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# Technical Paper 3

## Noise and Vibration

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Parramatta Light Rail Stage 2  
Environmental Impact Statement



**GHD Pty Ltd | ABN 39 008 488 373| ABN 39 008 488 373| ABN 39 008 488 373| ABN 39 008 488 373**

133 Castlereagh Street, Level 15






Sydney, New South Wales 2000, Australia

**T** +61 2 9239 7100 | **F** +61 2 9239 7199 | **E**

sydmail@ghd.comsydmail@ghd.comsydmail@ghd.comsydmail@ghd.com

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<b>Author</b>	Marco Velasco, Rosy Browell, Pri Pandey
<b>Project manager</b>	Aryel Pylotis
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# Glossary and abbreviations

The table below outlines a list of the abbreviations and terms contained within this report. The key noise metrics used throughout the report are summarised at the start of each relevant section and acoustical terms are also detailed in Appendix A.

Term / abbreviation	Description
AVTG	<i>Assessing Vibration: A Technical Guideline</i> (DEC, 2006)
CBD	Central Business District
CNVIS	Construction Noise and Vibration Impact Statement
CNVS	<i>Construction Noise and Vibration Strategy</i> (Transport for NSW, 2019a)
Definition design	High level description of the project, including general alignment and major structures
EIS	Environmental Impact Statement
EPA	Environment Protection Authority
GPOP	Greater Parramatta and Olympic Peninsula area
HAMU	Historical Archaeological Management Unit
NCA	Noise Catchment Area
NML	Noise Management Level
NPfI	<i>Noise Policy for Industry</i> (EPA, 2017)
NSW	New South Wales
NVMP	Noise and Vibration Management Plan
OOHW	Out of hours work
Operational footprint	The operational footprint forms part of the overall project site. It consists of land that would be occupied by the permanent project infrastructure.
Parramatta Light Rail Stage 1	Refers to Stage 1 of the Parramatta Light Rail network, between Westmead and Carlingford via Parramatta and Camellia. Stage 1 is currently under construction and expected to be operational in 2024.
Parramatta Light Rail network	Refers to Stage 1 and Stage 2 of the Parramatta Light Rail network
PAD	Potential archaeological deposit
PPV	Peak particle velocity
Project	The project comprises two main elements: <ul style="list-style-type: none"> <li>– construction of about 10 kilometres of light rail infrastructure between Camellia and the Carter Street precinct adjacent to Sydney Olympic Park</li> <li>– operation of about 13 kilometres of light rail alignment between the Parramatta CBD and the Carter Street precinct, including a section of infrastructure constructed by Parramatta Light Rail Stage 1 between Camellia and the Parramatta CBD.</li> </ul>
Project alignment	The project alignment refers to the physical horizontal and vertical location, position and direction of the light rail tracks.
Project route	The route refers to the locations/suburbs through which the project travels i.e. Parramatta, Camellia, Melrose Park, Wentworth Point, Sydney Olympic Park etc.
Project site	Refers to the area that would be directly disturbed by construction of the project (for example, as a result of ground disturbance and the construction of foundations for structures). It includes the location of construction activities, compounds and work sites, and the location of permanent infrastructure.

Term / abbreviation	Description
Primary project working hours	The primary project working hours, subject to approval: <ul style="list-style-type: none"> <li>– Monday to Sunday: 7am to 7pm</li> <li>– Public holidays: 7am to 7pm, when required.</li> </ul>
RBL	The Rating Background Level is used to establish construction and operational noise goals at residential Noise Catchment Areas (NCAs) within the study area.
Recommended standard hours	The recommended standard hours for construction work as defined in the <i>Interim Construction Noise Guideline</i> (DECC, 2009): <ul style="list-style-type: none"> <li>– Monday to Friday: 7am to 6pm</li> <li>– Saturday: 8am to 1pm</li> <li>– No works on Sundays or public holidays.</li> </ul>
Roads and Maritime Services	The former Roads and Maritime Services is now part of Transport for NSW.
RING	<i>Rail Infrastructure Noise Guideline</i> (EPA, 2013)
RNP	<i>Road Noise Policy</i> (DECCW, 2011)
SEARs	Secretary's Environmental Assessment Requirements
SEL	Sound exposure level
SOPA	Sydney Olympic Park Authority
Sydney Metro West	An underground metro railway that would link the Parramatta and Sydney CBDs and communities in between. The Sydney Metro West project is currently in planning stage, with stations proposed at Sydney Olympic Park and Parramatta.
Study area	The noise and vibration study area under investigation as described in section 2.2.
TORFM	Top of rail friction modifier
Transport and Infrastructure SEPP	State Environmental Planning Policy (Transport and Infrastructure) 2021
Transport for NSW	Transport for NSW is the lead agency of the NSW Transport cluster.
VDV	Vibration dose value
WHO	World Health Organisation



# Executive summary

## Description of the project

### Project overview

Parramatta Light Rail will deliver an integrated light rail service that supports the population and employment growth as well as the additional development expected throughout the Greater Parramatta and Olympic Peninsula area (GPOP). It will integrate with existing and future modes of transport, including buses, trains, ferries and active transport (pedestrian and cycle networks), as well as Sydney Metro West services and the existing road network.

Parramatta Light Rail will be delivered in stages to keep pace with development:

- Stage 1 will connect Westmead to Carlingford via the Parramatta central business district (CBD) and Camellia. The construction and operation of Parramatta Light Rail Stage 1 was approved by the NSW Minister for Planning in May 2018. Major construction is underway and Stage 1 is expected to start operating in 2024. Further information on Stage 1 is available at [Parramatta Light Rail](#)
- Transport for NSW is now proposing to construct and operate Stage 2 of Parramatta Light Rail ('the project'). Stage 2 would connect the Parramatta CBD and Stage 1 to Camellia, Rydalmere, Ermington, Melrose Park, Wentworth Point and Sydney Olympic Park.

### Key features

The key features of the project relevant to the assessment of noise and vibration are listed below:

- a new 10 kilometre long dual-track light rail line, with 14 stops, between the Parramatta Light Rail Stage 1 line in Camellia and the Carter Street precinct adjacent to Sydney Olympic Park
- two bridges over the Parramatta River to allow the light rail line to cross between Camellia and Rydalmere, and between Melrose Park and Wentworth Point
- a bridge over Silverwater Road between Rydalmere and Ermington
- other bridge works in Ken Newman Park and Sydney Olympic Park
- turnback facilities, including along part of Macquarie Street in the Parramatta CBD
- adjustments to the Parramatta Light Rail stabling and maintenance facility at Camellia
- five new traction power substations to provide convert electricity to a form suitable for use by light rail vehicles.

## Existing environment

Sensitive receivers have been identified within the study area and categorised by the type of occupancy residing within the lot. The study area has been divided into 19 discrete noise catchment areas, 15 of which contain residential land uses. Noise monitoring was undertaken at 11 residential locations in December 2021 to quantify and characterise the existing background, ambient and road traffic noise environment throughout the study area.

For all of the noise monitoring locations, the background and ambient noise environment is dominated by the local road traffic network. The noise monitoring was undertaken during a period when there was COVID-19 related restrictions in NSW, and as such, there may have been a reduction in traffic and commercial activity in the study area resulting in lower background, ambient and road traffic noise levels. Lower background noise levels would result in more conservative construction and operational noise (fixed facilities) criteria at residences as the criteria is based on the measured background noise levels.

Noise monitoring undertaken at 5 Hope Street, Rosehill during the Parramatta Light Rail Stage 1 Environmental Impact Statement (EIS) assessment stage (2017) has been compared to the noise monitoring results from December 2021 at the same location, to identify any significant differences in noise levels. The comparison of noise levels from each measurement period indicates the background noise levels are within 1 dB and the ambient/road traffic noise levels are within 2 dB. The comparison indicates that the measurements taken in 2017 (pre-COVID) and 2021 (during COVID restrictions and NSW Health advice) are generally consistent, with the exception that the 2021 road traffic noise levels are slightly lower.

Noise monitoring data from recent publicly available noise assessments have also been used to quantify the noise environment at locations outside the main study area. The noise monitoring results have been used to establish both construction noise management levels (NMLs) and operational noise trigger levels at residences.

## Construction noise and vibration assessment

### Construction noise and vibration overview

Based on feedback from the community during the construction of Parramatta Light Rail Stage 1, an extension of the recommended standard hours prescribed in the *Interim Construction Noise Guideline* (ICNG) (DECCW, 2010) is being sought to shorten the length of construction and minimise associated disruptions to the community. The following working hours are proposed for the project ('the primary project working hours'):

- Monday to Sunday: 7am to 7pm
- public holidays: 7am to 7pm, when required.

A case study for extended work hours for track-works associated with Parramatta Light Rail Stage 1 has been included to demonstrate that there has been community support for extended hours works which resulted in a reduction in the construction program.

Engagement was undertaken with a selection of community members to gain an understanding of the community's preference with balancing the primary project working hours, the overall construction program length and their amenity during the construction period. Survey results found that a total of 75 per cent of respondents supported the primary project working hours on weekdays, 67 per cent supported them on Saturdays and 53 per cent supported the primary project working hours on Sundays and/or public holidays. Indicative construction scenarios have been developed to represent worst-case construction activities for the various construction work sites across the project site. Noise predictions were made for all the identified sensitive receivers in the study area, using 3D noise models, and compared against the ICNG noise management levels during all relevant assessment periods (for example, ICNG recommended standard hours, out-of-hours-works (OOHW) day, evening and night periods). Other works that may be required to be undertaken outside of the primary project working hours have also been assessed against the OOHW NMLs.

Safe working distances sourced from the *Construction Noise and Vibration Strategy* (Transport for NSW, 2019a) (CNVS) for vibratory intensive works have been used to identify the potential for vibration impacts in close proximity to construction works (for example human comfort impacts at receivers and structural damage to buildings and structures).

### Construction noise impacts

It is inevitable that a major infrastructure project in an urban area would result in noise impacts during construction, especially when noise intensive equipment is required in close proximity to sensitive receivers. The assessment is based on exceedances of the relevant NMLs and have been categorised into 'no exceedance', '<10 dB exceedance', '10 to 20 dB exceedance' and '>20 dB exceedance' categories based on the worst-case construction activity for the relevant construction scenario. A discussion of the anticipated duration of the worst-case construction noise levels is also provided for each construction activity.

For most of the time, noise levels would be lower than what has been predicted in this assessment as the modelling assumes the loudest equipment is at the closest point between the construction work area and the sensitive receiver. Additionally, the modelling in this assessment assumes the most noise intensive equipment would be operating during each of the modelled construction scenarios. This results in a conservative assessment as most of the time, lower noise emitting equipment would be used.

## High impact activities (long term)

The following construction activities are predicted to result in the highest level of impacts at sensitive receivers, during the ICNG recommended standard hours, with regards to extent and duration (majority of the construction period):

- light rail track and public domain works from Camellia to the Carter Street precinct in Lidcombe – highly noise affected receivers are expected during noise intensive works (e.g. concrete breaking) in close proximity to residences
- bridge works – highly noise affected receivers are expected during noise intensive works (e.g. impact piling) in close proximity to residences
- roadworks – highly noise affected receivers are expected during noise intensive works (e.g. asphalt milling) in close proximity to residences.

Where these works occur at large distances from sensitive receivers (for example in Camellia and sections of Sydney Olympic Park), exceedances of the noise management levels are predicted to be less than 10 dB.

OOW would also be required for the construction scenarios identified above to minimise disruptions to the transport network.

## High impact activities (short term)

The following construction activities are predicted to result in exceedances of the NMLs that are greater than 20 dB at sensitive receivers during the ICNG recommended standard hours, although noise intensive activities would be relatively short-term:

- demolition works – highly noise affected receivers are expected during noise intensive works (e.g. use of a rockbreaker) in close proximity to residences
- compound sites – for most of the time, noise at compound sites would be minimal except during deliveries to and from the site. Highly noise affected receivers are expected during noise intensive works (e.g. use of a concrete saw) in close proximity to residences
- construction of light rail stops – highly noise affected receivers are expected during noise intensive works (e.g. use of a rockbreaker) in close proximity to residences
- construction of traction power substations – no highly noise affected receivers.

Where these works occur at large distances from sensitive receivers (for example in Camellia and sections of Sydney Olympic Park), exceedances of the NMLs are predicted to be less than 10 dB.

For works outside the ICNG recommended standard hours, impacts would be greater as they are considered more sensitive time periods.

## Lower impact activities

The following construction activities are predicted to result in NML exceedances of less than 10 dB at sensitive receivers during all periods of the day:

- spoil and ballast recycling at the Grand Avenue compound site in Camellia
- modification works to the Parramatta Light Rail stabling and maintenance facility at Camellia
- light rail track and road works in Camellia where there is a minimum separation distance of 800 metres between the construction work area and the most-affected residences (in Rosehill and Rydalmere).

These construction sites are located within an industrial area where the nearest sensitive receivers are industrial and commercial land uses. The nearest residences are sufficiently distant that no significant noise impacts are anticipated during any period of the day.

## Impacts due to OOHW night works, including sleep disturbance impacts

The following construction activities have been identified to result in 10 to 20 dB or >20 dB exceedances of the NMLs at residences during the OOHW night period:

- concrete pouring and trackworks at the John Street and South Street intersection, in Rydalmere
- installation of the bridge structure (precast concrete elements) between abutments and piers with the use of cranes at Silverwater Road
- utility relocation that may be required within residential areas.

The above activities are also predicted to result in noise levels that exceed the sleep disturbance screening level at residences.

The following construction activities have been identified to result in no exceedances of the NMLs or exceedances of less than 10 dB at residences during the OOHW night period:

- night works required at the Macquarie Street turnback facility in the Parramatta CBD
- minor kerb adjustments at Australia Avenue, Sydney Olympic Park
- finishing roadworks near the Hill Road and Holker Street intersection, Sydney Olympic Park.

However, commercial receivers adjacent to the works listed above would experience noise levels that are <10 dB and 10 to 20 dB above the NMLs should they be undertaken during the night period.

## Construction vibration impacts

The outcomes of the construction vibration impact assessment indicate the following:

- 455 buildings fall within the safe working distance for cosmetic damage (unreinforced buildings) due to vibratory intensive works associated with the project
- 958 buildings have been identified as falling within the safe working distance for human comfort due to vibratory intensive works associated with the project
- the following built items fall within the adopted screening distance for potential damage to heritage structures:
  - Telstra house (former post office), Parramatta
  - St John's Parish Hall, Parramatta
  - Horse parapet façade and potential archaeological site, Parramatta
  - 45 Macquarie Street, Parramatta
  - Murrays' Building (and potential archaeological site), Parramatta
  - Shop (and potential archaeological site), Parramatta
  - Sewage Pumping Station 67, Camellia
  - Pumping station, Camellia
  - Bulla Cream Dairy (Willowmere), Ermington
  - (former) Ermington Wharf, Melrose Park
  - State Abattoir locality, Sydney Olympic Park
  - House at 46 John Street, Rydalmere
  - House at 69 John Street, Rydalmere
  - House at 71 South Street, Rydalmere
  - House at 67 Boronia Street, Ermington
- the following sensitive infrastructure items have been identified as falling with the screening distance for potential damage:
  - Rydalmere Wharf, Rydalmere
  - Ermington Boat Ramp, Melrose Park
  - Sydney Olympic Park Wharf, Wentworth Point
  - Olympic Park Station, Sydney Olympic Park.

Known Aboriginal sites, potential Aboriginal archaeological deposits and Historic Archaeological Management Units of potential high local and/or State significance have been identified within the project site. Detailed assessments and a test excavation program is proposed, prior to construction works, to confirm the presence of archaeological site and sensitivity to vibratory intensive works. As far as reasonably practical, direct impacts and indirect impacts (such as vibration) on items and sites of Aboriginal and non-Aboriginal heritage significance would be avoided and would be considered during the design development and construction planning phases of the project.

Where possible, less vibratory intensive works would be investigated and condition surveys would be undertaken at buildings and structures identified as falling within the safe working distances for cosmetic damage. Where appropriate, vibration management levels would be refined and vibration monitoring would be undertaken where vibratory intensive work would be expected to exceed vibration management levels (to determine site specific minimum working distances).

Vibration impacts to human comfort would be managed through the additional mitigation measures prescribed in the CNVS.

## **Construction management and mitigation measures**

Where noise levels have been predicted to exceed NMLs, reasonable and feasible work practices have been recommended to reduce potential impacts. The standard measures (management, source mitigation and path mitigation measures) prescribed in the CNVS would apply, where reasonable and feasible.

The outcomes of the assessment and the effectiveness of various mitigation measures discussed in this report have assisted with informing the following project specific mitigation measures:

- solid hoarding around compound sites in close proximity to residences, with special consideration given to the long-term compound site at Ken Newman Park
- scheduling of noise intensive equipment
- alternative construction techniques to lower noise emission
- mitigation at the source using silencers
- screening using sheds or structures at compound sites
- using lower vibration generating items for excavation plant and equipment.

Additionally, the following management measures have been recommended to reduce potential noise and vibration impacts:

- community engagement to determine their preference and priority to manage impacts
- stakeholder engagement with owners and operators at Rosehill Gardens Racecourse and Sydney Olympic Park to consider major events. Business and schools at Parramatta (CBD), Melrose Park, Wentworth Point and Sydney Olympic Park would also be engaged when scheduling construction activities
- development of Construction Noise and Vibration Impact Statements (CNVIS) for OOHW
- respite periods for highly noise affected receivers
- interaction with major projects interfacing with the project to reduce cumulative impacts and construction fatigue
- test excavations of potential Aboriginal and non-Aboriginal areas to determine presence and sensitivity to vibratory intensive works
- survey the study area for vibration intensive equipment during development design
- building condition surveys for structures identified within safe working distances
- vibration monitoring where vibratory works are required within safe working distances, following the completion of condition surveys.

The mitigation measures listed above take into account community and stakeholder consultation that has been undertaken to inform the project and would be further refined as community engagement progresses.

Residual noise impacts would be managed in accordance with the CNVS which prescribes additional mitigation measures to be applied once all reasonable and feasible mitigation measures have been implemented.

A hierarchy of time periods for works outside the ICNG recommended standard hours has been provided, as well as the requirement to develop a OOHW protocol to be included in the construction environmental management plan for the project.

## Construction traffic impacts

To assess noise impacts from construction traffic or temporary reroutes due to road closures, an initial screening test has been undertaken to evaluate whether noise levels would increase by more than 2 dB. Where an increase is 2 dB or less, no further assessment is required. Where noise levels increase by more than 2 dB and noise levels exceed the controlling criterion, then mitigation strategies should be considered to reduce potential noise impacts.

It has been assumed that no road traffic noise impacts due to the project would be experienced on arterial roads such as James Ruse Drive, Silverwater Road and the M4 Motorway due to the existing high traffic volumes on these arterial roads.

Receivers adjacent to the following roads have been identified as exceeding the *Road Noise Policy* (DECCW, 2011) noise requirements at sensitive receivers during the construction period:

- South Street (collector road) – between Silverwater Road and River Road
- John Street (local road) – between South Street and Antoine Street
- Fallon Street (local road) – between Primrose Avenue and John Street
- Primrose Avenue (local road) – between South Street and John Street
- Hilder Road (local road) – between Tristram Street and Coffey Street.

Management and mitigation measures have been recommended to reduce potential construction traffic noise related impacts at sensitive receivers.

## Operational noise and vibration assessment

### Rail-generated airborne noise (Sandown Boulevard stop to Carter Street stop)

Airborne noise generated by rail operations on surface tracks have been assessed against the trigger levels prescribed in the *Rail Infrastructure Noise Guideline* (RING) (EPA, 2013), based on volumes estimated for ten years after opening (2039).

Detailed 3D noise modelling has been undertaken to predict noise levels at sensitive receivers within 150 metres of the alignment between the Sandown Boulevard stop and the Carter Street stop. The results indicate the following:

- two residential receivers are predicted to receive noise levels above the RING trigger level of  $L_{Aeq(15hour)}$  60 dBA during the day
- 149 residential receivers are predicted to receive noise levels above the RING trigger level of  $L_{Aeq(9hour)}$  50 dBA during the night
- no residential receivers are predicted to receive noise levels above the RING trigger level of  $L_{Amax(95\%)}$  80 dBA during any time of the day.

No residential receivers have been identified as qualifying for mitigation consideration in accordance with the RING. A sensitivity check has also been undertaken applying a +2 dB correction to the predicted levels to account for the potential of highly resilient or very highly resilient trackform to reduce ground-borne noise and vibration from the track. The results indicate that six residential buildings could qualify for mitigation.

Future development in areas adjacent to the project site, such as the Camellia Town Centre, Melrose Park North Planning Proposal and Melrose Park South Planning Proposal, should consider the potential operational noise and vibration impacts of the project based on the outcomes of this assessment with consideration to the State Environmental Planning Policy (Transport and Infrastructure) 2021 (Transport and Infrastructure SEPP) and the *Development Near Rail Corridors and Busy Roads – Interim Guideline* (DoP, 2008).

## **Rail-generated ground-borne noise and vibration (Sandown Boulevard stop to Carter Street stop)**

A total of 129 residential receivers are predicted to exceed the controlling night-time ground-borne noise trigger level of  $L_{A\text{Smax}}$  35 dBA prescribed in the RING, at locations where the ground-borne noise level also exceeds the airborne noise level. The qualifying receivers are primarily located adjacent to the alignment between the John Street stop and the Melrose Park stop, with a few isolated receivers in Wentworth Point and the Carter Street precinct in Lidcombe.

## **Rail operations between Macquarie Street turnback facility and Sandown Boulevard stop**

The section of track that would be shared by the Stage 1 and Stage 2 light rail vehicles (Parramatta CBD to Camellia) has been modelled and assessed in detail as part of the design development for Stage 1. A review of the relevant documentation has been undertaken and corrections applied to the  $L_{Aeq}$  values to account for the doubling in frequency of light rail vehicles along this section of track.

Three additional receiver buildings have been identified as qualifying for noise mitigation consideration as a result of doubling light rail vehicle movements along this section of track for Stage 2, being:

- Pre-Uni New College Parramatta – 3 Barrack Lane, Parramatta (educational institute)
- PM Counselling Services – 153 George Street, Parramatta (medical)
- Arthur Phillip High School – 80-100 Macquarie Street (educational institute).

Transport for NSW and its contractors would co-ordinate during the design development process to ensure any mitigation implemented during Stage 1 would take into account the Stage 2 light rail vehicle volumes.

For the assessment of ground-borne noise to receivers along this section of track,  $L_{A\text{Smax}}$ , noise levels would not be expected to change as a result of an increase in frequency of light rail vehicle movements, and as such no additional receivers have been identified as qualifying for mitigation consideration. Ground-borne vibration, assessed as an estimated vibration dose value, would increase but is predicted to be well below the relevant criteria.

The closest restaurants and retail shops fronting the Macquarie Street turnback facility are predicted to receive internal noise levels of up to  $L_{Aeq(1\text{hour})}$  53 dBA and 50 dBA, respectively. The RING does not provide trigger levels for commercial receivers, and existing noise levels due to pedestrian activity and road traffic noise are well above the predicted noise levels for light rail vehicle movements. As such, no mitigation measures have been recommended for these receivers.

## **Development in Camellia town centre and Melrose Park north and south precincts**

Noise and vibration sensitive development approved prior to the approval of the project, within the Camellia town centre and the Melrose Park north and south precincts, would be considered during the design development process. Post-approval of the project, developers would be required to ensure the design of developments comply with Clause 87 of the Transport and Infrastructure SEPP. Operational noise contours have been provided in Section 4.1.5 to show indicative noise levels across these urban growth areas to assist in the planning of these locations. Planning controls have also been recommended for future development adjacent to the project alignment.

## **Noise from Public Address systems at stops**

Noise from public address (PA) systems would be designed to comply with the *Noise Policy for Industry* (NPfI) (EPA, 2017) noise trigger levels during the design development process. Given the infrequency of PA announcements, noise levels are not expected to significantly contribute to  $L_{Aeq(15\text{min})}$  noise levels at sensitive receivers. Temporary annoyance at residences may occur should PA systems be audible, where light rail stops are close to residences. Automatic volume adjustments would be installed at these stops to account for the ambient noise level, whilst providing an adequate level of speech intelligibility for customers.

## Modifications to the stabling and maintenance facility

Noise and vibration impacts of the stabling and maintenance facility at Camellia at existing and future receivers were assessed as part of the design development for the Stage 1 project but did not consider the operation of Stage 2. A qualitative assessment was undertaken of the potential impacts associated with the proposed modifications to the facility which indicated the following:

- Once Stage 2 is operational, noise and vibration levels at existing receivers would be well below the relevant trigger levels.
- Exceedances of the night noise trigger levels are predicted at potential future residences within the Camellia town centre and are expected to be controlled by stationary light rail vehicles on the external stabling roads and light rail vehicles entering/exiting the facility during the operation of Stage 1. The additional movements associated with the operation of Stage 2 light rail vehicles could increase noise levels at these receivers by 3 dB.
- At the future potential residential receivers in the Camellia town centre, noise from turnouts were predicted to be equal to the indicative sleep disturbance noise goal, being  $L_{A_{fmax}}$  53 dBA during both Stage 1 and Stage 2 operations.  $L_{A_{fmax}}$  noise levels at existing receivers would be well below the sleep disturbance noise goal.
- No ground-borne noise and vibration impacts are anticipated during operation of Stage 2 due to the adequate separation distances between the sources and the nearest existing or future receivers.

## Airborne noise from traction power substations

Noise levels at the nearest sensitive receivers have been predicted for each of the five new traction power substations to be installed across the project site. Noise trigger levels are not predicted to be exceeded at any sensitive receiver location.

## Changes to road traffic noise levels during operation

The estimated forecast 'no build' and 'build' traffic volumes along the local road network for 2031 have been used to calculate whether any sections of road are predicted to increase by more than 2 dB as a result of the project. The predictions indicate that no section of road is predicted to increase by more than 2 dB based on the forecast traffic volumes.

## Vehicles crossing over rails

Noise measurements were undertaken at the CBD and South East Light Rail track in Randwick to quantify the increase in noise levels at intersections where vehicles cross the rail track compared to regular intersections. These noise measurements were used as the basis of the noise assessment for intersections where vehicles would cross the rail track along the Parramatta Light Rail Stage 1 alignment.

It has been predicted that the  $L_{Aeq(15hour)}$  and  $L_{Aeq(9hour)}$  noise levels could increase by up to 0.6 dB at the most-affected sensitive receivers to these intersections. Taking into account the forecast traffic volumes and potential increase in  $L_{Aeq}$  noise levels where vehicles would cross the rail track,  $L_{Aeq(15hour)}$  and  $L_{Aeq(9hour)}$  road noise levels are not predicted to increase by more than 2 dB. Note should be made that  $L_{A_{fmax}}$  noise levels could increase by approximately 5 to 7 dB at these intersections depending on the type of vehicle and its speed.

## Reconfiguration of road at South Street and Boronia Street

Sections of South Street and Boronia Street would require minor reconfigurations as a result of the project, where the eastbound lanes would move closer to residences to the north of South Street and Boronia Street to allow for a centre-running light rail track. Additionally, there are various intersections along South Street and Boronia Street where vehicles would cross over the rail tracks.

A simple noise model was developed using SoundPLAN 8.2 noise modelling software to predict indicative 'no build' and 'build' road traffic noise levels at the first row of residences fronting South Street and Boronia Street based on 2031 traffic volumes. Where vehicles could cross over the rail tracks, a +4 dB  $L_{Aeq}$  correction has been applied to a 10-metre section of road to account for the potential increase in noise.



The results of the noise modelling indicate that 32 receivers north of South Street and Boronia Street are predicted to experience an increase in noise level greater than 2 dB and receive noise levels above the RNP controlling noise criteria for residences adjacent to collector roads, being  $L_{Aeq(15\text{hour})}$  60 dB for the day period and  $L_{Aeq(9\text{hour})}$  55 dB during the night period.

Should the RNP criteria be exceeded at sensitive receivers, mitigation consideration is required. Note should be made that the 3-dimensional design of these roads has not yet been completed and the road noise model has not been validated in accordance with the *Model Validation Guideline* (Transport for NSW, 2018).

Once the final road configuration is confirmed and designed, it is recommended that a detailed operational road traffic noise assessment be undertaken in accordance with RNP and the relevant Transport for NSW road traffic noise guidelines to confirm the requirement for mitigation measures.

