6%	5.8%
14:00	6.6%	6.0%	6.1%
15:00	8.0%	6.7%	7.1%
16:00	9.0%	7.3%	8.1%
17:00	9.2%	8.4%	8.8%
18:00	8.0%	7.0%	8.0%
19:00	4.8%	4.2%	4.8%
20:00	3.0%	2.3%	2.2%
21:00	2.1%	1.2%	1.8%
22:00	1.4%	1.0%	1.2%
23:00	0.5%	0.5%	0.5%
24 Hour Total	**100.0%**	**100.0%**	**100.0%**
18 Hour Total	**98%**	**97%**	**97%**
12 Hour Total	**82%**	**82%**	**82%**
10 Hour Total	**67%**	**68%**	**68%**

The analysis has shown approximately 97% of the daily traffic flow belongs to 18-hour period (6am to 12am). 82% of the daily traffic has been included in 6AM to 6PM time period, while maximum of 68% distributed over 10-hour period.

This 68% factor has been used to convert 10-hour survey volumes to AADT. Converted AADT volumes have then been factored by 97% to estimate traffic volumes for 18-hour period starting from 6AM.

Table 4 summarises the estimated AADT volumes for 2017 Base Case and 2021 and 2031 forecast scenarios. This table should be read in conjunction with Link ID illustration included in the Appendix A of this note for better clarity.

Table 3: AADT Traffic Volume Summary

Intersection	Link ID	Approach	2016 AADT	2017 10-Hour	2017 AADT	2021 AADT	2031 AADT
Eastern Terminal Intersection	1	Southbound Off-Ramp	-	5,503	8,093	9,197	12,663
	2	Southbound On-Ramp	-	7,123	10,475	10,900	12,041
	3	Monier Road EB	-	4,189	6,160	6,410	7,081
	4	Monier Road WB	-	3,924	5,771	5,946	6,407
	5	Westcombe Street NB	-	4,993	7,343	7,870	9,361
	6	Westcombe Street SB	-	5,481	8,060	9,429	13,958
	7	Sumners Road EB	-	10,698	15,732	18,405	27,243
Western Terminal Intersection	8	Northbound Off-Ramp	-	9,245	13,596	14,036	15,200
	9	Northbound On-Ramp	-	4,527	6,657	7,234	8,906
	10	Sumners Road WB	-	10,365	15,243	17,023	22,437
	11	Sumners Road (W) EB	-	11,058	16,262	16,788	18,181
	12	Sumners Road (W) WB	-	10,026	14,744	15,649	18,161
Centenary Mainline	13	Northbound	47,168	-	49,102	57,664	86,180
	14	Southbound	46,965	-	49,290	59,798	96,942

Using estimated 2017 AADT, Table 4 summarises the calculated 18-hour traffic volumes for the Base Case and forecast scenarios. Refer to Appendix A of this note for a Link ID illustration.

Table 4: 18-Hour Traffic Volume Summary

Intersection	Link ID	Approach	2017 AADT	2017 18-Hour	2021 18-Hour	2031 18-Hour
Eastern Terminal Intersection	1	Southbound Off-Ramp	8,093	7,850	8,921	12,284
	2	Southbound On-Ramp	10,475	10,161	10,573	11,680
	3	Monier Road EB	6,160	5,975	6,218	6,869
	4	Monier Road WB	5,771	5,597	5,767	6,215
	5	Westcombe Street NB	7,343	7,122	7,634	9,080
	6	Westcombe Street SB	8,060	7,818	9,147	13,539
	7	Sumners Road EB	15,732	15,260	17,852	26,426
Western Terminal Intersection	8	Northbound Off-Ramp	13,596	13,188	13,615	14,744
	9	Northbound On-Ramp	6,657	6,458	7,017	8,638
	10	Sumners Road WB	15,243	14,785	16,512	21,764
	11	Sumners Road (W) EB	16,262	15,774	16,285	17,635
	12	Sumners Road (W) WB	14,744	14,302	15,179	17,616
Centenary Mainline	13	Northbound	49,102	47,629	55,934	83,595
	14	Southbound	49,290	47,811	58,004	94,034

Table 5 summarises the proportion of heavy vehicles recorded during 10-hour traffic count surveys undertaken in 2017. Refer to Appendix A of this note for a Link ID illustration.

Table 5: Heavy Vehicle Proportions Recorded over 10-Hour Traffic Count Survey

Intersection	Link ID's	Link	10 Hour %
Western Terminal Intersection	9	North	8%
	7,10	East	5%
	8	South	9%
	11,12	West	6%
Eastern Terminal Intersection	1,2	North	5%
	3,4	East	4%
	5,6	South	6%
	7,10	West	5%
Centenary Mainline	13	Northbound	-
	14	Southbound	-

In absence of any other data to derive traffic profile specific to heavy vehicles, the proportions shown in the Table 5 to be used in 18-hour noise model.

DOCUMENT CHECKING

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Appendix A: Link ID Illustration