## **Mitigation strategy to minimise rail-generated airborne noise**

The results of the noise modelling indicate no residential receivers are predicted to qualify for noise mitigation consideration as the RING trigger levels are not predicted to be exceeded.

Once the final design of the light rail has been developed, the noise model would be updated. The noise mitigation strategies outlined below would be considered during this process:

- Generally, at-source control measures are the most-effective option as they benefit the greatest number of receivers. Potential at-source noise mitigation options have been discussed in Section 4.6.1.1, including control options for the trackform and maintenance of the track to minimise friction between the wheel and the rail.
- Control measures in transmission, such as noise barriers, have not been considered as most of the trackform would be embedded rail allowing pedestrian and vehicle access across the tracks. The installation of a noise barrier parallel to the embedded track would prevent pedestrian and vehicle access across the track.
- Property treatments at the receiver may be an appropriate mitigation strategy to reduce potential airborne noise impacts should there be residual noise impacts at sensitive receivers. This would be confirmed once all at-source feasible and reasonable mitigation measures have been considered.

## **Mitigation strategy to minimise rail-generated ground-borne noise (and vibration)**

At-source controls would be the most-effective option to reduce rail-generated ground vibration, and therefore ground-borne noise, to the affected sensitive receivers.

Decreasing the track stiffness (i.e. increasing track resilience), via the use of special boots, sleeper pads, under ballast mats or floating track systems, to provide high or very-high ground-borne noise and vibration attenuation would be investigated during the next stages of design. The focus of the investigation would specifically be located between the John Street and Melrose Park stops, where most of the affected residences are located.

It is understood that 'high' and 'very high' attenuation tracks are installed in some sections of Parramatta Light Rail Stage 1. Noise and vibration measurements of attenuated trackforms would need to be undertaken to accurately quantify potential ground-borne noise and vibration benefits and the potential increase in airborne noise levels. These measurements would be undertaken on similar track systems such as Parramatta Light Rail Stage 1 or the most representative system available at the time.

The potential noise and vibration mitigation options would be refined during the next stages of design taking into account the outcomes of the compliance noise monitoring undertaken for Stage 1 (generally conducted within 12 months of its opening).

## **Mitigation strategy to minimise airborne noise from fixed facilities**

PA systems would be designed to comply with the *Noise Policy for Industry* (NPfI) (EPA, 2017) intrusiveness and sleep disturbance trigger levels at all sensitive receivers. PA systems would also be self-adjusting to the ambient noise level to reduce noise levels during more sensitive periods of the day.

Traction power substations would also be designed to comply with the lower of the NPfI intrusiveness and amenity noise levels at sensitive receivers. The rectifier and auxiliary transformers would be housed inside buildings to reduce the potential for noise impacts at receivers.

It has been predicted that light rail vehicle noise at the stabling yards when entering or exiting the facility would be the dominant noise source contributing to exceedances of the operational noise trigger levels at potential future receivers at the Camellia town centre. For mitigation measures, it has been recommended to incorporate at-source noise mitigation to prevent curve squeal. Acoustic treatments would be considered as the design progresses.

# 1. Introduction

## 1.1 Parramatta Light Rail

The NSW Government's Greater Sydney Region Plan *A Metropolis of Three Cities* (Greater Sydney Commission, 2018) outlines a vision for a three-city metropolis. The Central River City covers the four local government areas of the City of Parramatta, Blacktown City, Cumberland City and The Hills Shire. A Metropolis of Three Cities highlights Greater Parramatta as the focal point for the Central River City, with employment growth and public transport being of key importance.

The Greater Parramatta and the Olympic Peninsula area (GPOP), which extends from Westmead and Parramatta in the west to Sydney Olympic Park to the east, is fast emerging as the heart of Sydney's Central River City and is set to grow and change significantly over the next 20 years. Forecasts predict that GPOP will accommodate almost 170,000 new residents by 2041. Employment opportunities will also grow, with an additional 100,000 jobs predicted by 2041 (SGS, 2017).

Parramatta Light Rail will deliver an integrated light rail service that supports the population and employment growth expected throughout GPOP. It will integrate with existing and future modes of transport, including buses, trains, ferries and active transport (pedestrian and cycle networks), as well as Sydney Metro West services and the existing road network. Parramatta Light Rail would be delivered in stages to keep pace with development:

- Stage 1 will connect Westmead to Carlingford via the Parramatta central business district (CBD) and Camellia. The construction and operation of Parramatta Light Rail Stage 1 was approved by the NSW Minister for Planning in May 2018. Major construction is underway with the track installation complete and light rail stop construction in progress. Stage 1 is expected to start operating in 2024. Further information on Stage 1 is available at [Parramatta Light Rail](#)
- Transport for NSW is now proposing to construct and operate Stage 2 of Parramatta Light Rail ('the project'). Stage 2 would connect the Parramatta CBD and Stage 1 to Camellia, Rydalmere, Ermington, Melrose Park, Wentworth Point and Sydney Olympic Park.

Figure 1.1 provides an overview of Parramatta Light Rail showing both stages.

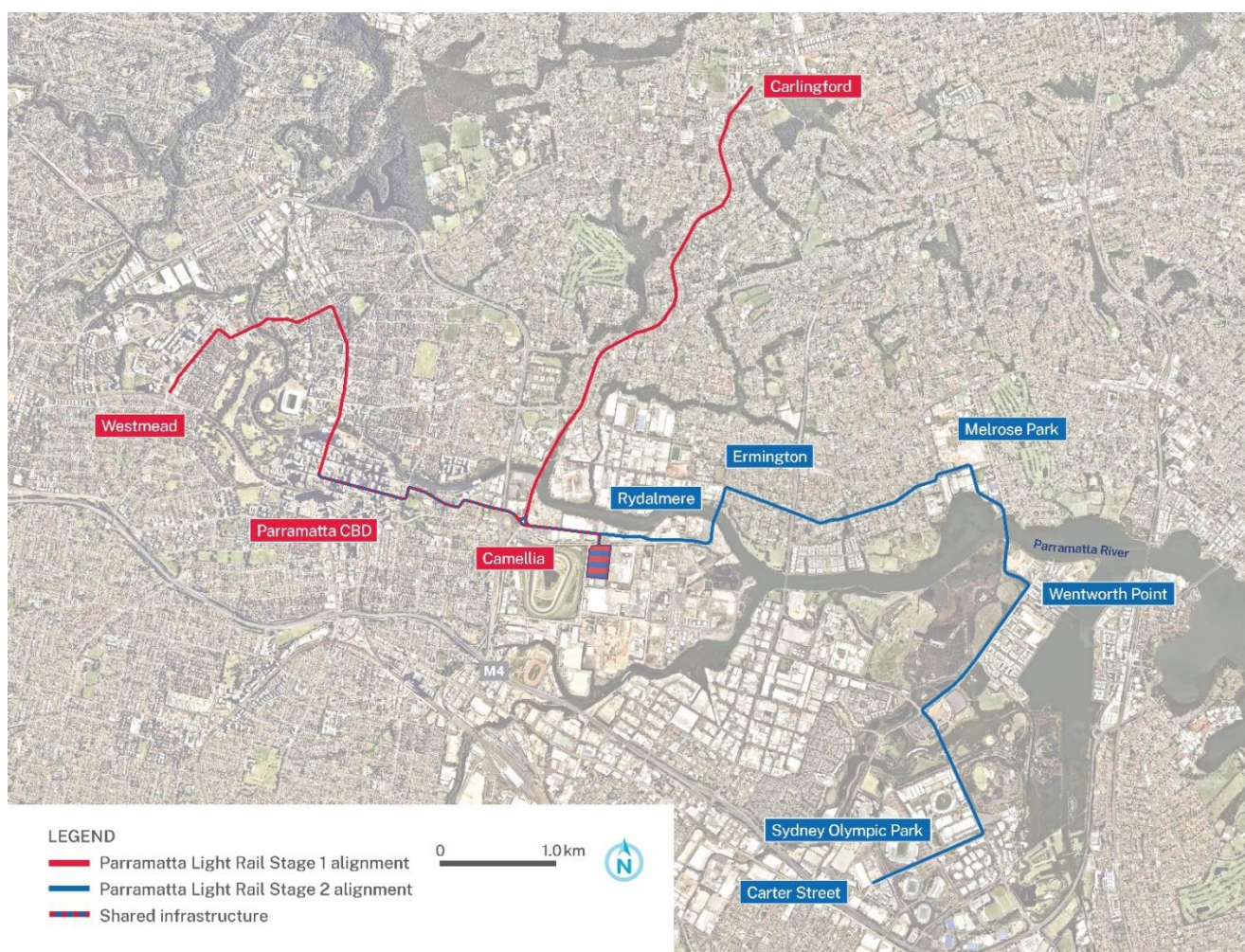


Figure 1.1 Parramatta Light Rail network

## 1.2 Project overview

The project comprises two main elements:

- construction of about 10 kilometres of light rail infrastructure between Camellia and the Carter Street precinct adjacent to Sydney Olympic Park
- operation of about 13 kilometres of light rail alignment between the Parramatta CBD and the Carter Street precinct, including a section of infrastructure constructed by Parramatta Light Rail Stage 1 between Camellia and the Parramatta CBD.

Further information on the location of the project, and a description of the project site for the purposes of this document, is provided in the environmental impact statement (EIS).

### 1.2.1 Key features

The key features of the project, which are shown on Figure 1.2, include:

#### Light rail track and bridges

- a new 10 kilometre long dual light rail track, with 14 stops, between the Parramatta Light Rail Stage 1 line in Camellia and the Carter Street precinct adjacent to Sydney Olympic Park
- two bridges over the Parramatta River to allow the light rail line to cross between Camellia and Rydalmere, and between Melrose Park and Wentworth Point
- a bridge over Silverwater Road between Rydalmere and Ermington
- other bridge works in Ken Newman Park and Sydney Olympic Park.

## Active and public transport integration

The project would also deliver:

- about 8.5 kilometres of new active transport links between Camellia and the Carter Street precinct, which would connect with the existing cycling and pedestrian network
- interchanges with other forms of public transport, including trains, ferries, buses and Sydney Metro West, with the main interchanges located in the Parramatta CBD, Rydalmere and Sydney Olympic Park
- a light rail and pedestrian zone (no through vehicle access) within Sydney Olympic Park along Dawn Fraser Avenue between Australia Avenue and Olympic Boulevard
- bus access over the proposed bridge between Melrose Park and Wentworth Point.

## Other works

Works proposed to support the project's operation:

- turnback facilities, including along part of Macquarie Street in the Parramatta CBD
- adjustments to the Parramatta Light Rail stabling and maintenance facility at Camellia
- five new traction power substations to convert electricity to a form suitable for use by light rail vehicles
- new and improved open spaces and recreation facilities at Ken Newman Park, the Atkins Road stop and Archer Park.

Further information on the project's features is provided in the EIS (see Chapter 6 (Project description – infrastructure and operation)).

## 1.2.2 Operation

The project would operate between the Parramatta CBD and the Carter Street precinct, using a section of the Parramatta Light Rail Stage 1 alignment and the alignment constructed as part of the project.

Between the Parramatta CBD and Camellia, the project would operate along about three kilometres of the Parramatta Light Rail Stage 1 alignment. Parramatta Light Rail Stage 2 services would terminate at the Stage 1 Parramatta Square stop to allow customers direct and convenient access to Parramatta's CBD, and interchange with Stage 1 light rail services, trains, buses and Sydney Metro West.

From Camellia, the project would operate along the light rail infrastructure proposed as part of Stage 2, terminating at the proposed Carter Street stop.

The project would operate as a turn-up-and-go light rail service from 5am to 1am, seven days a week, as for Parramatta Light Rail Stage 1. The project would have travel times of around 31 minutes from the Carter Street stop in Lidcombe to the proposed Sandown Boulevard stop in Camellia, and a further seven minutes from Camellia to the Parramatta Square stop in the Parramatta CBD.

Further information on the project's operation is provided in the EIS (see Chapter 6 (Project description – infrastructure and operation)).

## 1.2.3 Timing

It is anticipated that construction would start in 2025, subject to obtaining all necessary approvals, and the first passenger services are proposed to start from 2030/2031.

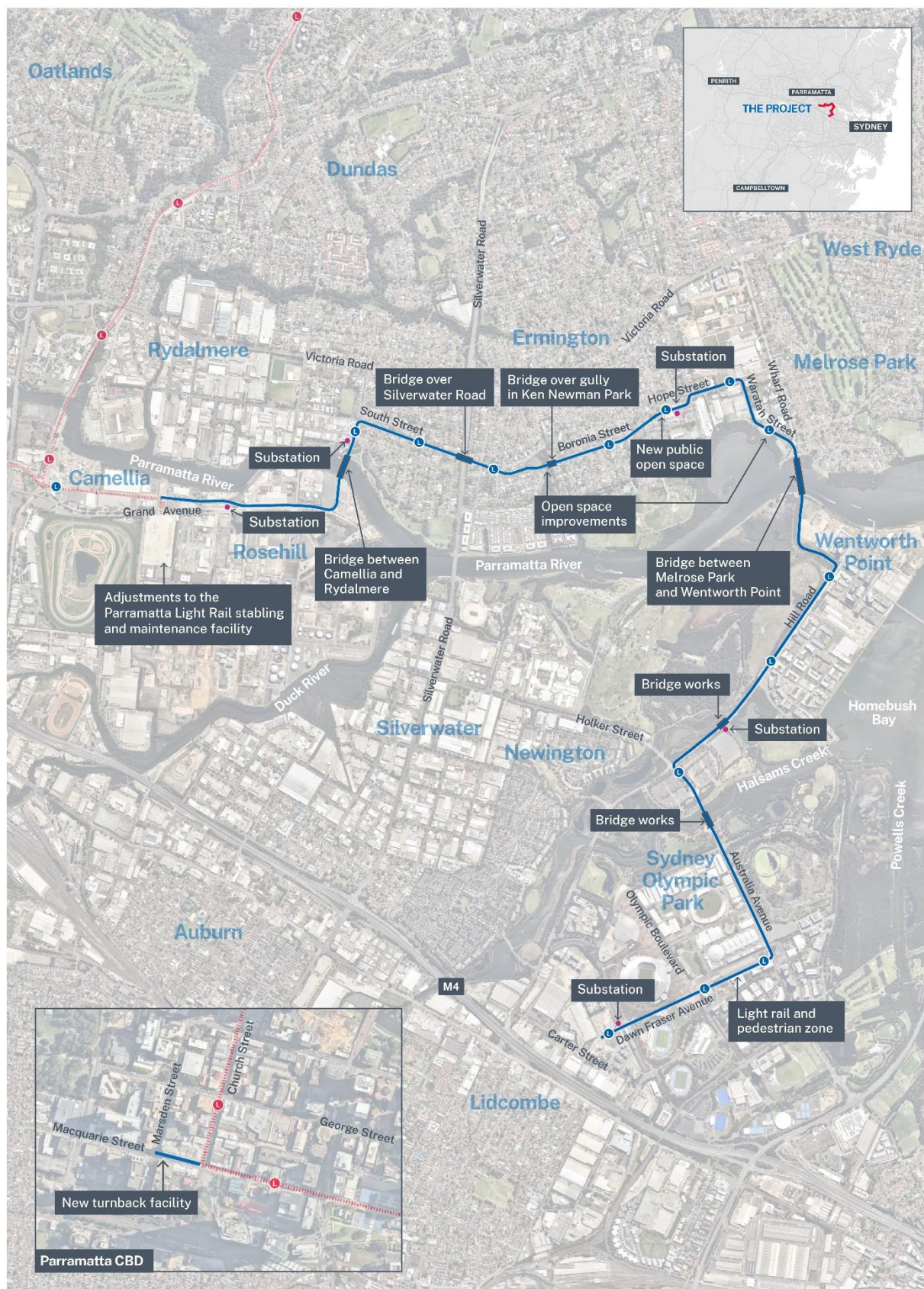
An indicative construction methodology is provided in the EIS (see Chapter 7 (Project description – construction)).

## 1.2.4 Approval requirements

The project is State significant infrastructure and is subject to approval by the NSW Minister for Planning under Part 5, Division 5.2 of the *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act).

The project is also determined to be a controlled action under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) and requires approval from the Australian Minister for the Environment and Water.





## 1.3 Purpose and scope of this report

The EIS has been prepared to support an application for approval of the project in accordance with Division 5.2 of the EP&A Act. It addresses the environmental assessment requirements of the Secretary of the Department of Planning and Environment (SEARs).

This report has been prepared as part of the EIS to assess the potential noise and vibration impacts from constructing and operating the project. The report:

- addresses the relevant SEARs listed in Table 1.1
- describes the existing environment with respect to noise and vibration
- assesses the impacts of constructing and operating the project on noise and vibration sensitive receivers
- recommends measures to mitigate and manage the impacts identified.

The methodology for the assessment is described in Section 2.

**Table 1.1** SEARs – Noise and vibration

Requirements	Where addressed in this report
<b>1. Construction and operational noise and vibration</b> impacts in accordance with relevant NSW noise and vibration guidelines, including how measures developed to satisfy the guidelines will be implemented and their effect on reducing the level and impact of noise and vibration; and how noise and vibration management strategies will be used and integrated into the proposal.	Section 3
<b>2. The assessment of construction noise and vibration must address:</b>	
(a) the nature of construction activities and related noise and vibration characteristics using typical and worst-case scenarios and highlight high-noise generating activities;	Section 3.3 for an overview of the construction works Section 3.3.7 for typical/worst-case scenarios and high-noise intensive equipment have been identified
(b) the intensity and duration of noise (both air and ground-borne) and vibration impacts. This must include consideration of construction impacts over an extended period associated with ancillary facilities (and the like) and construction fatigue;	Section 3.4 (airborne noise) Section 3.2.2 (ground-borne noise) Section 3.5 (vibration) Section 3.4.9 (construction fatigue)
(c) the identification of receivers (including sensitive infrastructure in respect of vibration and major events), during construction;	Section 2.2.4 (identification of sensitive land uses) Section 2.2.4.4 (sensitive infrastructure and major events)
(d) the structural integrity and significance of known or potential heritage items (including Aboriginal places and items of cultural and environmental heritage) that could be affected by vibration;	Section 2.2.2.2 (identification of heritage items and Aboriginal places) Section 3.5.4 (vibration impact to heritage items)
(e) the nature of the impact and the sensitivity of receivers and level of impact including for out-of-hours works;	Section 3.4.2 (summary) Section 3.4.3 (primary project working hours) Section 3.4.6.2 (outside of primary project working hours) Section 3.4.4 (utility works)
(f) the need to balance timely conclusion of noise and vibration-generating works with periods of respite, and other factors that may influence the timing and duration of construction activities (such as traffic management);	Section 3.3.1 (construction program) Section 3.3.2 (construction hours) Section 3.3.3 (justification for OOHV)



Requirements	Where addressed in this report
(g) noise impacts of out-of-hours works (including utility works and works associated with the SSI including those undertaken under another assessment pathway), possible locations where out-of-hours works would be undertaken, the activities that would be undertaken, the estimated duration of those activities and justification for these activities in terms of the <i>Interim Construction Noise Guideline</i> ;	Section 3.4.4 (outside of primary project working hours work and indicative duration) Section 3.3.5 (construction work areas) Section 3.4.4 (utility works) Section 3.3.3 (activities and justification for OOHW)
(h) sleep disturbance (including the number of noise-awakening events) in accordance with <i>Interim Construction Noise Guideline</i> ;	Section 3.4.6.3
(i) a cumulative noise and vibration assessment inclusive of impacts from the proposal, including concurrent construction activities within the proposal and the construction of other relevant development in the vicinity of the proposal;	Section 3.4.8 (project works) Section 3.4.9 (other major projects)
(j) qualitative assessment of the predicted effectiveness of mitigation measures (including, where relevant, case studies from other light rail projects) to adequately manage identified impacts, including impacts as identified in (i);	Section 3.4.5
(k) any potential residual noise and vibration impacts following application of mitigation measures.	Section 3.4.6.1 (works within primary project working hours) Section 3.4.6.2 (works outside primary project working hours)
<b>3. Construction traffic noise assessment must include:</b>	
(a) justification for the model used in accordance with <i>NSW Road Noise Policy</i> Appendix B4 and Appendix B5;	Section 3.6.2
(b) a sleep disturbance assessment (indicative maximum noise levels and number of events) and efficacy of potential mitigation.	Section 3.6.4 (sleep disturbance assessment) Section 3.4.5 (efficacy of mitigation measures)
<b>4. The assessment of operational noise and vibration must address:</b>	
(a) all noise producing aspects of the proposal including rail vehicles; stations/stops; the redistribution of traffic from the proposal, and ancillary plant and equipment, taking into account the characteristics of noise and vibration (for example, tonality and low frequency noise);	Section 4.1.1 (airborne noise – Light rail vehicles) Section 4.2.1 (vibration sources) Section 4.4 (fixed facilities) Section 4.5 (redistribution of traffic) Appendix C (detailed methodologies)
(b) the identification of receivers, their sensitivity, and level of impact;	Section 2.2.4 (identification and sensitivity of existing receivers) Section 2.2.4 (future receivers) Section 4.1 and Section 4.2 (Sandown Blvd to Carter Street) Section 4.3 (Sandown Blvd to Parramatta CBD) Section 4.4 (airborne noise from fixed facilities)
(c) sleep disturbance (in terms of noise levels and number of noise-awakening events) in accordance with <i>Rail Infrastructure Noise Guideline</i> ;	Section 4.1.7.2 (Light rail vehicles) Section 4.1.7.3 (Warning bells)
(d) traffic crossing over light rail tracks;	Section 4.5.5



Requirements	Where addressed in this report
(e) quantitative assessment of the predicted effectiveness of mitigation measures (including, where relevant, case studies from other light rail projects) to adequately manage identified impacts;	Section 4.6.1 (airborne noise from the light rail) Section 4.6.2 (ground-borne noise from the light rail) Section 4.6.1.2 (vehicles crossing rail tracks) Section 4.6.3 (airborne noise from fixed facilities)
(f) any potential residual noise and vibration impacts following application of mitigation measures.	Section 4.7
5. Description of how <b>receiver feedback</b> received during the preparation of the EIS has been taken into account (and would be taken into account post exhibition of the EIS) in the design of mitigation measures, including any tailored mitigation, management and communication strategies for sensitive receivers.	Section 3.7.7 (construction) Section 4.6.5 (operation)
6. The process for <b>community engagement</b> should be included or referenced in the noise and vibration assessment as part of the mitigation strategy and assessment.	Section 3.7.7 (construction) Section 4.6.5 (operational noise and vibration mitigation measures)

## 1.4 Disclaimer

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## 2. Methodology and approach

### 2.1 Overview of applicable guidelines

The applicable guidelines referenced in the SEARs, and others used in this assessment, are summarised in Table 2.1 including the relevance of the guidelines to this noise and vibration assessment.

**Table 2.1**      *Applicable guidelines used in this assessment*

Assessment guideline	Relevance to the assessment
<b>Guidelines referenced in SEARs SSI-10035</b>	
<i>Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration</i> (ANZECC , 1990)	Not applicable. No blasting is proposed as part of the project.
<i>Assessing Vibration: a technical guideline</i> (AVTG) (DEC, 2006)	Assessment of human comfort vibration impacts to sensitive receivers during construction and operation.
<i>Interim Construction Noise Guideline</i> (ICNG) (DECC, 2009)	Assessment of construction airborne noise and ground-borne noise impacts on sensitive receivers, including noise management levels (NMLs).
<i>Noise Policy for Industry</i> (NPfI) (EPA, 2017)	Assessment of operational noise impacts from fixed facilities and infrastructure such as traction power substations, modifications to the stabling and maintenance facility and light rail stops, including noise trigger levels.
<i>Rail Infrastructure Noise Guideline</i> (RING) (EPA, 2013)	Assessment of operational noise impacts from light rail movements to sensitive receivers, including noise trigger levels.
<i>NSW Road Noise Policy</i> (RNP) (DECCW, 2011)	Assessment of a road traffic noise impacts associated with the project during construction and operation, including noise trigger levels.
<i>Development Near Rail Corridors and Busy Roads – Interim guideline</i> (DoP, 2008)	Relevant for new noise and vibration sensitive development adjacent to the light rail alignment.
<i>Structural Vibration – effects of vibration on structures</i> (DIN 4150-3) (German Standards, 1999)	Determining relevant criteria for cosmetic damage to vibration sensitive structures of heritage significance (if found to be structurally unsound) and buried pipework/utilities.
<b>Additional guidelines referenced in this assessment</b>	
<i>Construction Noise and Vibration Strategy and Addendum</i> (CNVS) (Transport for NSW, 2019a)	Assessment of construction noise and vibration impacts for Transport for NSW rail projects and determination of additional mitigation measures for residual noise impacts following the application of reasonable and feasible mitigation measures.
<i>Evaluation and measurement for vibration in buildings Part 2</i> (BS7385) (British Standards, 1993)	Determining relevant criteria for cosmetic damage to vibration sensitive (non-heritage) standard structures (e.g. residential dwellings).
<i>Environmental Noise Management Manual</i> (ENMM) (RTA, 2001)	This document regarding operational road traffic noise is mostly superseded by the RNP, however is referenced by Transport for NSW to address Lmax noise levels associated with operational road traffic noise to identify potential sleep disturbance impacts (e.g. from heavy vehicle pass-bys or vehicles crossing over rail tracks).

## 2.2 Study area

### 2.2.1 Noise catchment areas

The study area for the noise and vibration assessment was developed based on the potential extent of the impacts of project activities including:

- construction activities at work areas and compounds
- construction heavy vehicle routes
- noise and vibration generated by the operation of light rail vehicles and permanent infrastructure.

The study area was been divided into 20 Noise Catchment Areas (NCAs labelled 'A' to 'T') based on the types of sensitive receivers and acoustic environments as shown on Figure 2.1). Table 2.2 provides a description of the typical land use types within each NCA.

**Table 2.2** Description of Noise Catchment Areas (NCAs)

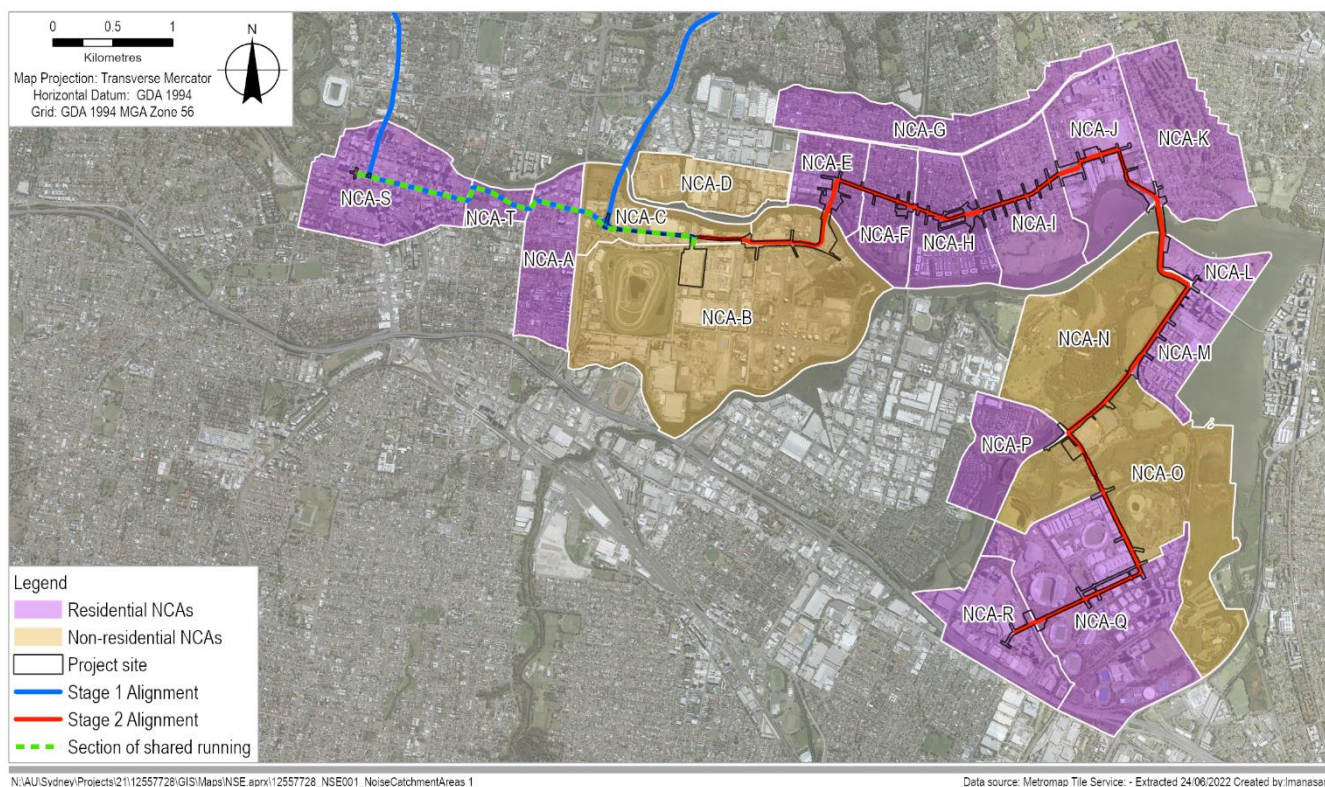
NCA	Area	Description
A	Camellia and Rosehill	Typically, urban and suburban residential land uses in Camellia and Rosehill (to the west of James Ruse Drive) and includes non-residential receivers such as Rosehill Public School, Rosehill Community Preschool, Rosehill Bowling Club and The Camellia Hotel.
B	Camellia industrial area	No existing residential land uses. Typically, industrial land uses to the east of James Ruse Drive and includes Rosehill Gardens Racecourse.
C	Camellia Master Plan area	Area identified for future redevelopment (Camellia town centre of mixed land uses) as shown in the Draft Camellia-Rosehill Place Strategy (DPIE, 2021) (area to the east of James Ruse Drive and South of Parramatta River). There are no existing residential land uses and typically consists of industrial and commercial land uses.
D	Rydalmere industrial area	Industrial area in Rydalmere to the north of Parramatta River and west of Park Road.
E	Rydalmere suburban area 1	Typically, suburban residential land uses in Rydalmere and includes non-residential land uses such as Rydalmere Public School, Saeum Presbyterian Church and Immanuel Australia Church.
F	Rydalmere suburban area 2	Typically, suburban residential land uses in Rydalmere, north of Parramatta River, south of Victoria Road and west of Silverwater Road.
G	North of Victoria Road	Typically, urban and suburban residential land uses north of Victoria Road in Rydalmere and Ermington (generally > 300 metres from the project site).
H	Ermington suburban area 1	Typically, suburban residential land uses in Ermington, north of Parramatta River, south of Victoria Road and west of Silverwater Road and east of Spurway Street. Includes non-residential land uses such as Future Starts Early Learning Centre, and commercial receivers directly south of Victoria Road.
I	Ermington suburban area 2	Typically, suburban residential land uses in Ermington, north of Parramatta River, south of Victoria Road, east of Spurway Street and west of Atkins Road. Includes non-residential land uses such as Rydalmere East Public School, Ermington Rainbow College, Tiny Scholars Childcare and Little Explorers Learning Centre.
J	Ermington and Melrose Park redevelopment area	Existing residential and industrial land uses in Ermington and areas identified for future redevelopment (mixed-use), including Melrose Park north precinct (approved for redevelopment) and Melrose Park south precinct (development application under consideration). Includes non-residential receivers such as Melrose Park Public School and Brethen Church.
K	Melrose Park/West Ryde suburban area	Typically, suburban residential land uses in Melrose Park and West Ryde, east of Wharf Road and north of Parramatta River. Includes non-residential receivers such as Ryde Parramatta Golf Course and Melrose Family Day Care.
L	Wentworth Point (near Ferry)	Typically, urban residential and mixed-use high-rise developments in Wentworth Point including Sanctuary Wentworth Point (partially constructed). Includes non-residential receivers such as Wentworth Point Public School and commercial receivers on the ground floor of mixed-use developments.

NCA	Area	Description
M	Wentworth Point (east of Hill Road)	Typically, urban residential buildings, mixed-use developments and commercial premises to the east of Hill Road and west of Parramatta River. Includes the approved redevelopment of an existing industrial site to a residential/mixed-use development at 37-39 Hill Road.
N	Sydney Olympic Park – west of Hill Road	Typically, open space (passive recreation) within Sydney Olympic Park (west of Hill Road, south of Parramatta River and east of Silverwater correctional facility) and includes non-residential receivers such as Sydney Olympic Park Lodge, Armory Theatre, Sydney Disc Golf Club and Birdlife Australia Discovery Centre.
O	Sydney Olympic Park – east of Hill Road	Typically, open space (passive recreation) within Sydney Olympic Park (east of Hill Road) and includes non-residential receivers such as the future URBN SURF wave pool (under construction) and the Sydney Olympic Park Archery Centre.
P	Newington	Typically, suburban residential receivers located within Newington.
Q	Sydney Olympic Park centre	Typically, commercial buildings within Sydney Olympic Park and includes residential and mixed-use buildings, hotels, Stadium Australia, Qudos Bank Arena, Sydney Showground and sports centres. Includes an area identified for future redevelopment in the <i>Sydney Olympic Park Master Plan 2030</i> (Sydney Olympic Park Authority, 2018).
R	Carter Street precinct, Lidcombe	Area identified for future (mixed-use) redevelopment that has already commenced as shown in the <i>Carter Street Master Plan</i> (DPIE, 2020). Existing land uses include high-rise residential buildings, commercial premises and industrial premises.
S	Parramatta CBD and surrounds	Typically consists of medium and high-rise commercial buildings with mixed-use developments in the CBD. Low-density residential dwellings are situated on the outskirts of the CBD area. Non-residential land uses include various places of worship, educational institutes, childcare centres and hotels/motels.
T	Parramatta suburban area	Typically consists of low and medium density residential buildings with scattered commercial buildings. Non-residential land uses include various places of worship, educational institutes, childcare centres and hotels/motels.

Receivers located in NCA-T, between NCA-A (Camellia and Rosehill) and NCA-S (Parramatta CBD and surrounds), would only be impacted by operational noise from the project. This would be a result of increased light rail vehicle traffic volumes on the existing Stage 1 alignment when Stage 2 is operational (between the Macquarie Street turnback and the Sandown Boulevard light rail stop).

The receivers in NCA-T would not be affected by construction noise from the project as there is a sufficient separation distance from the works that construction related impacts would be negligible. As such, receivers in NCA-T have not been included in the construction noise and vibration assessment.

Operational noise and vibration impacts to the receivers between the Macquarie Street turnback facility and the Sandown Boulevard light rail stop in Camellia have been assessed separately in section 4.3.



**Figure 2.1** Noise Catchment Areas

## 2.2.2 Construction study areas

### 2.2.2.1 Construction noise study area

The construction noise study area includes the sensitive receivers identified in each of the NCAs except for NCA-T (see Figure 2.1). The construction noise study area has been selected to ensure all potential construction noise impacts are captured.

### 2.2.2.2 Construction vibration study area

The study area to assess potential vibration impacts during construction is 100 metres from the project site as vibration impacts are not expected beyond that distance. This includes unreinforced and reinforced buildings, sensitive infrastructure (such as wharfs and train stations), built heritage items such as buildings or structures and Aboriginal heritage sites.

There could be potential for direct and indirect impacts associated with surface vibratory intensive works near Aboriginal sites. To identify potential impacts, Aboriginal sites within 100 metres of the project site have been assessed similarly to buildings of heritage significance. It has been assumed that other items of environmental heritage, such as wetlands, would not be indirectly affected by vibration intensive works.

## 2.2.3 Operation study areas

### 2.2.3.1 Airborne noise and ground-borne noise and vibration of light rail vehicles

The study area for the operational noise and vibration assessment is 150 metres from the light rail alignment as noise and vibration levels experienced at sensitive receivers outside of this distance are predicted to be well below the relevant trigger levels.

### **2.2.3.2 Airborne noise from fixed infrastructure**

For the operational noise assessment of fixed infrastructure (traction power substations, light rail stops and the modifications to the stabling and maintenance facility at Camellia), noise levels have been assessed at the nearest identified existing and future sensitive receivers. The assessment of impacts to the nearest sensitive receivers ensures that the worst-case impacts are identified and appropriate mitigation measures can be recommended.

## **2.2.4 Identification of sensitive land uses**

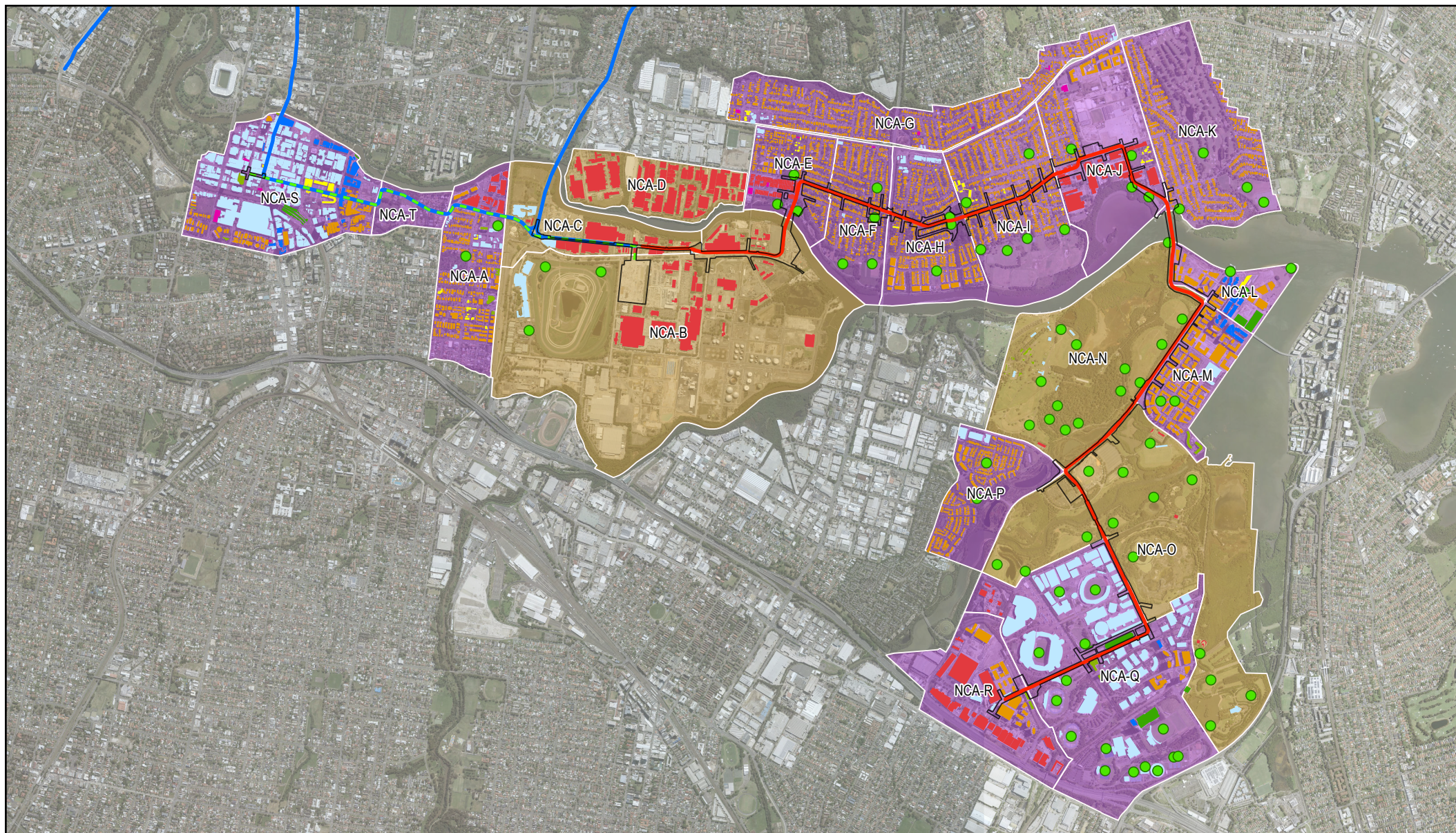
### **2.2.4.1 Sensitive receivers**

Noise sensitive land uses are defined based on the type of occupancy and the activities performed in the land use. For the purposes of this assessment, receivers sensitive to noise and vibration have been categorised as:

- residential – residences and mixed-use developments (typically commercial on the ground floor and residential above)
- non-residential:
  - educational institutes and classrooms at schools
  - hospital wards and operating theatres (not applicable to the study area)
  - places of worship
  - passive and active recreational areas such as parks, sporting fields, golf courses. Note that these recreational areas are only considered sensitive when they are in use or occupied
  - hotels and other temporary accommodation buildings
  - commercial buildings including businesses, retail, offices, sports centres, bars/cafes etc.
  - industrial premises.

The sensitive receivers identified in the study are shown in Figure 2.2 and listed in detail in Appendix B.





#### Legend

- |  |  |  |
|--|--|--|
| <span style="color: blue;">—</span> Stage 1 Alignment                    | <span style="color: green;">●</span> Open area receiver      | <span style="color: blue;">■</span> Mixed use        |
| <span style="color: green;">- - -</span> Shared running with PLR Stage 1 | <span style="color: lightblue;">■</span> Sensitive Receivers | <span style="color: green;">■</span> Non-sensitive   |
| <span style="color: red;">—</span> Stage 2 Alignment                     | <span style="color: yellow;">■</span> Commercial             | <span style="color: pink;">■</span> Place of worship |
| <span style="border: 1px solid black;"> </span> Project site             | <span style="color: orange;">■</span> Educational institute  | <span style="color: orange;">■</span> Residential    |
| <span style="color: purple;">■</span> Residential NCAs                   | <span style="color: green;">■</span> Hotel                   |  |
| <span style="color: tan;">■</span> Non-residential NCAs                  | <span style="color: red;">■</span> Industrial                |  |

Paper Size ISO A4  
0 0.5 1  
Kilometres

Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 56



Transport for NSW  
Parramatta Light Rail Stage 2 EIS  
Noise and vibration impact assessment

Project No. 12557728  
Revision No. -  
Date 28/06/2022

**Sensitive receivers**

**FIGURE 2.2**



#### 2.2.4.2 Planned development adjacent to the rail alignment

A review of recent major development applications has been undertaken to capture new developments adjacent to the project site, where information is available. The following planned developments have been included in this assessment.

- The Melrose Park North Planning Proposal applies to land at 8, 38-42, 44 & 44A Wharf Road, Melrose Park, 15-19 & 27-19 Hughes Avenue and 655 Victoria Road, Ermington. The majority of the existing buildings within this precinct either have been, or would be removed to be, redeveloped. The noise assessment assumes there are no existing sensitive receivers within this area. Future development in this area should be designed to comply with the requirements of the Transport and Infrastructure SEPP during the operation of the project.
- Sanctuary Wentworth Point (14-16 Hill Road, Wentworth Point). This is broken up into six phases with separate development applications. Phase 1 has been completed and the remaining phases are yet to be constructed. This assessment assumes all phases would have been built as per the Development Application (DA) architectural plans.
- Demolition of existing buildings and construction of multi-level residential buildings at 37-39 Hill Road, Wentworth Point. The assessment assumes the development has been built as per the DA architectural plans.
- An open water surf facility (URBN SURF) currently under construction in Sydney Olympic Park on the corner of Hill Road and Holker Busway.
- New residential developments in the Carter Street Precinct (Phase 3 and 4). The assessment assumes the following developments have been built as per their DA architectural plans:
  - 4-8 Uhrig Road
  - 5 Uhrig Road
  - 11A and 13 Carter Street.

The land use survey would be updated regularly to ensure new developments are captured and included in the Noise and Vibration Management Plan (NVMP) prior to construction works.

#### 2.2.4.3 Future urban growth areas

Several areas of land adjacent to the project site have been identified for future urban growth. These urban growth proposals are generally in the early stages of planning with limited information available to be included in the modelling and assessment. Where planned rail infrastructure projects (and/or corridors) have been approved, it is reasonable for a developer and consent authority to consider such approved projects in accordance with the requirements of the Transport and Infrastructure SEPP.

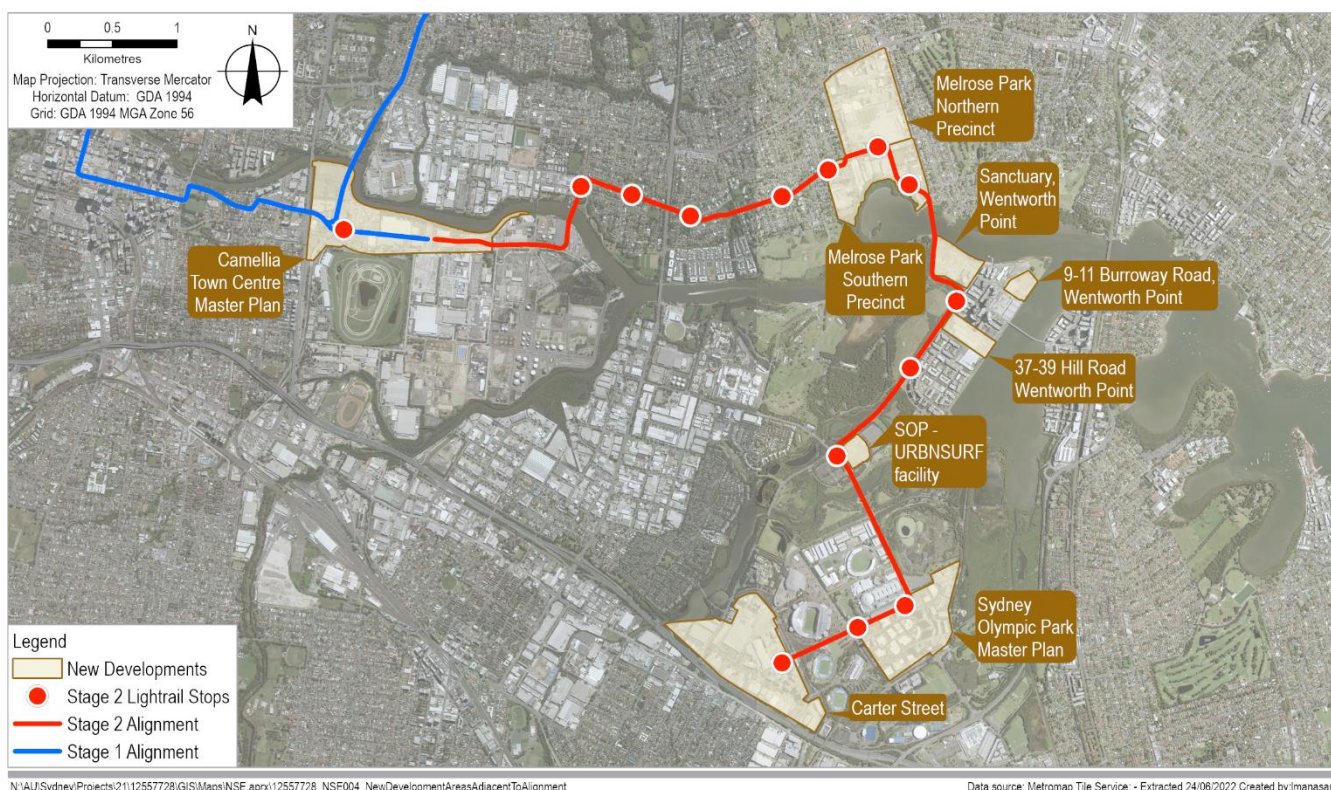
It is expected that future development in the following areas would consider the Parramatta Light Rail Stage 2 rail alignment to ensure the requirements of the Transport and Infrastructure SEPP can be achieved:

- the *Draft Camellia-Rosehill Place Strategy* (DPIE, 2021) has been made public for review and includes the redevelopment of areas within Camellia and Rosehill, including the Camellia town centre
- the Melrose Park North Planning Proposal applies to land at 8, 38-42, 44 & 44A Wharf Road, Melrose Park, 15-19 & 27-19 Hughes Avenue and 655 Victoria Road, Ermington
- the Melrose Park South Planning Proposal applies to two separate sites owned by Holdmark at 112 Wharf Road and 30 & 32 Waratah Street, Melrose Park (east site) and 82 Hughes Avenue, Ermington (west site)
- various areas identified within the Sydney Olympic Park Master Plan 2030 to include more residential homes, education sites, local parks and retail spaces, amongst other changes
- proposed land zoning changes Auburn Local Environmental Plan 2010 as part of the *Carter Street Precinct Master Plan* (DPIE, 2020), primarily to include 700 new homes, a future primary school and open space.

Future development in these areas should consider the potential operational noise and vibration impacts of the project based on the outcomes of this assessment, with consideration to the Transport and Infrastructure SEPP and the *Development Near Rail Corridors and Busy Roads – Interim Guideline* (DoP, 2008).

Future noise contours for the Camellia town centre and the Melrose Park north and south precincts are presented in section 4.1.5.2 to assist with planning in these areas. These areas are located directly adjacent to the light rail alignment with significant land use changes planned in the future.





**Figure 2.3** New development areas adjacent to the Stage 2 light rail alignment

#### 2.2.4.4 Major events

Noise and vibration during construction has the potential to impact major events held at the following locations:

- Rosehill Gardens Racecourse
- Stadium Australia (Accor Stadium)
- Qudos Bank Arena
- Sydney Showground and associated exhibition halls and pavilions.

Predictions have been made to the receiver buildings and at open areas (where relevant) to identify potential noise impacts should construction works occur concurrently with any potential major events.

### 2.2.5 Identification of heritage items in the vibration study area

#### 2.2.5.1 Listed heritage items (State and local significance)

Built items of heritage significance or exposed archaeological sites within 100 metres of the project site have been identified for consideration in the vibration assessment and are presented in Table 2.3 (Parramatta CBD) and Table 2.4 (Camellia to Carter Street precinct). Note should be made that heritage items should not be assumed to be structurally unsound. Should a heritage item fall within the safe working distance for vibratory equipment, investigations would be undertaken at these buildings to determine if there are any buildings or structures within these sites that are structurally unsound.

**Table 2.3** *Heritage listed buildings within 100 metres of the project site (Parramatta CBD)*

Heritage items within 100 metres of the project site	Address	Significance	Listing number
Bicentennial Square and adjoining buildings	188, 188R (part of Church Street road reserve) and 195A Church Street, 38 Hunter Street and 83 Macquarie Street, Parramatta	Local	Parramatta LEP (I651)
Horse parapet facade and potential archaeological site	198–216 Church Street and 38–46 Macquarie Street, Parramatta	Local	Parramatta LEP 2011 (I656)
Archaeological site and associated artifacts	45 Macquarie Street, Parramatta	State	SHR 02027
St John's Anglican Cathedral	195 Church Street, Parramatta	State	SHR 01805 Parramatta LEP (I01805)
Warden's cottage (verger's cottage)	45 Hunter Street, Parramatta	Local	Parramatta LEP (I653)
St John's Parish Hall	191 Church Street Parramatta	Local	Parramatta LEP (I713)
Two-storey residence	41 Hunter Street, Parramatta	Local	Parramatta LEP (I714)
Parramatta Town Hall	182 Church Street Parramatta	Local	Parramatta LEP (I650)
Leigh Memorial Uniting Church	119 Macquarie Street Parramatta	Local	Parramatta LEP (I719)
Roxy Theatre	65-69 George Street Parramatta	State	SHR 00711 Parramatta LEP (I0711)
Woolpack Hotel	19 George Street, Parramatta	Local	Parramatta LEP (I702)
HMV (former Commonwealth Bank)	215 Church Street, Parramatta	Local	Parramatta LEP (I658)
Telstra House (former post office)	211 Church Street, Parramatta	Local	Parramatta LEP (I657)
Murrays' Building (and potential archaeological site)	188A Church St	Local	Parramatta LEP (I652)
Shop (and potential archaeological site)	205 Church Street Parramatta	Local	Parramatta LEP (I655)
Former courthouse wall and sandstone cellblock	235 Church Street, Parramatta	Local	Parramatta LEP (I659)
Kia Ora (and potential archaeological site)	64 Macquarie Street, Parramatta	Local	Parramatta LEP (I716)
Shops	47 George Street, Parramatta	Local	Parramatta LEP (I703)
Marsdens Building	154 Marsden Street, Parramatta	Local	Parramatta LEP (I701)
Centennial Memorial Clock	Centenary Square, Church Street, Parramatta	Local	Parramatta LEP (I654)

**Table 2.4** *Heritage listed buildings within 100 metres of the project site (Camellia to Carter Street precinct)*

Heritage items within 100 metres of the project site	Address	Significance	Listing number
Sewage Pumping Station 67	Grand Avenue North, Camellia	State	State Heritage Register (SHR) 01643 Parramatta Local Environmental Plan (LEP) (I01643)
Pumping Station	41 Grand Avenue, Camellia	Local	Parramatta LEP (I5)
Tram Alignment	Grand Avenue, Camellia	Local	Parramatta LEP (I35)
Rose Farm House	15-17 Honor Street, Ermington	Local	Parramatta LEP (I63)
Well	1 Spurway Street, Ermington	Local	Parramatta LEP (I75)
Bulla Cream Dairy (Willowmere)	64 Hughes Avenue, Ermington	Local	Parramatta LEP (I64)
Ermington Wharf (former Pennant Hills Wharf/Wharf)	Wharf Road, Melrose Park	Local	Parramatta LEP (I82) Ryde LEP (165) SEPP (Biodiversity and Conservation) 2021
State Abattoir locality	1 Herb Elliott Avenue, Sydney Olympic Park	State	State Environmental Planning Policy (Precincts—Central River City) 2021

### 2.2.5.2 Potential heritage items

Based on a visual inspection undertaken as part of the non-Aboriginal heritage assessment (see Technical Paper 5 (Statement of Heritage Impact – Built Heritage), the following properties have been identified to be potential heritage items assessed as having local significance, located within or adjacent to the project site:

- house at 46 John Street, Rydalmere
- house at 69 South Street, Rydalmere
- house at 71 South Street, Rydalmere
- house at 67 Boronia Street, Ermington.

### 2.2.5.3 Aboriginal heritage sites

Technical Paper 4 (Preliminary Aboriginal Cultural Heritage Assessment Report) identified two registered Aboriginal sites (AHIMS 45-6-2977, AHIMS 45-6-4015) which are located on Macquarie Street within the Parramatta CBD section of the project site.

An additional eight potential archaeological deposits (PADs) either within or adjoining the project site were identified during an archaeological field survey for the project:

- PAD1 Ermington Boat Ramp, Melrose Park
- PAD2 Melrose Park Public School Oval (outside project site)
- PAD3 Rydalmere Wharf
- PAD4 Haslams Creek, Sydney Olympic Park
- PAD5 Broadoaks Park, Rydalmere
- PAD6 Ken Newman Park, Ermington
- PAD7 Hill Road West, Sydney Olympic Park
- PAD8 Brickpit, Sydney Olympic Park.

AHIMS sites and PADs have the potential to be directly or indirectly impacted by vibratory intensive works. It is not yet known whether the PADs above may have Aboriginal items that may be sensitive to nearby vibration works and a test excavation program is proposed, prior to construction works, to confirm the presence and sensitivity of Aboriginal archaeology to vibratory intensive works.

### 2.2.5.4 Historical archaeological management units and maritime archaeological areas

Technical Paper 6 (Historical Archaeological Assessment) identified 25 historical archaeological management units (HAMUs) across the project site. Those HAMUs where there is a medium to high potential for non-Aboriginal State significant archaeological resources or high potential for locally significant archaeological resources that, if present, could be impacted by vibration are listed in Table 2.5. Two maritime archaeological management units (MAMUs) were also identified in the riverbed between Camellia and Rydalmere and between Melrose Park and Wentworth Point however both have been identified as having low potential for archaeological resources with no further assessment with respect to vibration required.

**Table 2.5** Key historical archaeological management units with medium to high potential

Reference	Site location
Historical archaeological management units	
HAMU 03	37 & 13 Grand Avenue, Camellia
HAMU 07	Broadoaks Park, Rydalmere
HAMU 11	Ken Newman Park, Ermington
HAMU 15	Ermington Wharf and Archer Park, Melrose Park
HAMU 16	East of Wharf Road and Koonadan Reserve, Melrose Park

### 2.2.5.5 Sensitive transport infrastructure

Sensitive transport infrastructure within 100 metres of the project site include:

- Rydalmere Wharf
- Ermington Boat Ramp
- Sydney Olympic Park Wharf
- Olympic Park Station.

## 2.3 Assessment approach

### 2.3.1 Noise monitoring overview

Noise monitoring was undertaken from Thursday 9 December 2021 until Wednesday 22 December 2021 at 11 residential locations to quantify and characterise the existing ambient noise environment across the study area. The long-term noise monitoring program was undertaken in accordance with *Noise Policy for Industry* (EPA, 2017) and the full noise monitoring methodology is outlined in Appendix C-1, along with the results of the attended noise monitoring survey at each location.

For NCA-G, NCA-P and NCA-S, rating background levels (RBLs) have been sourced from recent acoustic reports in an area representative of most-affected residences in the relevant NCA. The use of previous acoustic assessments to establish RBLs for residences within each relevant NCA is considered appropriate for this project as these noise measurements occurred during conditions that are representative of 'normal' (no COVID-19 related restrictions) traffic and commercial activity.

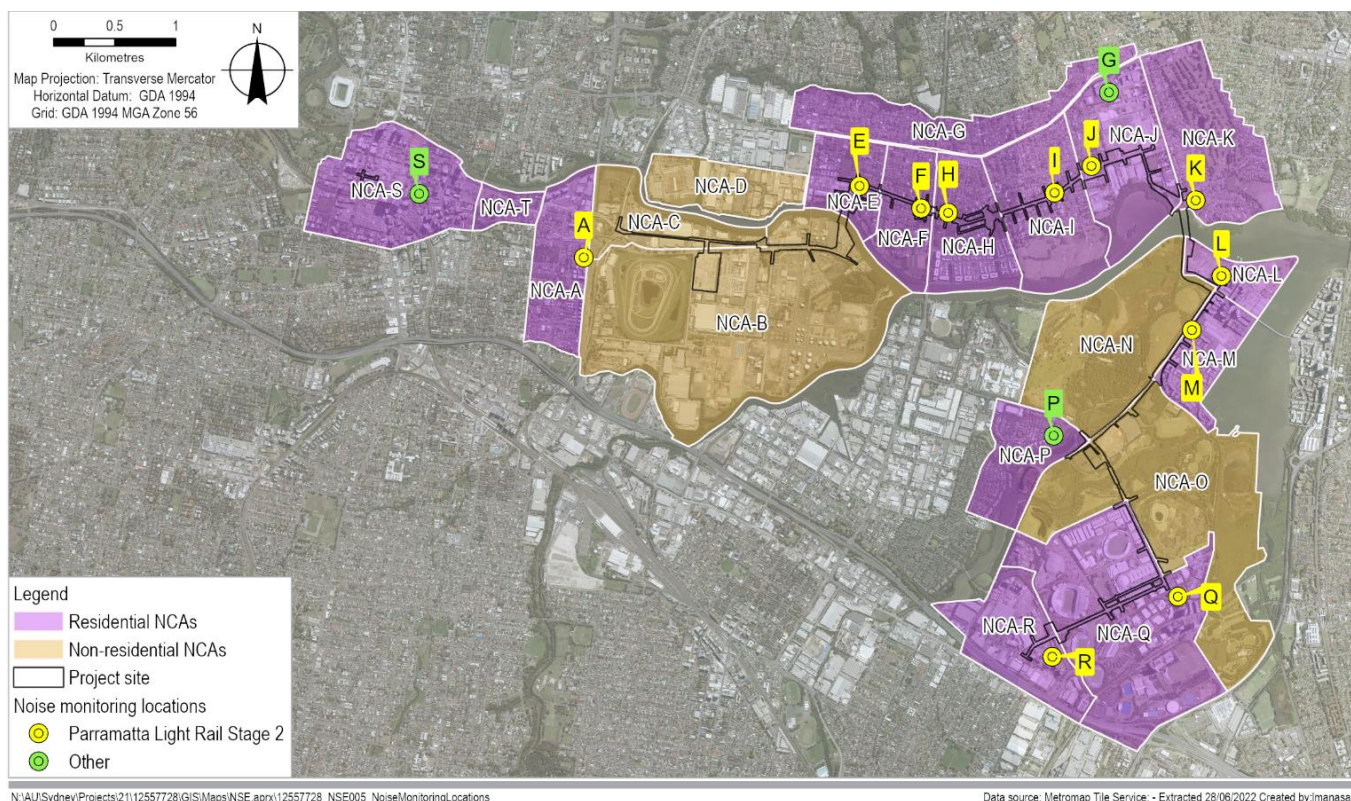
Table 2.6 Source of rating background levels (RBLs) for each NCA with residential land uses

NCA	Source of noise monitoring data
A <sup>1</sup>	Noise monitoring undertaken at 5 Hope Street, Rosehill.
E <sup>1</sup>	Noise monitoring undertaken at 100 South Street, Rydalmere.
F <sup>1</sup>	Noise monitoring undertaken at 168 South Street, Rydalmere.
G	Noise impact assessment for Development Application 659 Victoria Road, 2020 (White Noise Acoustics, 2020). Monitoring location at 657-661 Victoria Road, Melrose Park.
H <sup>1</sup>	Noise monitoring undertaken at 33 River Road, Rydalmere.
I <sup>1</sup>	Noise monitoring undertaken at 55 Boronia Street, Ermington.
J <sup>1</sup>	Noise monitoring undertaken at 9 Hope Street, Ermington.
K <sup>1</sup>	Noise monitoring undertaken at 78 Lancaster Avenue, Melrose Park.
L <sup>1</sup>	Noise monitoring undertaken at 105/16 Hill Road (Sanctuary), Wentworth Point.
M <sup>1</sup>	Noise monitoring undertaken at 286/33 Hill Road (Palermo), Wentworth Point.
P	Acoustic report for Development Application URBNSURF (Wood & Grieve Engineers, 2017). Monitoring location at nearest residences on Blaxland Avenue, Newington.
Q <sup>1</sup>	Noise monitoring undertaken at 101/9 Australia Avenue, Sydney Olympic Park.
R <sup>1</sup>	Noise monitoring undertaken at G59/9 Grazier Street, Lidcombe.
S	Noise monitoring undertaken for Parramatta Light Rail Stage 1 EIS (SLR, 2017). Monitoring location at Arthur Phillip High School.

Note: 1. Noise monitoring data has been undertaken as part of the Parramatta Light Rail Stage 2 EIS

The noise monitoring locations are shown in Figure 2.4. The unattended noise monitoring results are presented in Table 2.7 for each monitoring location.





**Figure 2.4** Unattended noise monitoring locations within the study area

**Table 2.7** Unattended noise monitoring results, dBA

NCA	Rating Background Level <sup>1</sup> (RBL), $L_{A90}(\text{Period})$			Ambient noise descriptors <sup>1</sup> $L_{Aeq}(\text{period})$			Road traffic noise levels $L_{Aeq}(\text{period})$			
	Day	Evening	Night	Day	Evening	Night	$L_{eq}(1 \text{ hour})$ Day	$L_{eq}(15 \text{ hour})$ Day	$L_{eq}(1 \text{ hour})$ Night	$L_{eq}(9 \text{ hour})$ Night
A	51	49	40	61	60	57	62	61	60	57
E	42	39	33	57	55	50	58	56	52	50
F	47	45	36	60	56	59	60	59	55	59
G	47	40	35	64	59	45	-	-	-	-
H <sup>2</sup>	47	45	36	60	56	59	60	59	55	59
I	40	39	35	57	54	50	57	56	51	50
J	43	40	36	59	56	51	59	58	55	51
K	37	37	32	55	50	45	54	54	48	45
L	48	47	38	59	57	51	58	58	54	51
M	53	51	36	63	63	57	64	63	60	57
P	44	45	39	55	54	54	-	-	-	-
Q	50	48	41	59	59	55	60	59	57	55
R	50	48	45	61	52	49	63	60	51	49
S	58	53	43	69	67	62	-	-	-	-

Notes: 1. Day, evening and night periods as defined in the Noise Policy for Industry (EPA, 2017).

2. The noise monitoring equipment at this location failed after four days and is considered insufficient data to establish RBLs in accordance with the NPfI.  $L_{Aeq}$  and RBL values from 168 South Street (NCA-F) has been used to quantify the noise environment for NCA-H. The noise environment is very similar at both locations as they are both suburban residences at similar distances from South Street and Silverwater Road and the measured RBLs was similar for the first four days.

For all of the noise monitoring locations, the background and ambient noise environment is dominated by the local road traffic network. The noise monitoring was undertaken during a period when there was COVID-19 related restrictions in NSW, and as such, there may have been a reduction in traffic and commercial activity in the study area resulting in lower background, ambient and road traffic noise levels.

Noise monitoring undertaken at 5 Hope Street, Rosehill during the Parramatta Light Rail Stage 1 EIS assessment stage (ref: BG10) has been compared to the noise monitoring results during December 2021 to identify any significant differences in noise levels as listed in Table 2.8. The comparison of noise levels indicates the background noise levels are within 1 dB and the ambient/road traffic noise levels are within 2 dB for each measurement period. The comparison indicates that the measurements taken in 2017 (pre-COVID) and 2021 (during COVID restrictions and NSW Health advice) are generally consistent, with the exception that the 2021 road traffic noise levels are slightly lower.

**Table 2.8 Comparison of noise levels – Parramatta Light Rail Stage 1 and Parramatta Light Rail Stage 2**

NCA	Rating Background Level (RBL), $L_{A90}(\text{Period})$			Ambient noise descriptors $L_{Aeq}(\text{period})$			Road traffic noise levels $L_{Aeq}(\text{period})$			
	Day	Eve	Night	Day	Eve	Night	$L_{eq}(1 \text{ hour})$ Day	$L_{eq}(15 \text{ hour})$	$L_{eq}(1 \text{ hour})$ Night	$L_{eq}(9 \text{ hour})$
Parramatta Light Rail Stage 1 (BG10) 2017	51	48	41	61	58	57	64	61	62	57
Parramatta Light Rail Stage 2 (NCA-A) 2021	51	49	40	61	60	57	62	61	60	57

## 2.3.2 Construction noise and vibration assessment overview

The key tasks in the construction noise and vibration assessment are summarised below (a detailed methodology along with key assumptions used is provided in Appendix C-2):

- defined the proposed primary project working construction hours and compared them against the ICNG recommended standard hours including a justification for the extension of standard hours and a supporting case study
- established indicative scenarios associated with construction of the project to be modelled and assessed. For each scenario, the following was taken into account and at this stage are indicative only:
  - construction equipment
  - construction footprint extent
  - works scheduling (hours, timing and duration)
- identified the need for works outside of the primary project working hours
- established NMLs for each sensitive receiver type and at each residential NCA in accordance with the ICNG
- established appropriate vibration management levels for cosmetic damage and human comfort
- developed a 3-dimensional noise model to predict airborne noise levels at sensitive receivers for each of the modelled construction scenarios. The predicted noise levels were then compared against the NMLs (including sleep disturbance) and assessed against the requirements of the ICNG
- qualitatively discussed the effectiveness of at-source and in-transmission mitigation options to reduce potential impacts
- qualitatively assessed the potential residual noise impacts, following the incorporation of mitigation measures
- determined safe working distances for cosmetic damage to buildings (heritage and standard structures) and human comfort due to vibration intensive construction works and identifying buildings that fall within these distances
- provided standard and project specific mitigation measures to reduce the potential of construction noise and vibration impacts due to the construction of the project
- discussed how residual impacts would be addressed by applying additional mitigation measures in accordance with the CNVS
- discussed the potential for cumulative noise impacts and construction fatigue.

### 2.3.3 Operational noise assessment overview

A summary of the key tasks in the operational assessment is provided as follows while a detailed methodology along with key assumptions used is provided in Appendix C-3 (light rail vehicles) and Appendix C-5 (traction power substations):

- Identified and discussed the primary noise and vibration sources associated with the project during its operation, namely:
  - noise from light rail vehicle movements (airborne noise and ground-borne noise and vibration)
  - noise from traction power substations (airborne noise)
  - noise from the stabling and maintenance facility (airborne noise and ground-borne noise and vibration)
  - noise from PA systems at light rail stops (airborne noise).
- Determined relevant noise trigger levels for the light rail infrastructure based on the relevant guidelines in section 2.1.
- Determined key assumptions used for the noise modelling of the light rail track (rolling stock, noise corrections applied to the track, service frequency etc.) based on assumptions used in the Parramatta Light Rail Stage 1 project (EIS and post-approval design documents). These assumptions are summarised in section 4.1.3 and are discussed in detail in Appendix C-3.
- Developed a 3-dimensional noise model of the study area including the definition design of the project and predicting noise levels at sensitive receivers for the opening year and opening + 10 years (including special events). The predicted noise levels were then compared against the RING noise trigger levels to identify receivers that may qualify for mitigation.
- Determined indicative source noise levels for equipment associated with the traction power substations based on previous studies undertaken for Parramatta Light Rail Stage 1. This is discussed in detail in Appendix C-5.
- Predicted noise levels from the traction power substations at sensitive receivers and compared them against the NPfI noise trigger levels to identify any locations where noise trigger levels may be exceeded.
- Provided a qualitative assessment of potential noise impacts associated with the proposed modifications at the stabling and maintenance facility and from PA systems at the proposed and potential light rail stops.
- Discussed reasonable and feasible mitigation measures that can be implemented to reduce potential noise impacts during operation to be considered during the design development process.
- Discussed the effectiveness of mitigation measures based, including lessons learnt from previous light rail projects in NSW, where relevant.

### 2.3.4 Operational ground-borne noise and vibration assessment overview

A detailed methodology for the operational ground-borne noise and vibration assessment is provided in Appendix C-4 along with the key assumptions used in the modelling. A summary of the key tasks in the assessment is provided as follows:

- identified and discussed the primary vibration sources associated with the movement of light rail vehicles
- determined key assumptions used for the modelling of the vibration from the light rail track (rolling stock, corrections applied to the track, service frequency etc.) based on assumptions used in the Parramatta Light Rail Stage 1 project (EIS and post-approval design documents)
- determined relevant ground-borne noise and vibration trigger levels based on the relevant EPA guidelines (see section 2.1)
- predicted ground-borne vibration levels at sensitive receivers using calculations taking into account the minimum distance between the closest track and the receiver building and compared them against the vibration trigger levels

- applied a correction factor to convert the vibration level to a ground-borne noise level based on the predicted vibration levels, I and compared the predicted levels against the trigger levels to identify any potential exceedances at sensitive receivers
- discussed potential ground-borne noise and vibration mitigation options to be considered during the design development process.

### 2.3.5 Road traffic noise during construction

A detailed methodology for the assessment of potential construction traffic noise impacts is provided in Appendix C-6 along with the key assumptions used in the modelling. A summary of the key tasks in the assessment is provided as follows:

- identified the haulage routes that would be used by construction related vehicles and categorising each road by functional hierarchy (for example arterial, sub-arterial, local road)
- estimated the 'pre-construction traffic volumes (including heavy vehicle composition) on these roads
- estimated traffic volumes (including heavy vehicle per cent composition) on these roads during the construction period (pre-construction volumes plus construction traffic generated by the project)
- identified road sections where more than a 2 dB increase is predicted using the Calculation of Road Traffic Noise (CoRTN) prediction method
- assessed the potential changes in road traffic noise against the requirements of RNP and discussed potential mitigation strategies address noise impacts, if required.

### 2.3.6 Road traffic noise during operation

A detailed methodology for the assessment of potential construction traffic noise impacts is provided in Appendix C-7 (screening assessment), Appendix C-8 (maximum noise events) and Appendix C-9 (South Street and Boronia Street realignment) along with the key assumptions used in the modelling. A summary of the key tasks in the assessment is provided as follows:

- identified sections of roads where traffic volumes may change as a result of the project and categorised by functional hierarchy (for example arterial, sub-arterial, local road)
- estimated the 'no build scenario' and 'build scenario' traffic volumes (including heavy vehicle composition) on these sections of road
- identified road sections where more than a 2 dB increase is predicted using the Calculation of Road Traffic Noise (CoRTN) prediction method
- identified sections of road where the road alignment may move closer to existing sensitive receivers as a result of the project
- provided a screening assessment based on 'no-build scenario' and 'build scenario' to predict the change in noise levels at the most-affected receivers to the road, which took into account potential impacts associated with vehicles crossing over rail tracks
- provided a sleep disturbance screening assessment with reference to the *Environmental Noise Management Manual* (RTA, 2001), where the road alignment may move closer to residences and where vehicles would cross over rail tracks near residences
- assessed the potential changes in road traffic noise against the requirements of RNP and discussed the potential mitigation strategies to address noise impacts, if required.



## 3. Construction noise and vibration

### 3.1 Key descriptors

The metrics used to describe noise and vibration levels for the construction noise and vibration assessment are defined in Table 3.1.

**Table 3.1** Key construction noise and vibration metrics

Metric	Description
<b>Noise</b>	
L <sub>Aeq(15min)</sub>	The A-weighted equivalent continuous (energy average) sound pressure level of the construction works under consideration over a 15-minute period which excludes other noise sources such as from industry, road, rail and the community.
L <sub>AFmax</sub>	The A-weighted maximum noise level only from the construction works under consideration, measured using the fast time weighting on a sound level meter.
NML	The noise level where there may be a community reaction to construction noise. Where the predicted or measured construction noise level is above the NML at a sensitive receiver, the proponent should apply all feasible and reasonable work practices to minimise noise.
RBL	Rating background level (RBL) – the background noise level in the absence of proposed construction activities. This parameter represents the noise level exceeded for 90% of the time for a given assessment period (day, evening and night). The RBL is used to set the L <sub>Aeq(15 minute)</sub> NMLs for residential receivers.
<b>Vibration</b>	
PPV	Peak Particle Velocity (PPV) is the greatest instantaneous particle velocity during a given time interval measured in mm/s.
VDV	When assessing intermittent vibration, such as construction activities, the cumulative measurement of the vibration level received a location over the relevant assessment period (day or night) is a Vibration Dose Value (VDV).

### 3.2 Summary of management levels

#### 3.2.1 Construction noise management levels

The *Construction Noise and Vibration Strategy and Addendum* (CNVS) (Transport for NSW, 2019a) outlines the Transport for New South Wales approach to mitigate and manage construction noise and vibration for infrastructure projects and applies to light rail infrastructure works. The CNVS references the *Interim Construction Noise Guideline* (ICNG) (DECC, 2009) for assessing and managing construction noise impacts.

The ICNG contains procedures for determining project specific NMLs for sensitive receivers. The ‘worst-case’ noise levels due to construction works associated with a project are predicted and compared to the NMLs based on a 15-minute assessment period to determine the likely impact at sensitive receivers. The NMLs are not mandatory limits, however where construction noise levels are predicted or measured to be above the NMLs, feasible and reasonable works practices are to be investigated to reduce potential noise impacts.

A detailed description of the derivation of NMLs for sensitive receivers is provided in Appendix E-1. For NCAs with residential land uses, NMLs have been established based on the RBLs measured at each NCA. A summary of residential and non-residential NMLs is provided in Table 3.2 and Table 3.3, respectively.

A comparison of typical noise levels is provided in Figure 3.1 for reference.

## Noise level comparisons

People's perception of noise is strongly influenced by their environment.  
A noise level that is perceived as loud in one situation may appear quiet in another.

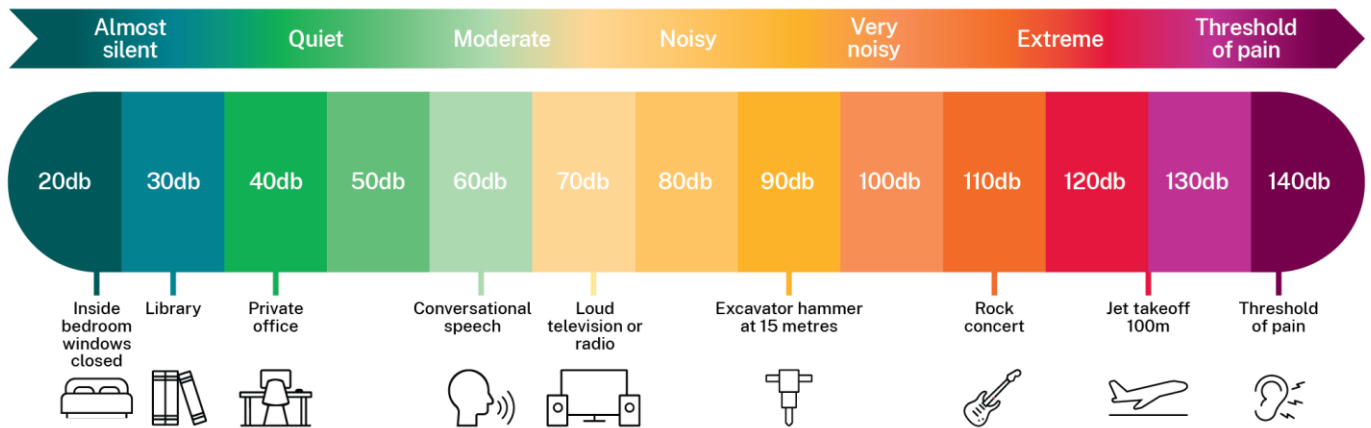


Figure 3.1 Noise level comparisons

Table 3.2 Project specific construction noise management levels – residential, dBA

NCA	Suburb/area	Construction Noise Management Levels, $L_{Aeq}(15min)$					
		ICNG standard construction hours		Outside the ICNG standard construction hours			
		Noise affected (RBL + 10 dB)	Highly noise affected	Day (RBL + 5 dB)	Evening (RBL + 5 dB)	Night (RBL + 5 dB)	Sleep disturbance, $L_{Amax}$
A	Camellia and Rosehill	61	75	56	54	45	55
E	Rydalmere suburban area 1	52	75	47	44	38	52
F	Rydalmere suburban area 2	57	75	52	50	41	52
G	North of Victoria Road	57	75	52	45	40	52
H	Ermington suburban area 1	57	75	52	50	41	52
I	Ermington suburban area 2	50	75	45	44	40	52
J	Ermington and Melrose Park redevelopment area	53	75	48	45	41	52
K	Melrose Park/West Ryde suburban area	47	75	42	42	37	52
L	Wentworth Point (near ferry)	58	75	53	52	43	53
M	Wentworth Point (east of Hill Road)	63	75	58	56	41	52
P	Newington	54	75	49	50	44	54
Q	Sydney Olympic Park centre	60	75	55	53	46	56
R	Carter Street precinct	60	75	55	53	50	60
S	Parramatta CBD	68	75	63	58	48	58

Note: 1. The NMLs apply at the residential receivers within each NCA.

**Table 3.3** Project specific construction noise management levels – non-residential receivers

Land use	Noise management level $L_{Aeq}(15min)$
Classrooms at schools and other educational institutions	External 55 dBA <sup>1</sup>
Hospital wards and operating theatres (not applicable to study area)	External 55 dBA <sup>1</sup>
Places of worship	External 55 dBA <sup>1</sup>
Active recreation	External 65 dBA
Passive recreation	External 60 dBA
Commercial premises	External 70 dBA
Industrial premises	External 75 dBA
Hotels, temporary accommodation	External 70 dBA (day/eve)/50 dBA (night)

Note: 1. External noise levels are set at 10 dB above internal noise levels based on assumed attenuation of an open window.

### 3.2.2 Ground-borne noise management levels

Ground-borne construction noise is usually present on tunnelling projects when equipment such as tunnel boring machines, road headers, rock-hammers and drilling rigs are operated underground where this is no contribution or minimal contribution from airborne noise during construction. As no tunnelling works are proposed as part of the project, airborne noise impacts are likely to dominate and ground-borne noise impacts are not anticipated at residential or commercial receivers. For critical spaces such as recording, studios, cinemas and operating theatres, an assessment of ground-borne construction noise for surface construction works (such as rock-breaking) may be required.

The ICNG NMLs for construction related ground-borne noise to assess impacts to amenity and sleep during the evening and night periods at residences are presented below:

- evening (6 pm – 10 pm) internal  $L_{Aeq}(15 min)$ : 40 dBA
- night (10 pm – 7 am) internal  $L_{Aeq}(15 min)$ : 35 dBA.

These impacts only apply if and when the ground-borne noise levels are higher than the airborne noise levels for the same activity. As no critical spaces have been identified within 200 metres of the project site, it is anticipated that airborne NMLs would be exceeded before ground-borne NMLs at sensitive receivers (for example airborne noise levels would be higher than ground-borne noise levels when assessed internally). As such, during construction, an assessment of ground-borne noise impacts to sensitive receivers is not necessary.

### 3.2.3 Vibration management levels

The assessment and measurements of cosmetic damage to structures and pipework is based on peak particle velocity (PPV) in mm/s. The vibration screening levels used in this assessment have been based on *BS7385 Evaluation and measurement for vibration in buildings* (British Standards, 1993) for reinforced and unreinforced buildings and *DIN 4150-3 Vibration in Buildings – Part 3* (German Standards, 1999) for structurally unsound heritage items as vibration guide values to assess the minimum risk of vibration induced damage.

The assessment and measurement of human comfort due to intermittent vibration (e.g. construction vibratory intensive works) is based on a Vibration Dose Value (VDV) as presented in *Assessing Vibration: A Technical Guideline* (AVTG) (DEC, 2006). The estimated VDV (eVDV) takes into account the level and duration of vibration events at a receiver location. The relevant vibration screening levels are listed in Table 3.4 and are consistent with the guide values adopted in Transport for NSW's CNVS. Further detail regarding the vibration management levels is provided in Appendix E-2, including VDV values for the assessment and measurement of intermittent vibration (human comfort).

**Table 3.4**      *Vibration levels for human comfort and cosmetic damage*

Vibration impact type	Impact	Screening level	Source
Human comfort	Human comfort to building occupants	See eVDV levels in Appendix E-2	CNVS/AVTG
Cosmetic damage to structures	Reinforced structures	PPV 25 mm/s	CNVS/BS7385 (guide values reduced by 50%)
	Unreinforced structures/residential dwellings	PPV 7.5 mm/s	CNVS/BS7385 (guide values reduced by 50%)
	Heritage items that are classed as structurally unsound	PPV 2.5 mm/s	CNVS/DIN4150-3
Damage to buried pipework	Steel	PPV 100 mm/s	CNVS/DIN4150-3
	Clay, concrete and metal	PPV 80 mm/s	CNVS/DIN4150-3
	Masonry, plastic	PPV 50 mm/s	CNVS/DIN4150-3

### 3.2.4 Construction road traffic noise

The potential impacts from construction traffic associated with the project when travelling on public roads are assessed under the RNP. An initial screening test is first applied to evaluate if existing road traffic noise levels are expected to increase by more than 2 dB due to construction traffic. Where this is considered likely, further assessment is required using the following relevant road traffic noise criteria:

- existing freeway/arterial/sub-arterial roads:
  - $L_{Aeq}(15\text{hour})$  60 dBA day
  - $L_{Aeq}(9\text{hour})$  55 dBA night
- existing local roads:
  - $L_{Aeq}(1\text{hour})$  55 dBA day
  - $L_{Aeq}(1\text{hour})$  50 dBA night.

Where road traffic noise levels are predicted to increase by more than 2 dBA and the controlling noise criteria (presented above) is also exceeded, feasible and reasonable mitigation and management measures would be considered to minimise impacts.

## 3.3 Construction work description

### 3.3.1 Construction program

The construction program presented within this technical paper provides indicative timing only. The final construction program may vary. Subject to planning approval and procurement, it is anticipated that construction would start in 2025 and the project would take about five to six years to complete. The indicative timing of the main work phases is shown on Figure 3.2, and the first passenger services are proposed to start from 2030/2031. The two bridges over the Parramatta River are expected to take about 30 to 36 months to construct. While the main construction activities would take up to about five four years to complete, the project may be delivered in stages, in particular with early works to facilitate the delivery of the project. Staging would be investigated in detailed project planning and confirmed via a Staging Report. Where the works would be staged at discrete locations these work areas would not remain active for the full duration of construction.

Work phase	2024		2025				2026				2027				2028				2029				2030				2031			
	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Pre-construction preparation																														
Site establishment																														
Main construction works																														
Testing and commissioning																														

Figure 3.2 Indicative construction program

### 3.3.2 Construction hours

Construction works have the potential to result in impacts on the local areas where the project is located. To minimise the potential noise and vibration amenity impacts, construction works are generally undertaken during the following ICNG recommended standard working hours:

- Monday to Friday: 7am to 6pm
- Saturday: 8am to 1pm
- no works on Sundays or public holidays.

The recommended standard hours and out-of-hours works (OOHW) are identified in the CNVS and categorised as: recommended standard hours (ICNG/CNVS), OOHW Period 1 Evening, OOHW Period 1 Day and OOHW Period 2 Night.

As the project would be constructed in sections through busy urban areas and along road corridors for most of its length, construction has the potential to disrupt traffic, particularly at key intersections and critical utility services. To minimise disruptions to traffic, access and services, and associated safety issues, it is proposed to undertake works outside the recommended standard construction hours. The following primary project working hours are proposed:

- Monday to Friday: 7am to 7pm
- Saturday: 7am to 7pm
- Sundays: 7am to 7pm.

Works may also be undertaken during the above hours on public holidays to take advantage of lower traffic volumes at key locations on these days.

Where there is the potential for construction noise impacts no work would be undertaken in that area one weekend per month, except in the following circumstances:

- where a substantial majority of potentially affected receivers agree that the work can be undertaken
- where construction works do not exceed the noise management levels specified in the *Interim Construction Noise Guideline* (DECC, 2009) (Table 3) at residential sensitive receivers
- where emergency work is required to avoid the loss of life or damage to property, or to prevent environmental harm.

Affected receivers in a particular area would be notified of the proposed weekend works schedule between one and three months beforehand. The method for this communication would be detailed in the Community Communication Strategy. Where receivers have the potential to be impacted by more than one construction activity, co-ordination would be occur between the contractors to ensure the scheduled weekend off is consistent.

The extended primary project working hours would:

- shorten the duration of construction in any one location and associated amenity (including noise) and access impacts
- provide the flexibility to program works within the road corridor at times when traffic volumes are lower, minimising the potential for disruption and providing safety benefits for workers and the general public
- enable works within Sydney Olympic Park to be planned around special events.

The proposed primary project working hours fall into all four of the CNVS construction periods as shown as in the striped area in Figure 3.3. As such, construction activities have been assessed against all of the CNVS construction periods and NMLs are established for each of the assessment periods. Where night works are required as part of the project, the relevant construction activities have been assessed to identify potential sleep disturbance impacts.

Hour commencing	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11			
	am	am	am	am	am	am	am	am	am	am	am	am	pm	pm	pm	pm	pm	pm	pm	pm	pm	pm	pm	pm			
Monday																											
Tuesday								Recommended														OOHW			OOHW		
Wednesday	OOHW							standard														Period 1			Period 2		
Thursday	Period 2							construction hours														Evening			Night		
Friday	Night																										
Saturday																											
Sunday									OOHW Period 1												OOHW Period 2						
Public Holidays									Day													Night					

Figure 3.3 ICNG recommended standard hours, CNVS OOHW periods and primary project working hours

### 3.3.3 Works outside of the ICNG recommended standard hours

#### 3.3.3.1 Justification for OOHW

The ICNG states that *'the five categories of works that might be undertaken outside the recommended standard hours are:*

- the delivery of oversized plant or structures that police or other authorities determine require special arrangements to transport along public roads
- emergency work to avoid the loss of life or damage to property, or to prevent environmental harm
- maintenance and repair of public infrastructure where disruption to essential services and/or considerations of worker safety do not allow work within standard hours
- public infrastructure works that shorten the length of the project and are supported by the affected community
- works where a proponent demonstrates and justifies a need to operate outside the recommended standard hours.

Additionally, the ICNG states that *'only works undertaken on public infrastructure need to be undertaken outside the recommended standard hours. This need is typically based on a requirement to sustain the operational integrity of public infrastructure, as works to restore operation of the infrastructure provide benefit to the greater community (that is more than just local residents).'*

*Examples of public infrastructure are:*

- *transport – railways, roads, ferries, airports*
- *utilities – water, electricity or gas, sewerage or drainage'.*

A strong justification is required for works outside of the recommended standard hours. The justification for these works is summarised in Table 3.5.

Where reasonable and feasible, preference would be given to scheduling construction works within the primary project working hours. Construction activities resulting in impulsive, tonal or higher noise emissions (special audible characteristics) would be limited to the ICNG standard recommended hours, where possible, except as permitted by an environment protection licence which would be obtained once the project is approved.

It is proposed that construction works at the stabling and maintenance facility and the recycling of spoil and ballast at the Grand Avenue construction compound be undertaken 24 hours, seven days a week, if required, as it can be demonstrated that, subsequent to the incorporation of reasonable and feasible mitigation measures, the residual noise levels would be below the NML (as listed in section 3.4.6.2). This would include other works in Camellia, such as light rail track and road works, given there is a minimum separation distance of 800 metres between the works and the nearest residences (residences in Rosehill and Rydalmere).

**Table 3.5** *Proposed construction hours and justification for OOHW*

Construction activity	Justification of works outside of the ICNG standard hours	Construction hours	General comments
All construction works	<ul style="list-style-type: none"> <li>– Shorten the duration of construction</li> <li>– Minimising the potential for disruption and providing safety benefits for workers and the general public</li> <li>– Enable works within Sydney Olympic Park to be planned around special events</li> </ul>	<p>Primary project working hours:</p> <ul style="list-style-type: none"> <li>– Monday to Sunday: 7am to 7pm</li> <li>– Public holidays: 7am to 7pm, when required.</li> </ul>	Preference would be given to scheduling construction works to within the ICNG recommended standard hours, where possible, especially for noise intensive activities (high noise levels and/or special audible characteristics from equipment).
<ul style="list-style-type: none"> <li>– Nightworks for the civil and trackworks at the Macquarie Street turnback facility (reference to the following construction scenarios: S05.03, S05.04, S09.03 and S09.04)</li> <li>– Nightworks to construct the track slab and rail works across John Street intersection (ref: S05.03 and S05.04)</li> <li>– Nightworks at the bridge over Silverwater Road – Silverwater Road closure to enable setup of crane (ref: S08.03)</li> <li>– Nightworks for minor kerb adjustments on Australia Avenue, Sydney Olympic Park (ref: S09.03)</li> <li>– Nightworks for finishing works near Hill Road and Holker Street intersection (ref: S09.04)</li> </ul>	Provide the flexibility to program works within the road corridor at times when traffic volumes are lower, minimising the potential for disruption and providing safety benefits for workers and the general public.	Works outside the primary project working hours would be required, including OOHW Period 2 Night works.	<p>Noise intensive works would be restricted to the ICNG recommended standard hours, where possible.</p> <p>Community consultation would be undertaken at the most-affected receivers, where required.</p> <p>Preference would be given to OOHW Period 1 working hours before OOHW Period 2, where possible.</p>
Utility works	Provide the flexibility to program works for impacts to critical utility services at times when demand is lower, minimising the potential for disruption to the general public.	Works outside the primary project working hours may be required at certain sites, including OOHW Period 1 Day/Evening and OOHW Period 2 Night works.	<p>Noise intensive works would be restricted to the ICNG recommended standard hours, where possible.</p> <p>Preference would be given to OOHW Period 1 working hours before OOHW Period 2, where possible.</p>
<p>Spoil and ballast recycling and modifications to the stabling and maintenance facility at Camellia (Ref: S03.01 and S06.01 to S06.05).</p> <p>Track infrastructure works and road works in Camellia with a minimum separation distance of 800 metres from the nearest receivers in Rosehill and in Rydalmere.</p>	Works where it can be demonstrated that, subsequent to the incorporation of reasonable and feasible mitigation measures, the residual noise levels would be below the NMLs (see section 3.4.6.2).	24 hours a day, seven days per week, if required.	This approach would be consistent with Parramatta Light Rail Stage 1 and is considered appropriate as the nearest residences are over 800 metres away.
Construction compounds	Required to support construction activities within the primary project working hours and delivery of large equipment, and materials to construction sites.	<p>Primary project working hours:</p> <ul style="list-style-type: none"> <li>– Monday to Sunday: 7am to 7pm</li> <li>– Public holidays: 7am to 7pm, when required.</li> </ul>	Hoarding recommended around construction compounds adjacent to residential receivers (Section 3.7.3 – Mitigation Measure NV03).

### 3.3.3.2 Community consultation for noise and vibration and the primary project working hours

Community and stakeholder consultation has been undertaken to inform project development as described in Chapter 8 (Community and stakeholder engagement) of the EIS. The overarching engagement plan prepared by Transport for NSW provides for engagement across the following project phases:

1. prior to preparation of the EIS
2. during preparation of the EIS
3. during public exhibition of this EIS
4. during design development and delivery.

Community engagement has included some of the sensitive receivers who would have the potential to experience exceedances of the relevant noise management levels during construction (see section 3.4). Key activities to seek feedback on noise and vibration aspects included:

- A social impact and outcomes online survey between November 2021 and January 2022, which asked respondents to rate potential impacts (including noise and vibration) as very significant, significant, neutral, insignificant, very insignificant or do not know. The survey also asked about what time of day respondents were most concerned about (day time, night-time, both or none of the above).
- A Have Your Say survey between May 2022 and July 2022, which asked respondents to indicate their level of concern about different construction impacts (including noise and vibration) and if they were concerned about potential impacts associated with day works, evening works, night works, all of the above, or none of the above, along with feedback on suggested measures.

The key findings from this engagement, and the process of how receiver feedback has been, and would continue to be, incorporated into the mitigation strategy, is discussed in section 3.7.7.

A case study for extended hours associated with trackworks for Parramatta Light Rail Stage 1 is discussed in Section 3.3.3.3. For Stage 1, feedback from community consultation indicated that the majority of stakeholders had no objection to undertaking works outside the ICNG recommended standard working hours if it resulted in a reduction of the overall construction program duration.

Transport for NSW issued surveys to about 7,000 properties located along the project site to understand the community's preference about how to balance the following factors:

- the primary project working hours
- the overall construction program duration
- receiver amenity during the construction period
- project-specific mitigation and management measures to reduce potential impacts.

The following types of questions were asked in the survey to ascertain the above:

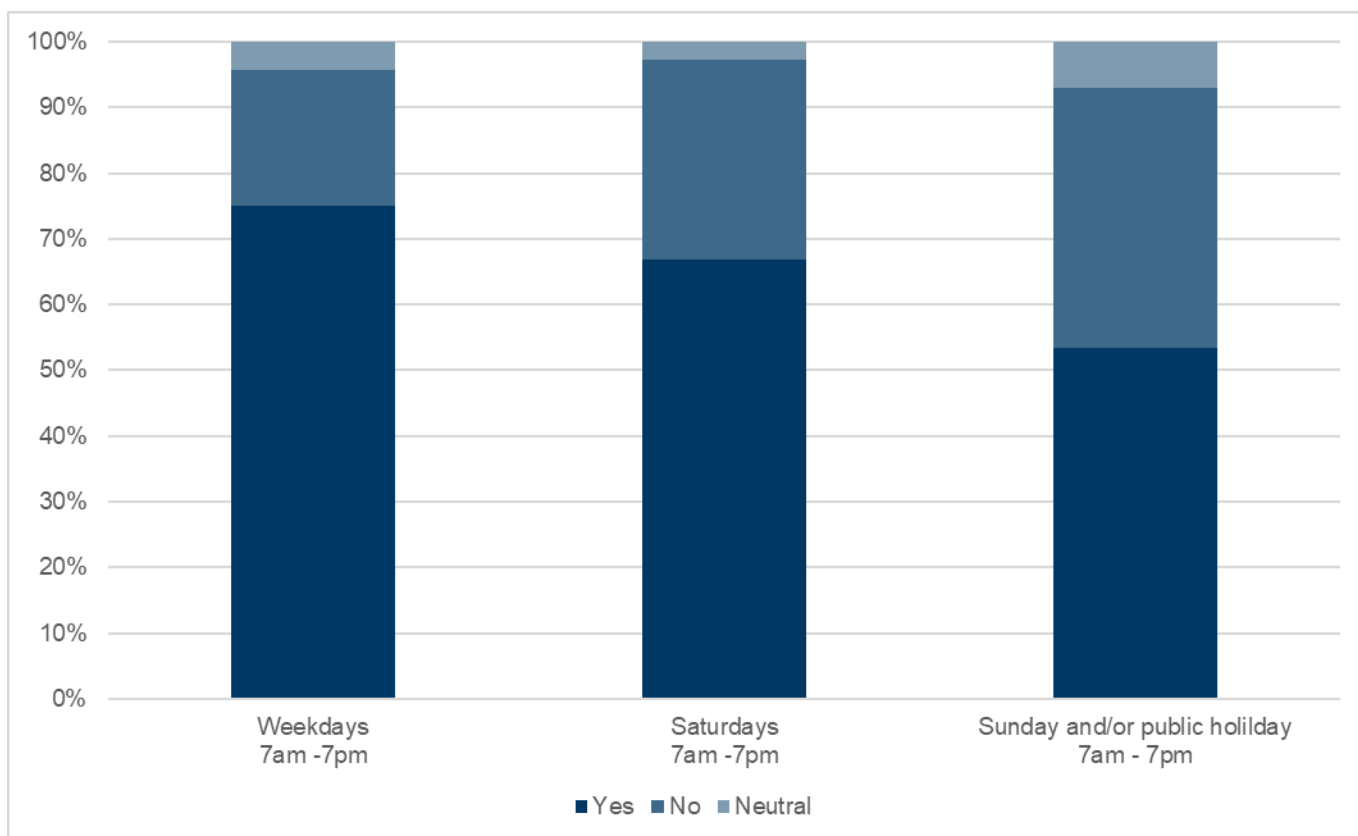
- Would you support extended construction hours (7am -7pm) on weekdays, weekends or Sundays and/or public holidays?
- Do you think extended construction hours would impact your day to day lifestyle?
- If extended construction hours were to be implemented, what mitigations would you recommend?

A total of 257 responses were received from community members. The survey results found:

- About half of respondents believed the extended construction hours would not impact their day to day lifestyle.
- 75 per cent of respondents supported the primary project working hours during weekdays.
- 67 per cent of the respondents supported the primary project working hours on Saturdays.
- 53 per cent of respondents supported the primary project working hours on Sundays and/or public holidays.

The level of support for the primary project working hours is shown in Figure 3.4.





**Figure 3.4** Level of support for primary project working hours

Transport for NSW has considered the feedback received regarding the primary project working hours and have included the requirement for no work to be undertaken one weekend per month to provide respite in areas where there is the potential for construction noise impacts.

### 3.3.3.3 Extended hours case study – Parramatta Light Rail Stage 1 intersection works

A variation was sought to the environment protection license (EPL) 21347 to enable extended Out-of-Hours Works (OOHW) at the intersection of Church Street and George Street, Parramatta in June and July of 2021 for the construction of the track slab and associated services for Parramatta Light Rail Stage 1. Community consultation was undertaken with the affected receivers, including residents and businesses, via a comprehensive door knock campaign, to request feedback on the proposed extension of hours. A total of 126 stakeholders (where the majority of stakeholders were commercial operators) had no objection to the proposed hours (98 per cent of the stakeholders who were consulted) and one stakeholder objected.

For the works at the intersection of Church Street and Phillip Street, Parramatta, similar community consultation was undertaken where feedback was sought from the affected residences and businesses. A total of 62 stakeholders (where the majority of stakeholders were commercial operators) had no objection (94 per cent of respondents) with four stakeholders objecting.

Stakeholders were provided with the additional information regarding the works program, where relevant:

- due to the nature of utility relocation works, safety risks and impacts to traffic, high noise activities are unavoidable at night
- duration of night work schedules, scheduling of noisy works and link to weekly works
- explanation of works being undertaken
- explanation of the plant and equipment being used
- explanation of Parramatta Connect (Parramatta Light Rail Stage 1 construction contractor) Construction Noise and Vibration Management Sub-plan, noise modelling and noise monitoring.

Feedback was requested on the mitigation measures that had been implemented for their suitability and effectiveness. The respondents were satisfied with the information provided and were supportive of the duration reduction to the construction program as a result of the extended hours. Parramatta Connect also collaborated with Bankwest Stadium to minimise impacts, where works during scheduled events were limited to low noise activities between 6pm and 12am, to minimise impacts to adjacent restaurants.

### 3.3.4 Indicative construction activities

Works required to construct the project have been grouped into nine indicative construction scenarios. The exact details of the construction methodology, plant or equipment for the project, such as the intensity of works, sound power levels or operating duration are not yet known, therefore this assessment is based on a variety of conservative assumptions. This information would be refined during the design development process and construction planning where a Construction Noise and Vibration Impact Statement (CNVIS) would be prepared for each site-specific construction activity to determine mitigation measures to be implemented. The CNVIS would be consistent with the Noise and Vibration Management Plan (NVMP) prepared for the project.

The majority of scenarios contain sub-scenarios for various construction activities within the project site to represent activities that would require different noise-generating construction equipment. Table 3.6 presents the various scenarios, sub-scenarios, indicative duration for each sub-scenario and requirements for OOHW night works. The duration is shown as a percentage of the entire construction period showing many of the activities would occur for less than 10 per cent of the entire construction period.

This assessment assumes the 'worst-case' noise impacts, assuming the works are located at the nearest location between the construction area and each receiver location as illustrated in Figure 3.5. The worst-case scenario also excludes mitigation measures such as at-source noise controls and temporary hoarding around construction compounds.

During the construction period, the actual construction noise impacts would vary greatly depending on the following factors:

- location of the work within the project site and the distance to the nearest receiver
- overall duration of the construction works
- intensity of the noise levels
- time at which the construction works would occur
- character of the noise source
- at-source and in-transmission mitigation measures implemented to reduce impacts.

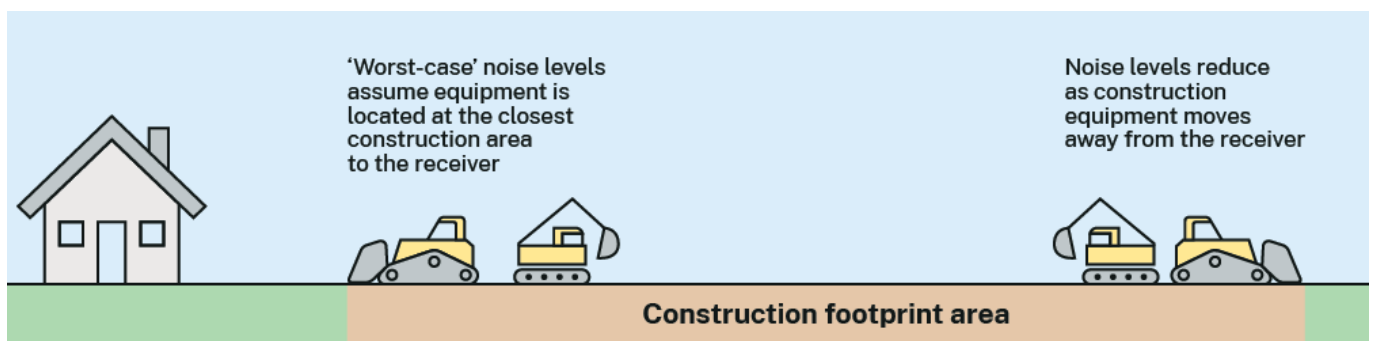


Figure 3.5 Worst-case noise levels for the construction work area

**Table 3.6** *Indicative construction scenarios, hours and duration*

Scenario	Scenario ID	Activity description	Project standard hours	OOHW Day, Evening and Night	Indicative duration (weeks)	Percentage of total construction duration
Demolition and clearing	S01.01	Removal Works	✓	✓	4	2%
	S01.02	Demolition and Clearing	✓	-	10	5%
	S01.03	Removal at the Sandown Line	✓	-	4	2%
Compounds (including clearing)	S02.01	Site establishment	✓	-	4	2%
	S02.02	Services & utilities	✓	-	12	6%
	S02.03	Site deliveries	✓	-	190	100%
Spoil & ballast recycling	S03.01	Screening & crushing	✓	✓	30	16%
Substations	S04.01	Site establishment	✓	-	3	2%
	S04.02	Construction & installation	✓	-	6	3%
Light rail track and public domain works (stabling and maintenance facility to Carter Street)	S05.01	Earthworks	✓	-	8	4%
	S05.02	Earthworks (with breaker/saw)	✓	-	4	2%
	S05.03	Concrete works	✓	✓	8	4%
	S05.04	Trackworks – no tamping	✓	✓	15	8%
	S05.05	Trackworks – with tamping	✓	-	15	8%
	S05.06	Steel erection & wiring	✓	-	5	3%
Modifications to the existing stabling and maintenance facility	S06.01	Earthworks (carpark and track)	✓	✓	17	9%
	S06.02	Concrete works (carpark and track)	✓	✓	62	33%
	S06.03	Trackworks (track only)	✓	✓	42	22%
	S06.05	Steel erection & wiring (track)	✓	-	73	38%
Stops	S07.01	Concrete works	✓	-	3	2%
	S07.02	Finishing works	✓	-	10	5%
Bridges	S08.01	Site establishment	✓	-	23	12%
	S08.02	Pilling - including temporary jetties	✓	-	19	10%
	S08.03	Construction & installation	✓	✓	95	50%
	S08.04	Concrete works	✓	-	34	18%
Roadworks and other pavement works	S09.01	Excavation	✓	-	8	4%
	S09.02	Excavation (with breaker)	✓	-	6	3%
	S09.03	Pavement works	✓	✓	12	6%
	S09.04	Signage and line marking	✓	✓	6	3%

Note: 1. For works occurring outside the primary project working hours, refer to Table 3.5 for their specified locations.

### 3.3.5 Construction work areas

The following sections provide a description of the indicative construction scenarios, including where these works would be required.

#### **S01 – Demolition, removal and clearing**

The project would require the demolition and removal of buildings and structures, including commercial, industrial and residential buildings. Demolition and removal works would also be required at the Silverwater Road pedestrian bridge. Removal works would be required at the former freight rail (Sandown) line in Camellia.

Vegetation clearance, trimming and tree removal/relocation would be required at various locations.

#### **S02 – Construction compounds (including clearing)**

Construction compounds are areas that would be located along the project site and at bridge abutments for construction material storage, site access and egress, waterway access, laydown areas, and to facilitate and enable construction works. The construction compound sites for the project are listed in Table 3.7. Vegetation clearance, trimming and tree removal/relocation would be required at various locations during the site establishment of construction compounds.

Construction compounds would generally include the following facilities:

- site offices
- staff and workforce amenities
- stockpiling of material and laydown areas
- plant and equipment storage
- workshops and maintenance facilities
- workforce parking (where sufficient space is available).

Some construction compounds would also include:

- work areas for larger infrastructure such as bridges, including at compounds 2 (Grand Avenue), 3 (John Street), 8 (Wharf Road) and 9 (Future road)
- soil, water and groundwater treatment facilities – dewatering and water treatment plants are proposed at compounds 2 (Grand Avenue), 3 (John Street) and 8 (Wharf Road)
- erosion and sedimentation control devices, such as sedimentation basins and wheel wash facilities.

For most of the time, construction compounds would not generate significant construction noise emissions. For the purpose of this assessment, the worst-case construction activities that may occur at each compound site have been assessed.

**Table 3.7** *Proposed construction compound sites*

No.	Name	Location	Purpose
1	Grand Avenue west	Grand Avenue, Camellia	Support works along the western section of the project site (including along the Sandown Line and Grand Avenue) in Camellia.
2	Grand Avenue east	Grand Avenue, Camellia	Support works for the bridge between Camellia and Rydalmere from the southern side of the Parramatta River.
3	John Street	John Street, Rydalmere	Support works for the bridge from the northern side of the Parramatta River. It would also provide support for works around John Street and South Street including the John Street stop.
4	Broad Oaks Park	Broad Oaks Park, Primrose Avenue, Ermington	Support works along South Street and bridge works at Silverwater Road.
5	Ken Newman Park west	Ken Newman Park, Hilder Road, Ermington	Support works east of Silverwater Road, including the River Road stop and works within Ken Newman Park.
6	Ken Newman Park east	Ken Newman Park, Heyson Avenue, Ermington	Support works within and around Ken Newman Park, including relocation of the water mains, and works along Boronia Street.
7	Hope Street	Hope Street, Melrose Park	Support works along Boronia Street and Hope Street, and works at the Atkins Road stop.
8	Wharf Road	Future realigned Wharf Road and adjusted car park, Melrose Park	Support works for the bridge between Melrose Park and Wentworth Point from the northern side of the Parramatta River and works for the Waratah Street stop.
9	Wentworth Point north	Future road within Sanctuary Wentworth Point development	Support works for the bridge from the southern side of the Parramatta River, and the Wentworth Point stop.
10	Hill Road north	Hill Road (at Bennelong Parkway), Wentworth Point	Support works along Hill Road including the Hill Road light rail stop.
11	Hill Road south	Hill Road (north of Holker Busway), Sydney Olympic Park	Support works along Hill Road.
12	Holker Busway	Holker Busway, Sydney Olympic Park	Support works along Hill Road and the Holker Busway, including bridge strengthening works and the Holker Busway stop. The compound would include a construction workforce parking area for about 200 vehicles.
13	Australia Avenue	Australia Avenue, Sydney Olympic Park	Support works along Australia Avenue and the Jacaranda Square stop.
14	Dawn Fraser Avenue east	Dawn Fraser Avenue, Sydney Olympic Park	Support works along Dawn Fraser Avenue including the Olympic Boulevard stop.
15	Dawn Fraser Avenue west	Dawn Fraser Avenue, Sydney Olympic Park	Support works at and around the Carter Street stop.

### **S03 – Spoil and ballast recycling**

Screening and crushing plant to recycle spoil and ballast from the former freight rail (Sandown) line in Camellia would be located at the Grand Avenue construction compound site. The site is currently surrounded by industrial land uses with the nearest residences located more than 600 metres away in Ermington (north of the Parramatta River).

### **S04 – Substations**

Five traction power substations would be constructed for the project and located in Camellia, Rydalmere, Melrose Park, Wentworth Point and Sydney Olympic Park.

## **S05 – Light rail track and public domain works**

The track infrastructure works required to construct the project can be categorised as civil engineering works, pavement works, rail installation works (embedded, permeable or ballast) and overhead-wiring poles and street lighting. The exact chainages for each trackform type would be finalised in the design development process and as such, equipment required to construct all trackform types have been assumed for the entire alignment as a worst-case.

This would also include public domain works at various locations along the project alignment to ensure a safe and efficient interface between the light rail and the pedestrian footpaths. Additionally, some clearing works may be required to allow for the track infrastructure.

The track between the Parramatta CBD and the turn-off to the stabling and maintenance facility at Camellia is being constructed as part of Parramatta Light Rail Stage 1.

## **S06 – Modifications to the stabling and maintenance facility**

The stabling and maintenance facility at Camellia would be modified to increase stabling capacity, including:

- construction of six new stabling tracks for the increased light rail vehicle fleet
- construction of two new turnouts to connect the Stage 1 and Stage 2 stabling areas
- construction of a new car park for staff and an access road within the site
- installation of associated drainage, services and overhead wiring for new tracks
- installation of light rail systems and operational infrastructure.

## **S07 – Light rail stops**

Construction works for light rail stops and interchanges would occur concurrently with the track infrastructure works or may be constructed separately depending on the preferred construction methodology. A total of 14 stops proposed along the alignment have been assessed from Sandown Boulevard, Camellia to the Carter Street precinct, Lidcombe along with two potential future stops (as a worst-case).

## **S08 – Bridges and culverts**

A number of new bridges are proposed for the project, one over Parramatta River between Camellia and Rydalmere, one over Silverwater Road between Rydalmere and Ermington, and another over the Parramatta River between Melrose Park and Wentworth Point.

Other bridge works include a new bridge over the drainage gully at the eastern end of Ken Newman Park, duplication of the bridge at Hill Road and strengthening of the Holker Busway bridge in Sydney Olympic Park.

Bridge construction works would typically involve the following activities:

- preparation of the bridge construction work areas, such as demolition of existing structures and earthworks
- installation of the temporary work platforms for those bridges over Parramatta River
- installation of piled foundations
- construction of formwork, steel reinforcement and pouring concrete for pier caps to support the bridge
- mobilisation of the crane and installation of precast beams or culverts
- installation of drainage behind abutments
- concrete pouring for the deck slab and edge barriers
- install handrails, barriers and other safety infrastructure landscaping, scour protection and restoration of disturbed areas.

## **S09 – Road pavement works and other pavement works (including active transport links)**

The general approach to sequencing of works would be to widen the road corridor prior to establishing the track zone. This would enable the long term traffic arrangements to be implemented as early as possible, enabling the light rail corridor to be partitioned permanently.



The road network would be modified in numerous locations (particularly around intersections) to accommodate the track infrastructure and to ensure network management and viability during and following construction.

These works would generally be completed during intersection or road closure periods which may be for a specific extended duration or at night and weekends depending on traffic and access considerations. Works would be carried out in consultation with Transport for NSW, the relevant road authorities, and relevant councils and in accordance with the relevant standards and specifications.

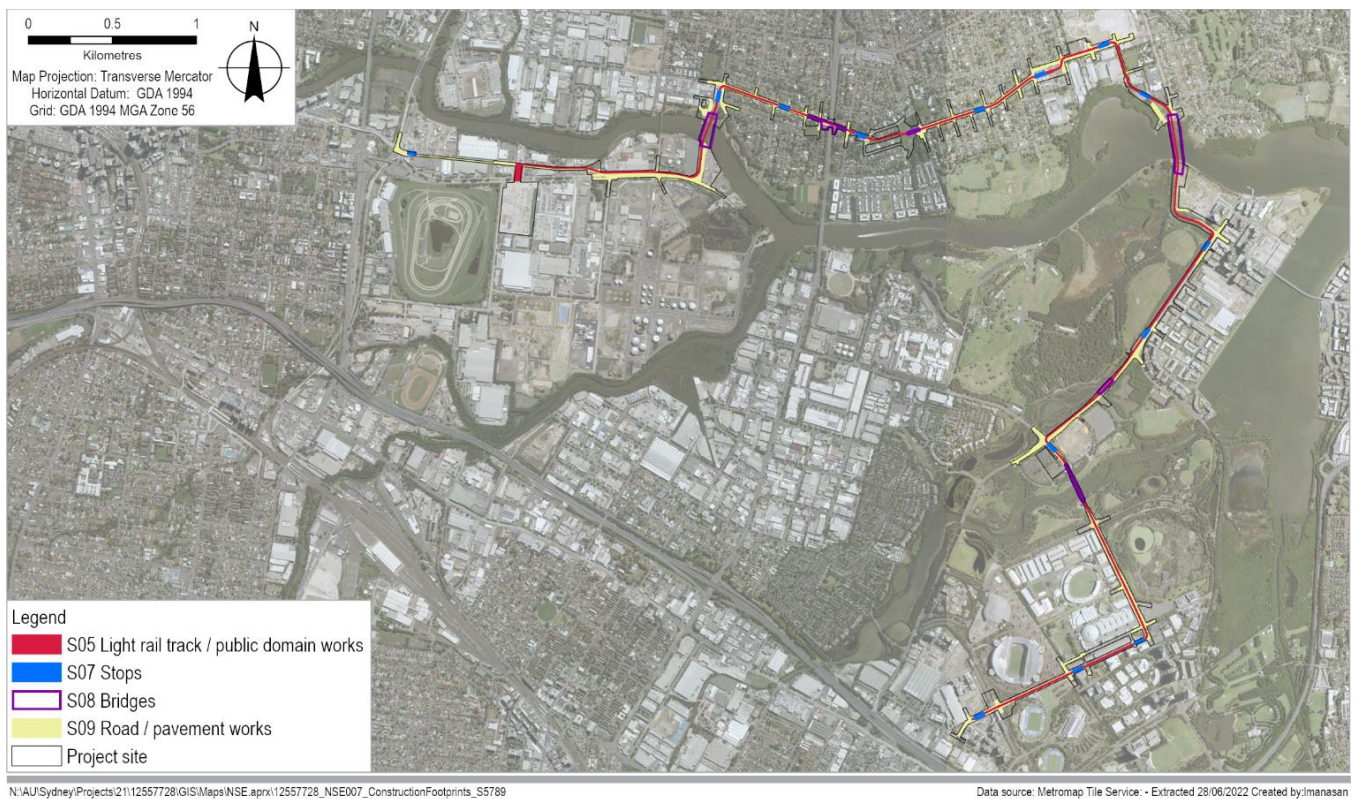
### 3.3.6 Modelled construction work areas

The exact construction work areas would be refined during the design development process. To assess potential impacts from construction activities, indicative construction work areas have been assumed for each scenario seen in Figure 3.6, Figure 3.7 and Figure 3.8.



**Figure 3.6** Indicative construction work areas – S01, S02, S03, S04 and S06 (Camellia to Carter Street)





**Figure 3.7** Indicative construction work areas - S05, S07, S08 and S09 (Camellia to Carter Street)



**Figure 3.8** Indicative construction work areas – S05 and S09 (Parramatta CBD)

### 3.3.7 Construction equipment

The full list of indicative construction equipment assumed for each sub-scenario is listed in Appendix C-2 along with the key assumptions used as inputs in the noise modelling based on information provided regarding the construction staging at this stage of the project.

Noise levels for equipment has been sourced from the CNVS, *AS 2436 Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites* (Australian Standards, 2010) and the GHD internal database where sound power level data was not available. The activity sound power level assumes the two loudest items of equipment for the sub-scenario are operating simultaneously and is representative of the worst-case construction activities occurring.

For each sub-scenario, noise intensive equipment has also been identified and includes equipment that are considered to generate high noise emissions or equipment that contain special audible characteristics such as tonal or annoying qualities. The  $L_{AFmax}$  level, equivalent to the  $L_{AF1(1 \text{ minute})}$ , used to assess potential sleep disturbance assessment is based on the loudest item of equipment for each sub-scenario that has been identified as requiring night work.

The modelled activity  $L_{Aeq(15min)}$  sound power levels for each sub-scenario are listed in Table 3.8, along with the activity maximum  $L_{AFmax}$  sound power levels for the sleep disturbance assessment and relevant noise intensive equipment. The worst-case sub-scenario for each scenario is shaded in grey as the predicted noise levels at receivers are assessed in section 3.4.3.

**Table 3.8** Modelled activity sound power levels, dBA

Scenario	Scenario ID	Activity description	Activity SWL, $L_{Aeq(15 \text{ min})}$ dBA	Activity maximum SWL, $L_{Amax}$ dBA	Noise intensive equipment (High SWL and/or special audible characteristics)
Demolition, removal and clearing	S01.01	Removal Works	110	112 (Compressor)	– None
	S01.02	Demolition and Clearing	123	129 (Rockbreaker)	– Rockbreaker – Chainsaw – Mulcher
	S01.03	Removal Works at the Sandown Line	121	129 (Rail Saw)	– Rail saw
Compounds (including clearing)	S02.01	Site Establishment (including clearing)	117	122 (Chainsaw)	– Mobile crane – Vibratory roller – Chainsaw – Mulcher
	S02.02	Services & Utilities	120	126 (Concrete saw)	– Concrete saw – Excavator
	S02.03	Site Deliveries	115	116 (Mobile crane 50t)	– Mobile crane
Spoil & ballast recycling	S03.01	Screening & crushing	117	123 (Excavator 40t)	– Excavator
Substations	S04.01	Site Establishment	113	116 (Mobile crane 50t)	– Mobile crane
	S04.02	Construction & Installation	114	116 (Mobile crane 50t)	– Mobile crane
Light rail trackworks and public domain works (Stabling and maintenance facility to Carter St)	S05.01	Earthworks	116	123 (Excavator 40t)	– Excavator
	S05.02	Earthworks (with breaker or saw)	123	129 (Rockbreaker)	– Concrete saw – Rockbreaker
	S05.03	Concrete Works	114	116 (Mobile crane 50t)	– Mobile crane



Scenario	Scenario ID	Activity description	Activity SWL, $L_{Aeq}(15 \text{ min})$ dBA	Activity maximum SWL, $L_{Amax}$ dBA	Noise intensive equipment (High SWL and/or special audible characteristics)
	S05.04	Trackworks	122	129 (Rail saw)	<ul style="list-style-type: none"> <li>– Rail saw</li> <li>– Track laying machine</li> <li>– Mobile crane</li> </ul>
	S05.05	Trackworks – Tamping	121	126 (Ballast regulator)	<ul style="list-style-type: none"> <li>– Ballast regulator</li> <li>– Ballast tamper</li> </ul>
	S05.06	Steel Erection & Wiring	114	116 (Mobile crane 50t)	<ul style="list-style-type: none"> <li>– Mobile crane</li> </ul>
Modifications to stabling and maintenance facility	S06.01	Earthworks (car park and track)	118	123 (Excavator 40t)	<ul style="list-style-type: none"> <li>– Excavator</li> <li>– Vibratory roller</li> </ul>
	S06.02	Concrete Works (car park and track)	114	116 (Mobile crane 50t)	<ul style="list-style-type: none"> <li>– Mobile crane</li> </ul>
	S06.03	Trackworks (track only)	123	129 (Rail saw)	<ul style="list-style-type: none"> <li>– Rail saw</li> <li>– Ballast regulator</li> <li>– Ballast tamper</li> <li>– Track laying machine</li> <li>– Excavator</li> <li>– Mobile crane</li> </ul>
	S06.04	Steel Erection & Wiring (car park and track)	114	116 (Mobile crane 50t)	<ul style="list-style-type: none"> <li>– Mobile crane</li> </ul>
Stops	S07.01	Concrete Works	114	116 (Mobile crane 50t)	<ul style="list-style-type: none"> <li>– Mobile crane</li> </ul>
	S07.02	Finishing Works	115	123 (Excavator 40t)	<ul style="list-style-type: none"> <li>– Excavator</li> </ul>
Bridges	S08.01	Site Establishment	114	116 (Mobile crane 50t)	<ul style="list-style-type: none"> <li>– Mobile crane</li> </ul>
	S08.02	Pilling – including temporary work platforms	127	136 (Piling rig (impact))	<ul style="list-style-type: none"> <li>– Impact piling rig</li> <li>– Mobile crane</li> </ul>
	S08.03	Construction & Installation	113	116 (Mobile crane 50t)	<ul style="list-style-type: none"> <li>– Mobile crane</li> </ul>
	S08.04	Concrete Works	114	116 (Mobile crane 50t)	<ul style="list-style-type: none"> <li>– Mobile crane</li> </ul>
Roadworks and other pavement works	S09.01	Excavation	115	123 (Excavator 40t)	<ul style="list-style-type: none"> <li>– Excavator</li> </ul>
	S09.02	Excavation (with Breaker)	124	129 (Rockbreaker)	<ul style="list-style-type: none"> <li>– Rockbreaker</li> </ul>
	S09.03	Pavement Works	118	125 (Asphalt milling machine)	<ul style="list-style-type: none"> <li>– Asphalt milling machine</li> </ul>
	S09.04	Signage and Line Marking	109	116 (line Marking Plant)	<ul style="list-style-type: none"> <li>– None</li> </ul>

## 3.4 Airborne noise impacts

### 3.4.1 Presentation of modelling results

Three chart types have been used to display the predicted noise levels and impacts for each scenario, described below.

- **Noise levels** – a ‘violin’ plot showing the range of predicted noise levels against the NMLs (based on the worst-case construction activity for the scenario)
- **Noise impacts** – a bar chart showing the number of receivers predicted to receive noise levels above the NML for each assessment period (based on the worst-case construction activity for the scenario)
- **Sub-scenario impacts** – a pie chart showing the proportion of receivers in each NML exceedance category for each sub-scenario within a scenario.

The following sections provides a summary of how to interpret these charts. Charts for all sub-scenarios are presented in Appendix F-2 and the key outcomes of the assessment are discussed in the sections below.

Additionally, the number of impacted residences per NCA for each assessment period are shown for the worst-case construction activity in a table. Detailed results at each sensitive receiver location are presented in Appendix F-3 for each sub-scenario.

#### 3.4.1.1 Violin plots to display the predicted noise levels

A ‘violin’ plot has been used to show the predicted noise levels at sensitive receivers for the worst-case activity with a scenario. These plots convey the following information:

- the range of predicted noise levels as the extent across the vertical axis
- the distribution of noise levels for each NCA or non-residential receiver type, with the frequency shown in the extent across the horizontal axis
- the average predicted noise level as a single point within the violin
- the number of receivers in each receiver category are shown above the horizontal axis label
- the applicable NMLs, including out of hours periods and highly noise affected levels for residential receivers. These are shown as a horizontal bar to help demonstrate the number and extent of impacts using the colour scale listed in Table 3.9.

Table 3.9 Noise management levels – colour scale

Sensitive receiver type	Noise management level	Colour used in plots
Residential	ICNG standard hours	Green
	OOHW Period 1 Day	Dark Blue
	OOHW Period 1 Evening	Yellow
	OOHW Period 2 Night	Orange
	Highly noise affected	Black
Non-residential land uses		Light Blue

#### 3.4.1.2 Bar chart to show relative noise impacts

A stacked bar chart has been used to show the number of exceedances above the NML (described in this section as impacts) for the worst-case activity (without mitigation) within a scenario. The stacked bar chart shows the following information:

- the total number of receivers exceeding the relevant NML within each NCA, shown as ‘No exceedance’, ‘<10 dB exceedance’, ‘10-20 dB exceedance’ and ‘>20 dB exceedance’ categories
- for residential receivers, the number of impacted receivers is shown for the ICNG recommended standard hours
- for non-residential receivers, the total number of NML exceedances are shown per receiver type (when they are in use).

The assessment of predicted airborne noise impacts around the project site is based on the exceedance of the NMLs at sensitive receivers. Exceedances of the NMLs have been categorised as either 'No exceedance', '<10 dB', '10 – 20 dB' or '>20 dB'. These exceedance categories are listed in Table 3.10.

**Table 3.10** NML exceedance categories

Exceedance of NML	Colour used in plots
No exceedance	
< 10 dB	
10 – 20 dB	
> 20 dB	

### 3.4.1.3 Pie charts to show noise impacts per sub-scenario

Pie charts have been used to show the relative difference in noise impacts at sensitive receivers for each sub-scenario. These plots convey the following information:

- the proportion of total residential receivers (most-sensitive to noise) predicted to exceed the NML compared to the total number of receivers in the study area
- for the impacted receivers, the proportion of '<10 dB', '10-20 dB' and '>20 dB' NML exceedances predicted compared to receivers that are predicted to experience noise levels below the NML
- the differences of NML exceedances predicted for each CNVS assessment period
- the differences of NML exceedances predicted for sub-scenario within a construction scenario

## 3.4.2 Summary of airborne noise impacts

A summary of the total number of impacts predicted (collectively for all receiver types and NCAs) is presented in Table 3.11 for the following assessment periods:

- ICNG recommended standard hours
- OOHW Period 1 Day
- OOHW Period 1 Evening
- OOHW Period 2 Night
- when in use for non-residential receivers.

Impacts to the key non-residential receivers during the worst-case construction scenarios are listed in the following tables (based on the impact categories listed in Table 3.11):

- Table 3.12 – List of impacted educational institutes and childcare centres
- Table 3.13 – List of impacted recreational/open areas (open areas that would be used as construction compounds are listed in the 'CC' column)
- Table 3.14 – List of impacted commercial buildings
- Table 3.15 – List of impacted hotels
- Table 3.16 – List of impacted places of worship.

Note that many mixed-use developments in Wentworth Point have residential land uses on the ground floor. A conservative approach has been adopted assuming the ground floor of all mixed-use developments have residences on the ground floor (i.e. the more sensitive residential NML has been applied to all mixed-use developments).

The results indicate that without mitigation, works associated with the construction of the track (S05), the road interface (S09) and the works at the bridges (S08) would result in NML exceedances greater than 20 dB during all relevant assessment periods. Demolition works, noise-intensive works at compounds, the construction of traction power substations and stops would also result noise impacts during all relevant assessment periods, however these activities are relatively short-term compared to the trackworks, roadworks and bridge works.



The works associated with the recycling of spoil and ballast and the modification works at stabling and maintenance facility are predicted to result in NML exceedances less than 10 dB during the OOHW night period and can be considered low risk construction activities with regards to noise impacts due to the large separation distance between these areas and the nearest residential receivers.

The predicted noise levels assume no noise mitigation has been applied and informs appropriate mitigation measures to be implemented for the project. Indicative residual noise levels (subsequent to the incorporation of mitigation) are discussed in section 3.4.6.1, for works within the primary project working hours, section 3.4.6.2 for works outside the primary project working hours and section 3.4.6.3 for potential sleep disturbance impacts.

For the sub-scenarios identified as requiring works outside of the primary project working hours (see Table 3.6), the impacts at sensitive receivers with no mitigation applied can be interpreted from the results listed in Table 3.11.

Noise contour plots for the worst-case activities for each construction scenario are shown in Appendix F-1 (assuming no mitigation).

**Table 3.11** Summary of the total number of exceedances above the NML for each sub-scenario and assessment period – without mitigation

Scenario	Scenario ID	Residential																	Non residential			
		Standard hours				Highly noise affected	OOHW Day				OOHW Evening				OOHW Night							
		No exceed.	< 10 dB	10 - 20 dB	> 20 dB		No exceed.	< 10 dB	10 - 20 dB	> 20 dB	No exceed.	< 10 dB	10 - 20 dB	> 20 dB	No exceed.	< 10 dB	10 - 20 dB	> 20 dB	No exceed.	< 10 dB	10 - 20 dB	> 20 dB
Demolition, removal and clearing	S01.01	4122	290	119	34	16	3836	471	187	71	3734	523	220	88	2981	1008	377	199	822	9	1	1
	S01.02	2833	1072	425	235	164	2350	1103	717	395	2142	1150	802	471	1566	923	1231	845	780	29	19	5
	S01.03	4565	-	-	-	-	4563	2	-	-	4549	16	-	-	4378	187	-	-	827	1	5	-
Construction compounds (including clearing)	S02.01	3785	523	197	60	52	3163	954	313	135	2951	1103	352	159	2186	1253	768	358	801	19	6	7
	S02.02	3424	785	261	95	81	2675	1294	400	196	2524	1317	483	241	1784	1281	1016	484	790	29	3	11
	S02.03	3969	400	155	41	41	3424	785	261	95	3249	899	293	124	2411	1288	583	283	807	14	7	5
Spoil & ballast	S03.01	4565	-	-	-	-	4565	-	-	-	4564	1	-	-	4492	73	-	-	832	1	-	-
Substations	S04.01	4464	78	23	-	-	4328	193	42	2	4255	252	52	6	3884	551	99	31	827	5	-	1
	S04.02	4446	94	25	-	-	4293	226	44	2	4219	277	60	9	3779	633	120	33	827	5	-	1
Light rail track and public domain works (stabling and maintenance facility to Carter St)	S05.01	3120	791	422	232	218	2492	1114	565	394	2313	1190	619	443	1748	1037	968	812	726	58	34	15
	S05.02	2243	1196	649	477	394	1804	1058	958	745	1649	1068	995	853	904	1081	1175	1405	664	83	51	35
	S05.03	3339	710	311	205	202	2745	1013	494	313	2582	1062	544	377	1905	1138	851	671	742	50	29	12
	S05.04	2364	1162	606	433	336	1871	1115	883	696	1734	1123	929	779	1040	1031	1208	1286	675	78	47	33
	S05.05	2492	1114	565	394	308	1946	1174	791	654	1820	1156	871	718	1166	1001	1207	1191	681	82	42	28
	S05.06	3339	710	311	205	202	2745	1013	494	313	2582	1062	544	377	1905	1138	851	671	742	50	29	12
Modifications to existing stabling and maintenance facility	S06.01	4565	-	-	-	-	4565	-	-	-	4565	-	-	-	4561	4	-	-	832	1	-	-
	S06.02	4565	-	-	-	-	4565	-	-	-	4565	-	-	-	4565	-	-	-	832	1	-	-
	S06.03	4565	-	-	-	-	4565	-	-	-	4564	1	-	-	4425	140	-	-	831	1	1	-
	S06.04	4565	-	-	-	-	4565	-	-	-	4565	-	-	-	4565	-	-	-	832	1	-	-
Stops	S07.01	4052	365	113	35	31	3582	718	189	76	3461	785	223	96	2730	1172	450	213	815	11	6	1
	S07.02	3979	414	130	42	38	3478	789	212	86	3344	860	253	108	2584	1241	501	239	814	12	6	1
Bridges	S08.01	4209	250	83	23	20	3963	406	146	50	3868	462	174	61	3262	767	365	171	823	5	4	1
	S08.02	3210	868	338	149	125	2494	1235	560	276	2163	1436	635	331	1105	1847	891	722	792	29	6	6
	S08.03	4247	224	74	20	17	4021	378	122	44	3944	415	152	54	3335	743	333	154	823	6	4	-
	S08.04	4209	250	83	23	20	3963	406	146	50	3868	462	174	61	3262	767	365	171	823	5	4	1
Roadworks and other pavement works	S09.01	3116	803	331	315	274	2584	1025	490	466	2437	1054	571	503	1712	1143	915	795	702	64	42	25
	S09.02	2110	1111	742	602	538	1655	1049	981	880	1420	1130	1031	984	534	1261	1180	1590	603	106	61	63
	S09.03	2797	950	429	389	334	2213	1099	691	562	2040	1179	709	637	1368	1133	1054	1010	669	78	55	31
	S09.04	3604	454	206	220	209	3221	742	305	297	3090	799	356	320	2383	1109	554	519	742	57	17	17

**Table 3.12** NML exceedances at educational receivers

Receiver name	S01.02	S02.02	S04.02	S05.02	S07.02	S08.02	S09.02
Rosehill Community Preschool							
Rydalmere Public School							
Future Starts Early Learning Centre							
Ermington Rainbow College							
Tiny Scholars Childcare							
Little Explorers Learning Centre							
Rydalmere East Public School							
Melrose Park Public School							
Melrose Family Day Care							
Wentworth Point Public School							
University of New England							
Parramatta Public School							
Arthur Phillip Public School							

**Table 3.13** NML exceedances at recreation and biodiversity conservation areas

Receiver name	S01.02	S02.02	S04.02	S05.02	S07.02	S08.02	S09.02
Rosehill Gardens Racecourse							
Rydalmere Public School Playground							
Rydalmere East Public School playground							
Melrose Park PS playground							
URBNSURF Surf Park							
Sydney Olympic Park Archery Centre							
NSW Rugby League Centre of Excellence							
Cathy Freeman Park							
Sydney Showground							
Eric Primrose Reserve							
Eric Primrose Reserve (compound)							
Broad Oaks Park (compound)							
Bretby Park							
Ken Newman Park (compound)							
Hughes Avenue Reserve							
Ermington Bay Nature Trail							
Archer Park (compound)							
Melrose Park Playground							
Birdlife Australia Discovery Centre							
Woo-la-ra							
River Walk							
Sanctuary Hill							
Kronos Hill							
Wentworth Common							

**Table 3.14** NML exceedances at commercial receivers

Receiver name	S01.02	S02.02	S04.02	S05.02	S07.02	S08.02	S09.02
Cafe 4TY7 Ermington							
Sydney Olympic Park Athletic Centre							
NSW Rugby League Centre, Sydney Olympic Park							
Commercial receivers fronting Dawn Fraser Avenue							
Commercial receivers fronting Australia Avenue							
Stadium Australia							
Exhibition Hall, Sydney Olympic Park							
Commercial receivers fronting Macquarie Street turnback, Parramatta							

**Table 3.15** NML exceedances at hotel receivers

Receiver name	S01.02	S02.02	S04.02	S05.02	S07.02	S08.02	S09.02
Novotel Sydney Olympic Park							
Ibis Hotel at Sydney Olympic Park							
Pullman at Sydney Olympic Park							
Quest at Sydney Olympic Park							
Ibis Budget Sydney Olympic Park							
SKYE Suites Parramatta							

**Table 3.16** NML exceedances at place of worship receivers

Receiver name	S01.02	S02.02	S04.02	S05.02	S07.02	S08.02	S09.02
Saeum Presbyterian Church, Rydalmere							
Immanuel Australia Church, Rydalmere							
Harvest Christian Centre, Rydalmere							
Brethren Church, Ermington							
St Johns Church, Parramatta							
Leigh Memorial Church, Parramatta							
Parramatta Mosque, Parramatta							

### 3.4.3 Airborne noise impacts – all assessment periods

Detailed results are presented in Appendix F-2, including violin plots, bar charts and pie charts for each sub-scenario. The following sections summarise the key outcomes of the noise modelling results for each modelled construction scenario.

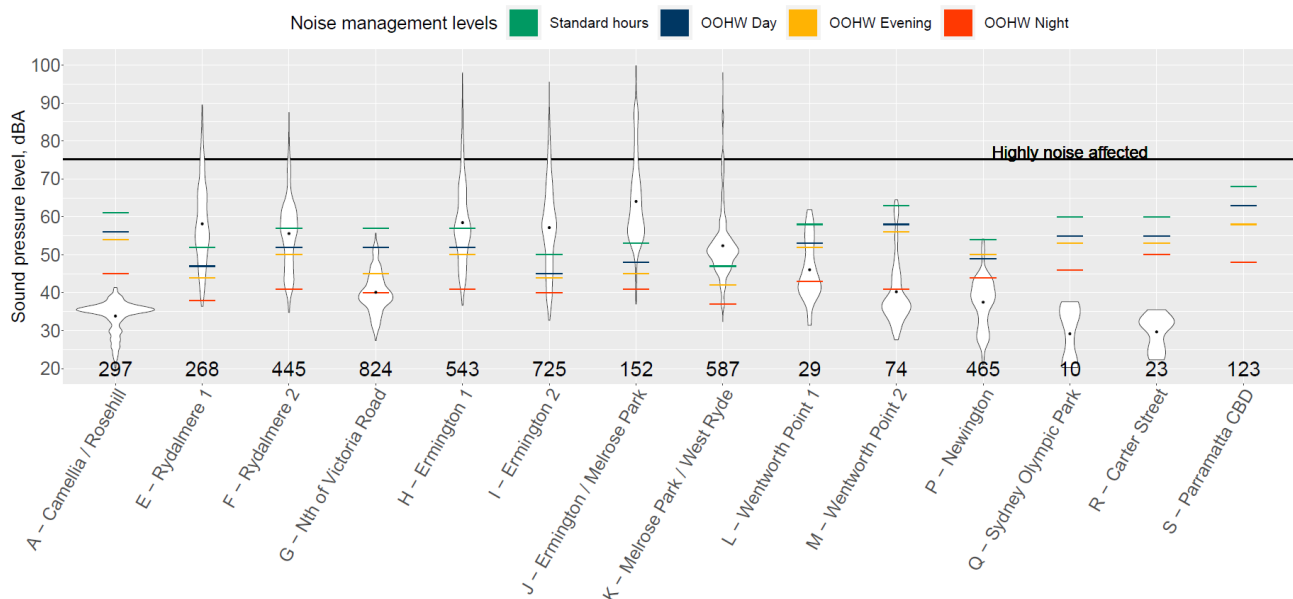
#### 3.4.3.1 S01: Demolition, removal and clearing works

Demolition and removal of buildings and structures, including commercial, industrial and residential buildings would be required at various locations along with vegetation clearance, trimming and tree removal/relocation. Demolition and removal works would also be required at the Silverwater Road pedestrian bridge and removal works at the former freight rail (Sandown) line in Camellia.

##### Worst-case impacts per residential NCA (S01.02 – use of a rockbreaker)

Demolition works with the use of a rockbreaker (S01.02) are predicted to result in the greatest number of impacts at residential receivers. Where demolition works are within close proximity to residences (for example in Rydalmere, Ermington and Melrose Park), construction works are anticipated to result in highly noise affected residences, however this is expected to be a short-term impact.

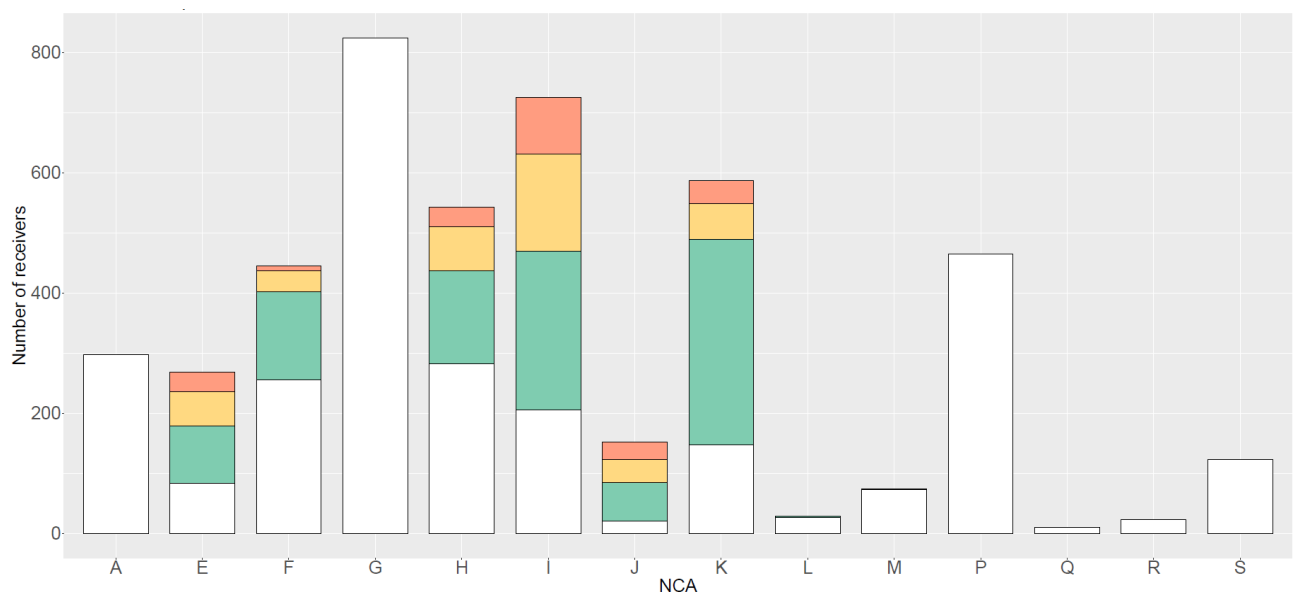
Figure 3.9 shows the range of predicted noise levels for each NCA along with relevant assessment NMLs. Table 3.17 shows the number of residences predicted to receive noise levels above the relevant NML and Figure 3.10 shows the number residences per exceedance category during the ICNG standard hours.



**Figure 3.9** S01.02 – Predicted noise level range at residences compared to NML at each NCA (worst-case)

**Table 3.17** S01.02 – Number of NML exceedances at residences per NCA

NML	Number of residences predicted to experience noise levels above the NML per NCA													
	A	E	F	G	H	I	J	K	L	M	P	Q	R	S
Standard	0	185	190	0	261	520	132	440	3	1	0	0	0	0
OOHW Day	0	224	285	10	385	592	146	541	7	6	19	0	0	0
OOHW Eve	0	237	310	131	421	608	148	541	8	6	13	0	0	0
OOHW Night	0	263	418	333	527	652	151	573	14	23	45	0	0	0
Highly Noise Affected	0	18	12	0	42	52	24	16	0	0	0	0	0	0



**Figure 3.10** S01.02 – Number of residences per exceedance category during standard hours

The results indicate that the average noise level at receivers is above the ICNG recommended standard hours NML in the following areas:

- Rydalmere (NCA-E)
- Ermington (NCA-H and NCA-I)
- Melrose Park and West Ryde (NCA-J and NCA-K).

NML exceedances of less than 10 dB are predicted at Camellia-Rosehill (NCA-A), north of Victoria Road (NCA-G), Wentworth Point (NCA-L and NCA-M), Newington (NCA-P), Sydney Olympic Park (NCA-Q) and at Carter Street (NCA-R) during the ICNG recommended standard hours as there is sufficient separation distance between demolition and clearing works and these areas. No demolition works are expected at Parramatta CBD (NCA-S).

### Worst-case impacts at non-residential receivers (S01.02 – use of a rockbreaker)

Figure 3.11 shows the range of predicted noise levels for each non-residential receiver type along with relevant assessment NMLs shown in blue. The number of receivers predicted to exceed the NML are also shown in blue. The modelling results indicate that the average received noise level for non-residential receivers is below the NML for all non-residential receiver types. The NML exceedances at key non-residential receivers are listed in section 3.4.2.

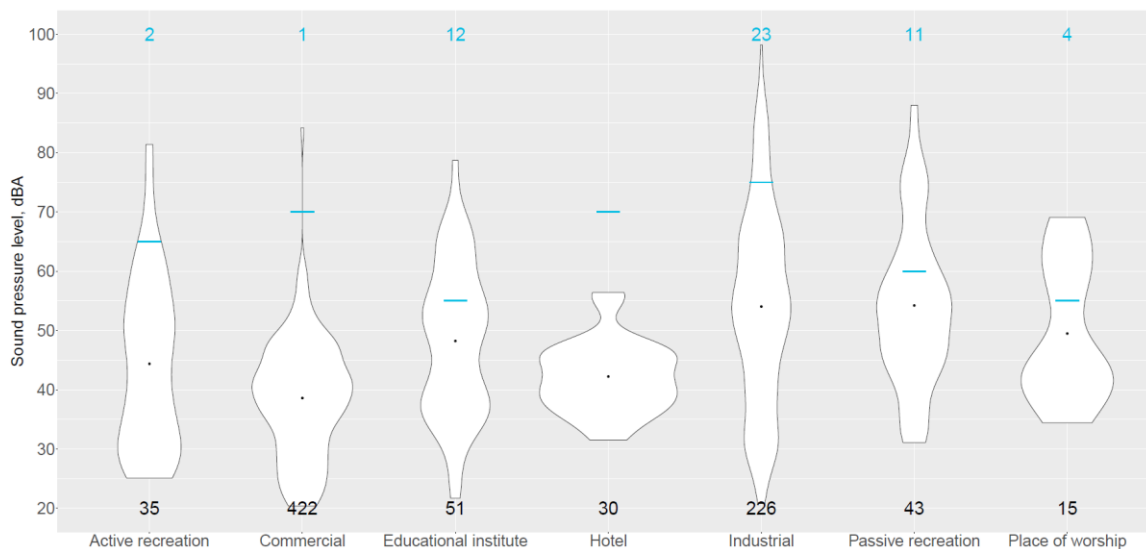


Figure 3.11 S01.02 – Predicted noise level range at non-residential receivers compared to the NML

### Impacts and duration of each sub-scenario at residences

The proportion of residences exceeding the NML out of the total number of residences is shown in Figure 3.12 for each of the sub-scenarios, along with the indicative duration of each sub-scenario. The number of receivers exceeding the NML for each sub-scenario and assessment period is listed in Table 3.11 (summary table). The results indicate:

- S01.02 (use of the rockbreaker) is anticipated to result in the greatest number of NML exceedances. When the rockbreaker is not in use (S01.01), a significant reduction in the number of exceedances is predicted.
- The number and extent of NML exceedances during OOHW day and OOHW evening are similar.
- Should demolition works occur during the OOHW night period, a significant number of NML exceedances are predicted. As such, any high-intensive equipment would be scheduled during the ICNG standard hours, where possible.
- S01.03 (removal of the former freight rail (Sandown) line) is predicted to result in NML exceedances of <10 dB at residences during the OOHW assessment periods.



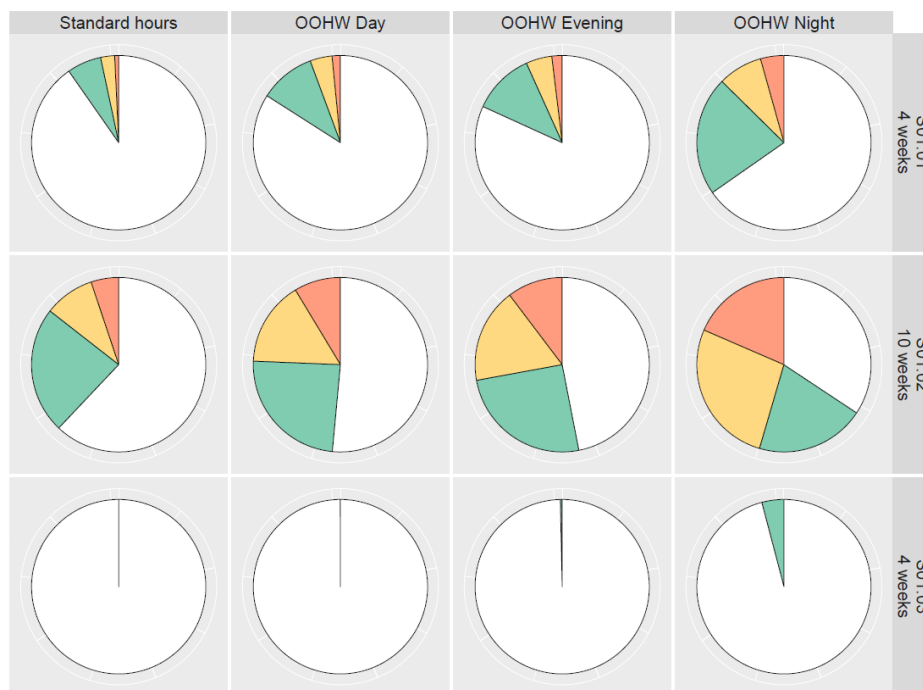


Figure 3.12 S01 – Proportion of NML exceedances at residences for each sub-scenario

### 3.4.3.2 S02: Construction compounds (including clearing)

Construction compounds are areas that would be located along the project site and at bridge abutments for construction material storage, site access and egress, waterway access, laydown areas, and to facilitate and enable construction works. For most of the time, noise emissions from construction compound sites would be minimal, especially during the night period. This assessment is based on the worst-case construction activities that may occur at compounds.

#### Worst-case impacts per residential NCA (S02.02 – use of a concrete saw)

Service and utilities construction activities within the compound sites including the use of a concrete saw (S02.02) are predicted to result in the greatest number of impacts at residential receivers. Where construction compounds are within close proximity to residences (for example Rydalmere, Ermington and Melrose Park and Carter Street precinct), construction works are anticipated to result in highly noise affected residences, however this is expected to be relatively short-term as the use of the concrete saw would likely be only be used for a few days.

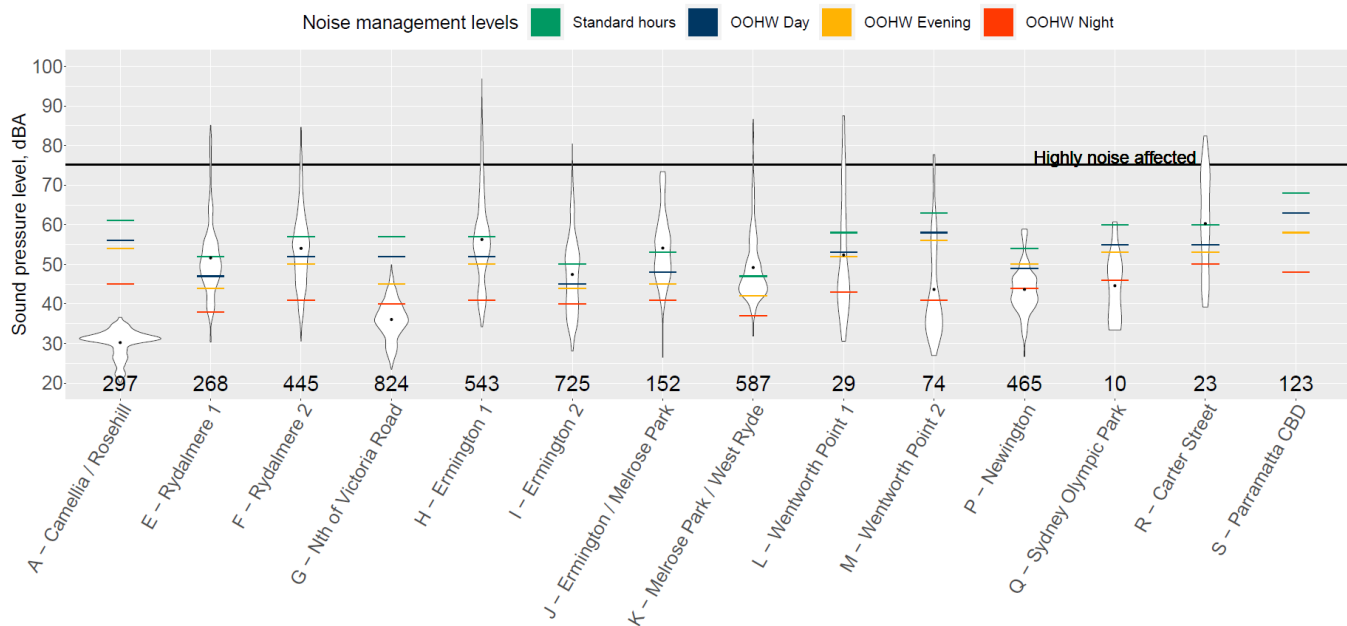
Figure 3.13 shows the range of predicted noise levels for each NCA along with relevant assessment NMLs.

Table 3.18 shows the number of residences predicted to receive noise levels above the relevant NML and Figure 3.14 shows the number residences per impact category during the ICNG standard hours.

The results indicate that the average received noise level is above the standard hours NML in the following areas:

- Melrose Park and West Ryde (NCA-J and NCA-K)
- Carter Street Precinct (NCA-R).

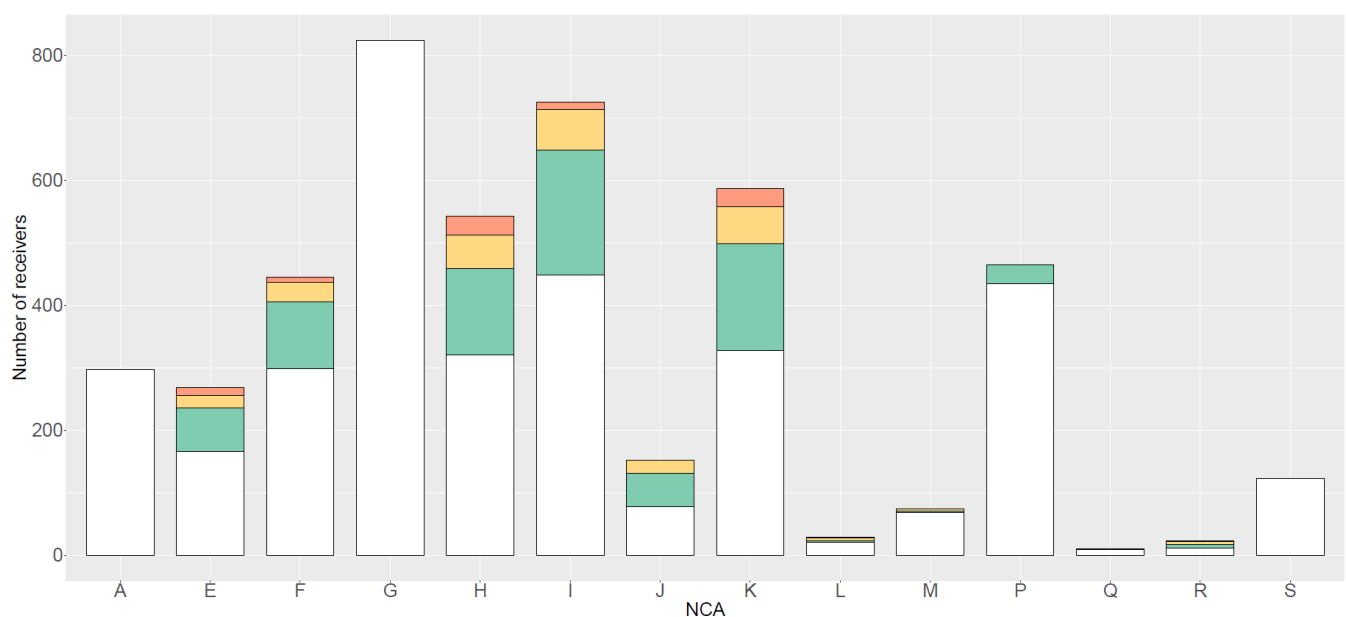
NML exceedances of <10 dB are predicted at Camellia-Rosehill (NCA-A), north of Victoria Road (NCA-G), Newington (NCA-P) and at Sydney Olympic Park (NCA-Q) during the recommended standard hours. No compound works are expected at Parramatta CBD (NCA-S).



**Figure 3.13** S02.02 – Predicted noise level range at residences compared to NML at each NCA (worst-case)

**Table 3.18** S02.02 – Number of NML exceedances at residences per NCA

NML	Number of residences predicted to experience noise levels above the NML per NCA													
	A	E	F	G	H	I	J	K	L	M	P	Q	R	S
Standard	0	102	147	0	223	276	75	259	9	6	31	1	12	0
OOHW Day	0	180	252	0	354	404	110	483	12	10	68	1	16	0
OOHW Eve	0	217	276	25	390	424	131	483	12	14	52	1	16	0
OOHW Night	0	253	403	143	487	516	144	573	19	30	192	5	16	0
Highly Noise Affected	0	10	16	0	37	2	0	9	3	2	0	0	2	0



**Figure 3.14** S02.02 – Number of residences per exceedance category during standard hours

## Worst-case impacts at non-residential receivers

Figure 3.15 shows the range of predicted noise levels for each non-residential receiver type along with relevant assessment NMLs shown as a blue line. The number of receivers predicted to exceed the NML are numbered in blue. The modelling results indicate that the average experienced noise level for non-residential receivers is below the NML for all receiver types. The NML exceedances at key non-residential receivers are listed in section 3.4.2.

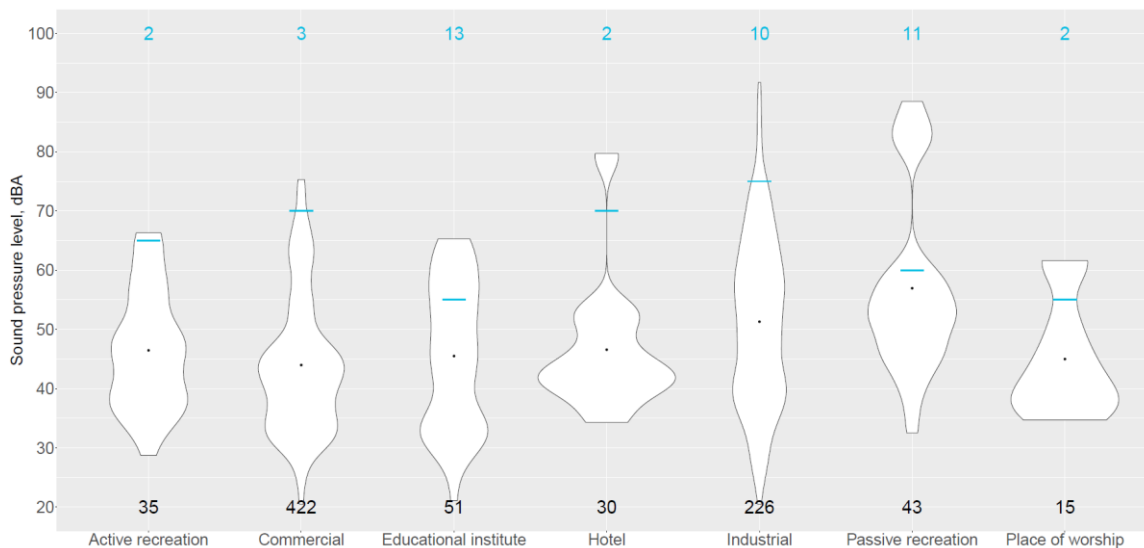


Figure 3.15 S02.02 – Predicted noise level range at non-residential receivers compared to the NML)

## Impacts and duration of each sub-scenario at residences

The proportion of NML exceedances for all three sub-scenarios are shown in Figure 3.16. The results indicate:

- S02.02 (service and utilities) is anticipated to result in the greatest number of NML exceedances.
- The number and extent of NML exceedances during the OOHW Day and OOHW Evening periods are similar.
- A significant number of NML exceedances are predicted during OOHW Period 2 (night) for all sub-scenarios.
- The activity that would occur for the longest duration is predicted to result in the least number of NML exceedances, being site deliveries (S02.03).

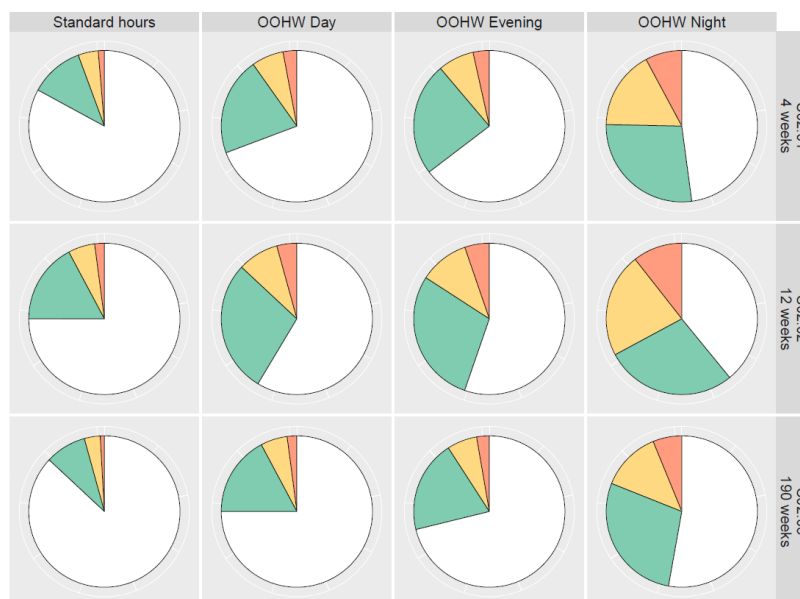


Figure 3.16 S02 – Proportion of NML exceedances at residences for each sub-scenario

### 3.4.3.3 S03: Recycling of spoil and ballast

Recycling of spoil and ballast from the former freight rail (Sandown) line would involve crushing and screening within the Grand Avenue construction compound site. Crushing and screening is the only noise generating construction activity during this scenario and as such no sub-scenarios are included. The indicative duration of the recycling of the spoil and ballast is approximately 30 weeks.

#### Worst-case impacts per residential–NCA (S03.01 – crushing and screening)

This construction activity is not anticipated to result in any NML exceedances at residential receivers during the recommended standard hours, OOHW day or OOHW evening periods due to the large separation between this compound site and the nearest residences. A small number of residences would experience NML exceedances of <10 dB in Ermington (NCA-E and NCA-F) during the OOHW night period and NML exceedances at non-residential receivers have also been predicted. No crushing and screening works are expected at Parramatta CBD (NCA-S).

Note should be made that the surrounding area has been identified for re-zoning as part of the Camellia Master Plan. Prior to construction, the land use survey would be updated to ensure any new sensitive land uses that could be impacted by construction noise are included in the NVMP.

Figure 3.17 shows the range of predicted noise levels for each NCA along with relevant assessment NMLs. Table 3.19 shows the number of residences predicted to receive noise levels above the relevant NML.

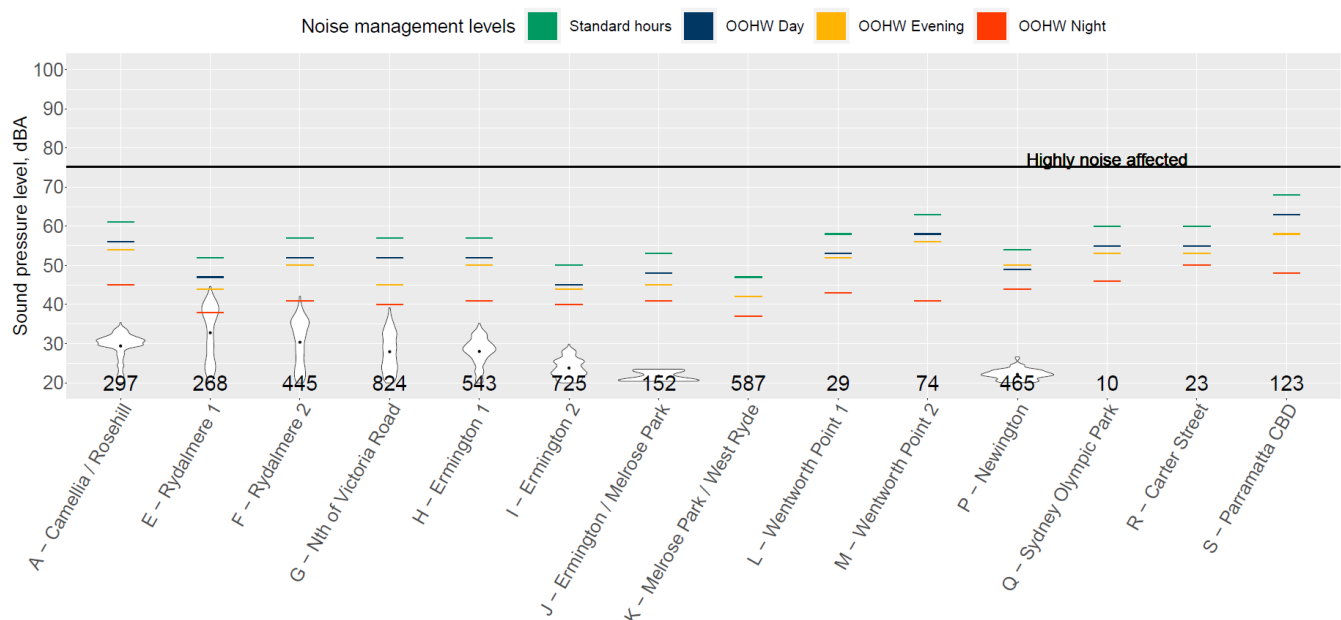


Figure 3.17 S03.01 – Predicted noise level range at residences compared to NML at each NCA (worst-case)

Table 3.19 S03.01 – Number of NML exceedances at residences per NCA

NML	Number of residences predicted to experience noise levels above the NML per NCA													
	A	E	F	G	H	I	J	K	L	M	P	Q	R	S
Standard	0	0	0	0	0	0	0	0	0	0	0	0	0	0
OOHW Day	0	0	0	0	0	0	0	0	0	0	0	0	0	0
OOHW Eve	0	1	0	0	0	0	0	0	0	0	0	0	0	0
OOHW Night	0	70	3	0	0	0	0	0	0	0	0	0	0	0
Highly Noise Affected	0	0	0	0	0	0	0	0	0	0	0	0	0	0

### Worst-case impacts at non-residential receivers (S03.01 – crushing and screening)

Figure 3.18 shows the range of predicted noise levels for each non-residential receiver type along with relevant assessment NMLs shown as a blue line. The modelling results indicate one industrial receiver is predicted to receive noise levels above the NML.

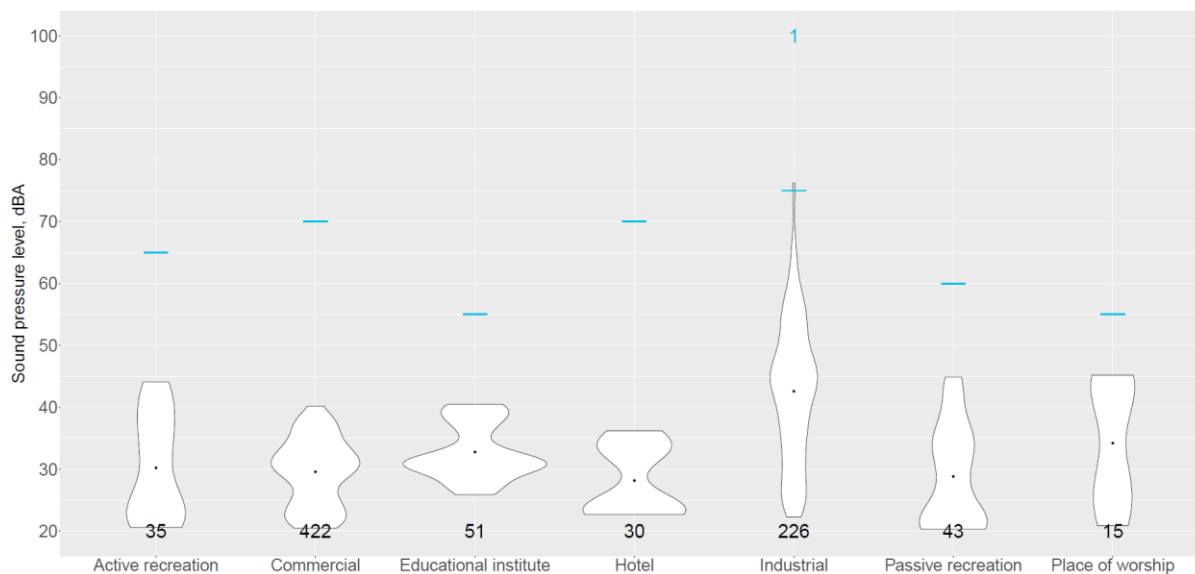


Figure 3.18 S03.01 – Predicted noise level range at non-residential receivers compared to the NML

### 3.4.3.4 S04: Construction of traction power substations

Five traction power substations would be required for the project, located in Camellia, Rydalmere, Melrose Park, Wentworth Point and Sydney Olympic Park. This construction activity involves site establishment (S04.01) and construction and installation of the traction power substations (S04.02) both of which are anticipated to generate similar noise levels. The total duration of this scenario is approximately nine weeks with the construction and installation comprising six of these weeks.

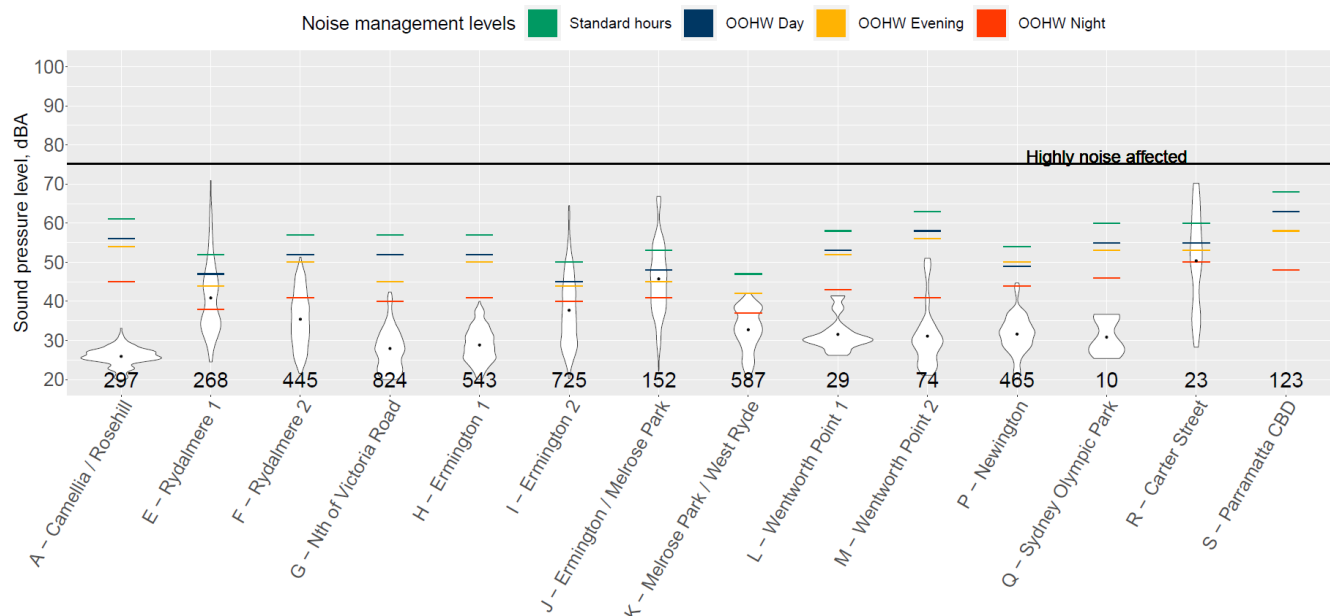
### Worst-case impacts per residential-NCA (S04.02 – construction of traction power substations)

The construction and installation of the traction power substations (S04.02) is predicted to result in the greatest number of NML exceedances at residential receivers. Short-term noise impacts are predicted to occur at residences adjacent to the Rydalmere, Melrose Park and Sydney Olympic Park substations. No residences are predicted to be highly noise affected.

Figure 3.19 shows the range of predicted noise levels for each NCA along with relevant assessment NMLs. Table 3.20 shows the number of residences predicted to receive noise levels above the relevant NML and Figure 3.20 shows the number residences per exceedance category during the ICNG standard hours.

Noise generated from the construction of the traction power substations is predicted to result in a relatively small number of NML exceedances during the ICNG recommended standard hours, where most of impacts would be <10 dB and experienced at residences in close proximity to substations.

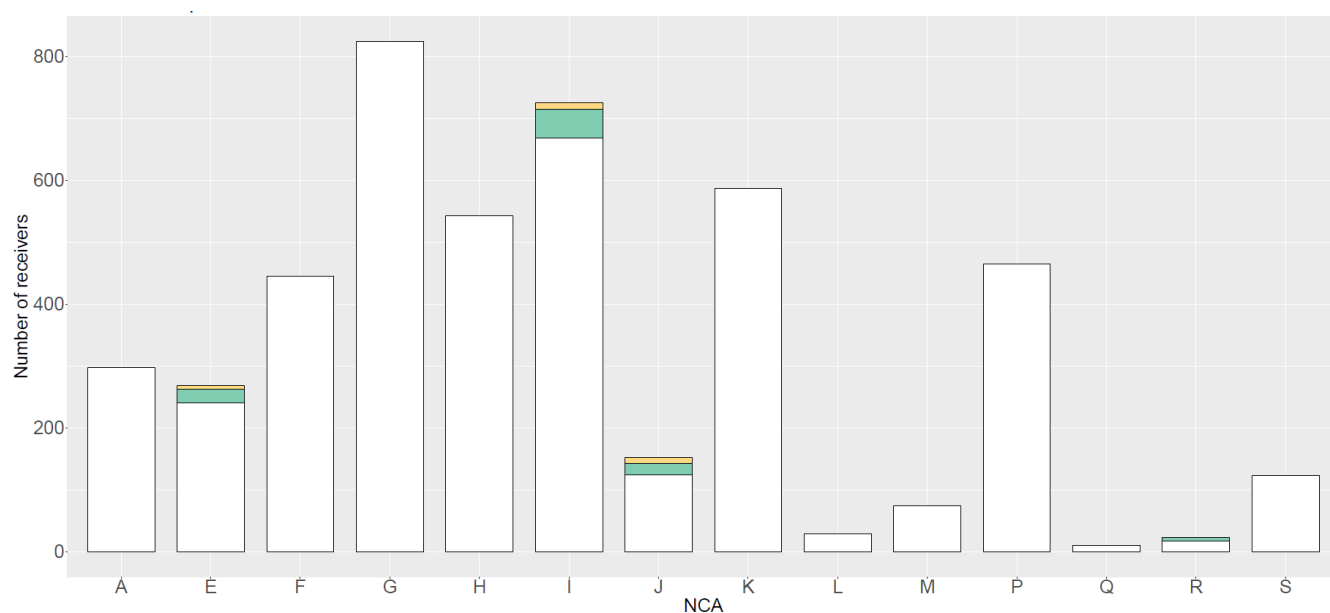
Due to the large separation distances between the traction power substations at Camellia and at Wentworth Point, no NML exceedances are predicted during the ICNG recommended standard hours and <10 dB exceedances are predicted during all OOHW periods. The majority of noise impacts at all locations during the OOHW Day, OOHW evening and OOHW night are predicted to be <10 dB.



**Figure 3.19** S04.02 – Predicted noise level range at residences compared to NML at each NCA (worst-case)

**Table 3.20** S04.02 – Number of NML exceedances at residences per NCA

NML	Number of residences predicted to experience noise levels above the NML per NCA													
	A	E	F	G	H	I	J	K	L	M	P	Q	R	S
Standard	0	28	0	0	0	57	28	0	0	0	0	0	6	0
OOHW Day	0	58	0	0	0	154	51	0	0	0	0	0	9	0
OOHW Eve	0	87	3	0	0	171	76	0	0	0	0	0	9	0
OOHW Night	0	142	100	18	0	268	98	139	0	7	1	0	13	0
Highly Noise Affected	0	0	0	0	0	0	0	0	0	0	0	0	0	0



**Figure 3.20** S04.02 – Number of residences per exceedance category during standard hours



### Worst-case impacts at non-residential receivers (S04.02 – construction of the traction power substations)

Figure 3.21 shows the range of predicted noise levels for each non-residential receiver type along with relevant assessment NMLs shown as a blue line. The number of receivers predicted to exceed the NML are numbered in blue. The modelling results indicate that the average experienced noise level for non-residential receivers is below NML for all non-residential receiver types. The NML exceedances at key non-residential receivers are listed in section 3.4.2.

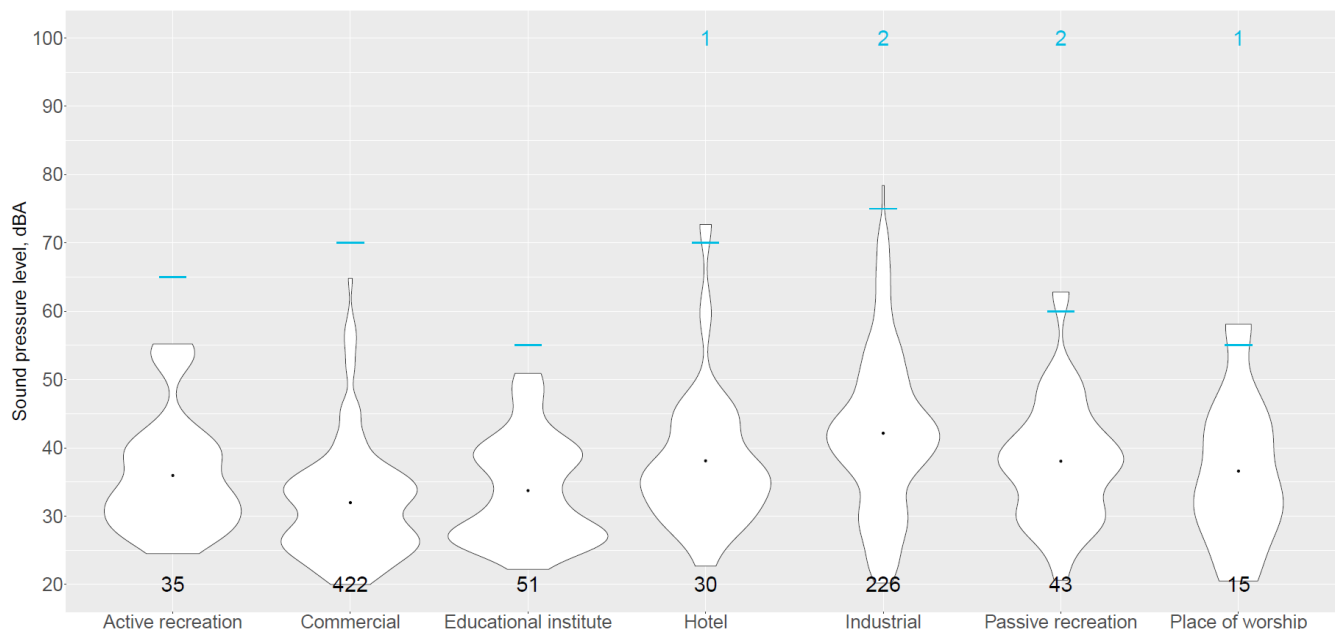


Figure 3.21 S04.02 – Predicted noise level range at non-residential receivers compared to the NML

### 3.4.3.5 S05: Light rail track and public domain works

The track infrastructure and public domain works extending from the stabling and maintenance facility in Camellia to the Carter Street stop can be categorised as civil engineering works, rail installation works (embedded, permeable or ballast) and overhead-wiring poles and street lighting.

Further trackwork would be required to construct the turnback facility for the project in the Parramatta CBD. The construction methodology would be similar to the works described above, however the track would be embedded, as such other installation options, such as ballast track, have not been assessed.

### Worst-case impacts per residential NCA (S05.02 – use of a rockbreaker)

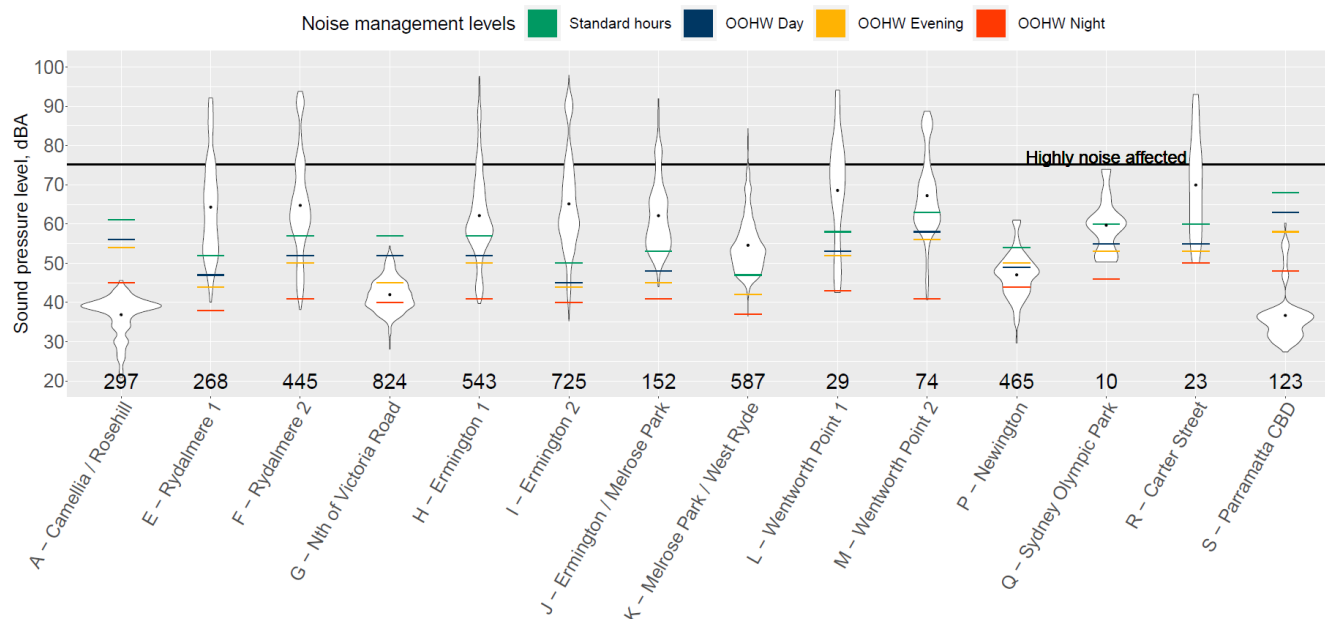
Earthworks with the use of a rockbreaker (S05.02) are predicted to result in the greatest number of NML exceedances at residential receivers, however this impact is expected to be relatively short-term (less than four weeks). Due to the high noise level of a rockbreaker and the proximity of works to residences, the average noise level is predicted to be above the standard hours NML and residences are anticipated to be highly noise affected at all NCAs except for Rosehill-Camellia (NCA-A), north of Victoria Road (NCA-G) and Newington (NCA-P).

As the works would progress in a linear manner along the project site, the worst-case impacts at any one receiver would be expected for a substantially shorter duration than the total duration for the activity.

Figure 3.22 shows the range of predicted noise levels for each NCA along with relevant assessment NMLs. Table 3.21 shows the number of residences predicted to receive noise levels above the relevant NML and Figure 3.23 shows the number residences per exceedance category during the ICNG standard hours.

The results indicate the following:

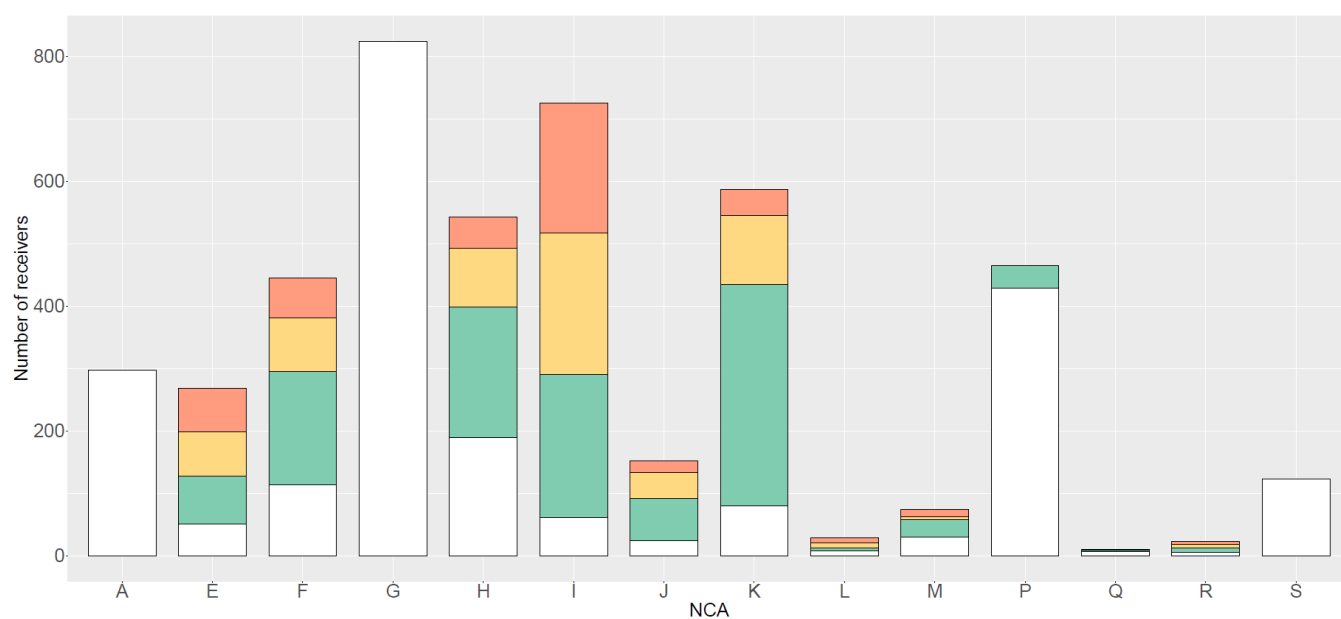
- A significant number of NML exceedances are predicted, particularly during OOHW periods.
- Impacts are predicted in majority of the residential NCAs, with the exception of those with a larger separation distance to the track alignment such as NCA-A, NCA-G and NCA-S.
- During ICNG recommended standard hours, the majority of NML exceedances are predicted to be <10 dB at each NCA except for at Ermington (NCA-I) due to the low background noise levels in this area.



**Figure 3.22** S05.02 – Predicted noise level range at residences compared to NML at each NCA (worst-case)

**Table 3.21** S05.02 – Number of NML exceedances at residences per NCA

NML	Number of residences predicted to experience noise levels above the NML per NCA													
	A	E	F	G	H	I	J	K	L	M	P	Q	R	S
Standard	0	217	331	0	354	664	128	507	21	44	36	3	17	0
OOHW Day	0	252	368	5	460	690	150	584	23	65	137	7	20	0
OOHW Eve	0	261	376	155	471	696	151	584	23	68	103	7	20	1
OOHW Night	2	268	438	500	536	718	152	586	28	73	317	10	22	11
Highly Noise Affected	0	50	87	0	69	133	17	5	11	15	0	0	7	0



**Figure 3.23** S06.02 – Number of residences per exceedance category during standard hours

### Worst-case impacts at non-residential receivers (S05.02 – use of a rockbreaker)

Figure 3.24 shows the range of predicted noise levels for each non-residential receiver type along with the relevant assessment NMLs shown as a blue line. The number of receivers predicted to exceed the NML are numbered in blue. The modelling results indicate that the average experienced noise level is below NML for active recreation areas, commercial receivers, industrial receivers, hotels (day NML only) and places of worship. NML exceedances at key non-residential receivers are listed in section 3.4.2. The majority of the impacts are at commercial receivers that front the trackworks at Sydney Olympic Park and at Parramatta CBD.

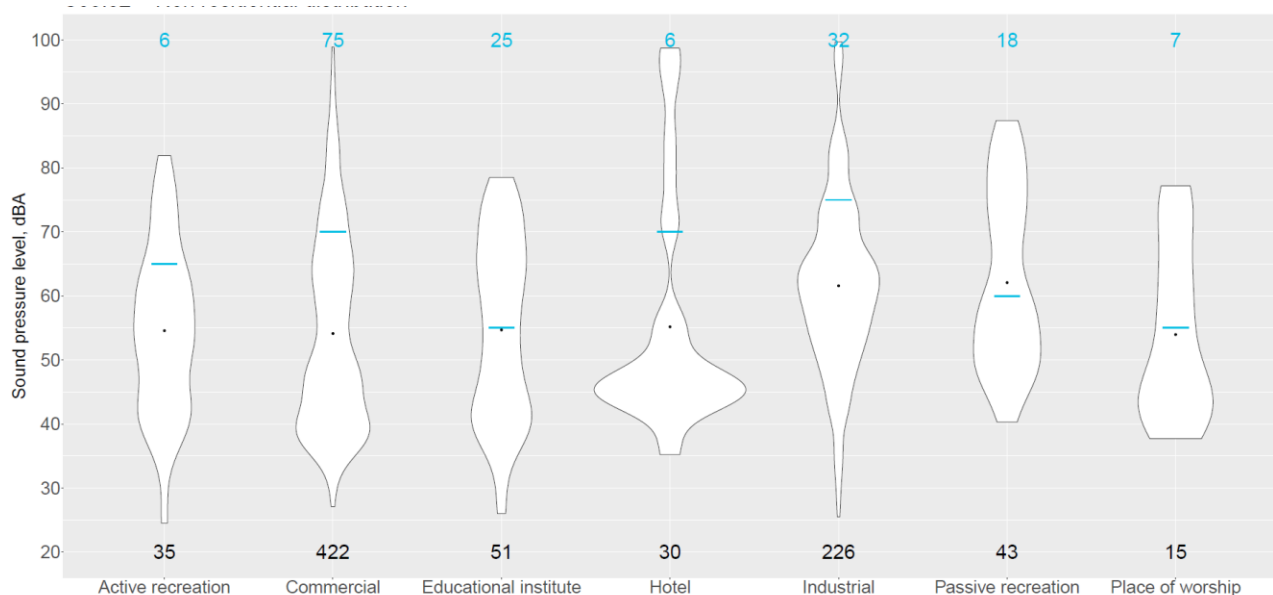


Figure 3.24 S05.02 – Predicted noise level range at non-residential receivers compared to NML (worst-case)

### Impacts and duration of each sub-scenario at residences

The proportion of NML exceedances for all six sub-scenarios are shown in Figure 3.25 along with the duration of each. The results indicate:

- S05.02 (earthworks with rockbreaker and the use of a concrete saw) is anticipated to result in the greatest number of noise impacts, followed by:
  - S05.04 (embedded trackworks for approximately 15 weeks)
  - S05.05 (trackworks – tamping for approximately 15 weeks, where a ballast would be installed)
  - S05.01 (earthworks for approximately eight weeks)
  - S05.03 (concrete works for approximately eight weeks)/S05.06 (steel erection/wiring for approximately five weeks).
- The number and extent of NML exceedances during the OOHW day and OOHW evening periods are similar for all sub-scenarios.
- A significant number of 10-20 dB exceedances and >20 dB exceedances of the NMLs are predicted during the OOHW night period for all sub-scenarios. Where possible, high-noise generating works would be scheduled between the ICNG standard hours.

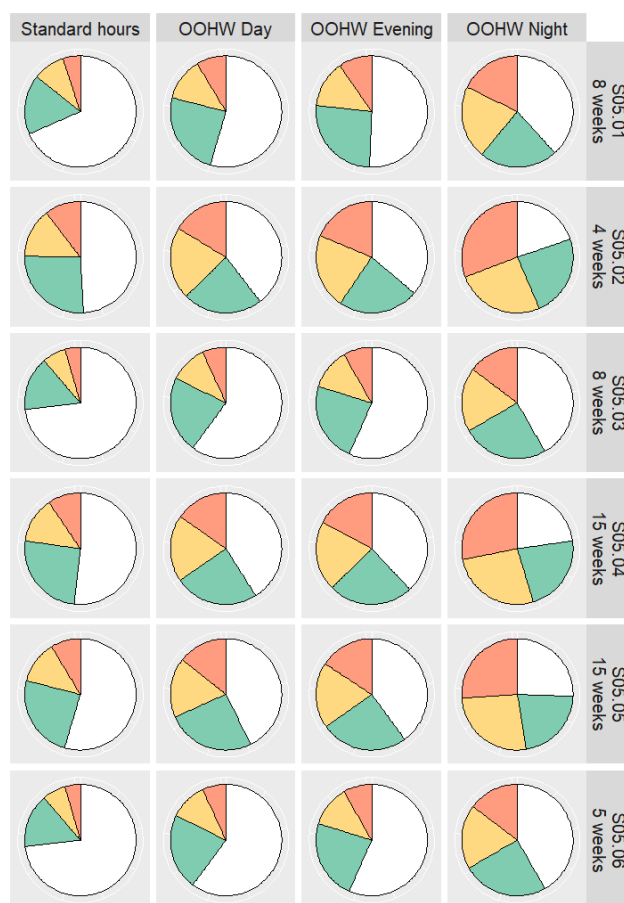


Figure 3.25 S05 – Proportion of NML exceedances at residences for each sub-scenario

### 3.4.3.6 S06: Modifications to the existing stabling and maintenance facility in Camellia

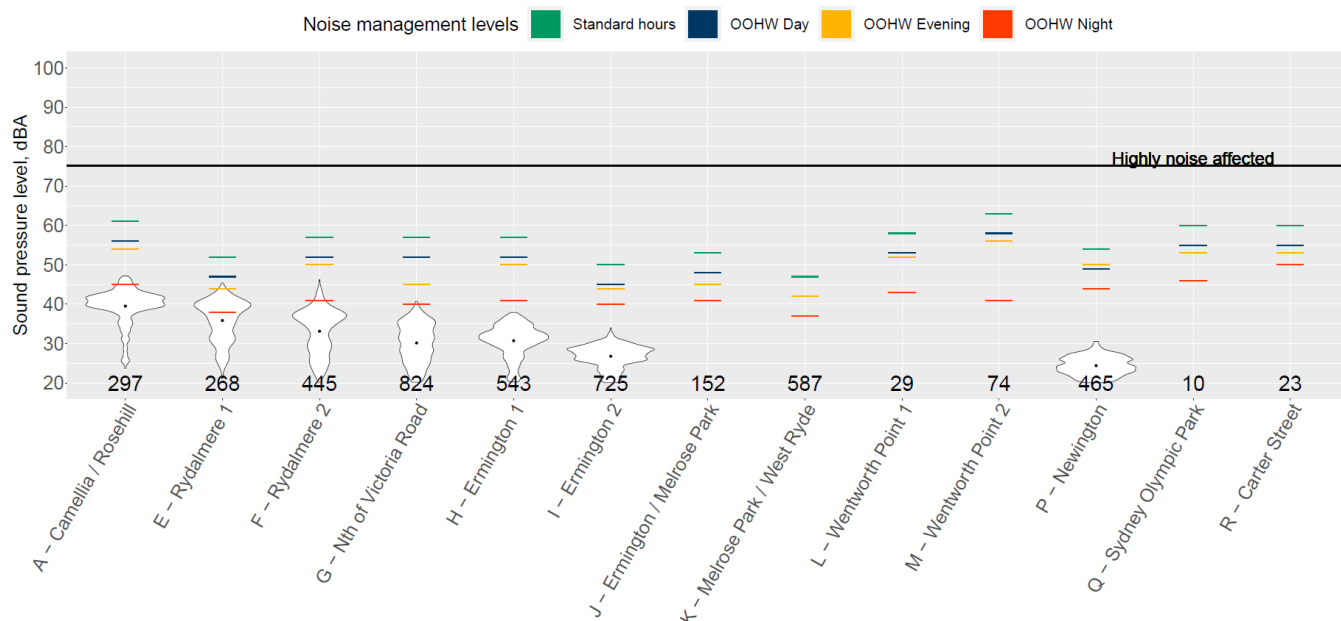
Construction works include works to modify the stabling and maintenance facility constructed as part of Stage 1 to increase the capacity to allow for additional light rail vehicles and staff vehicles. The total duration required to modify the stabling and maintenance facility would be 194 weeks, with 42 weeks being required to construct the track.

#### Worst-case impacts per residential NCA (S06.03 – trackworks)

The modification works to the stabling and maintenance facility are sufficiently distant from any existing residential receivers, that no NML exceedances are predicted during of the modelled sub-scenarios or during any of the standard construction or OOHW assessment periods.

A small number of residences in Rosehill (NCA-A) Ermington (NCA-E, NCA-F and NCA-G) would experience NML exceedances of <10 dB during the OOHW night period. Note should be made that the surrounding area has been identified for re-zoning as part of the Camellia Master Plan. Prior to construction, the land use survey would be updated to ensure any new sensitive land uses that could be impacted by construction noise are included in the NVMP.

Figure 3.26 shows the range of predicted noise levels for each NCA along with relevant assessment NMLs. Table 3.22 shows the number of residences predicted to receive noise levels above the relevant NML.



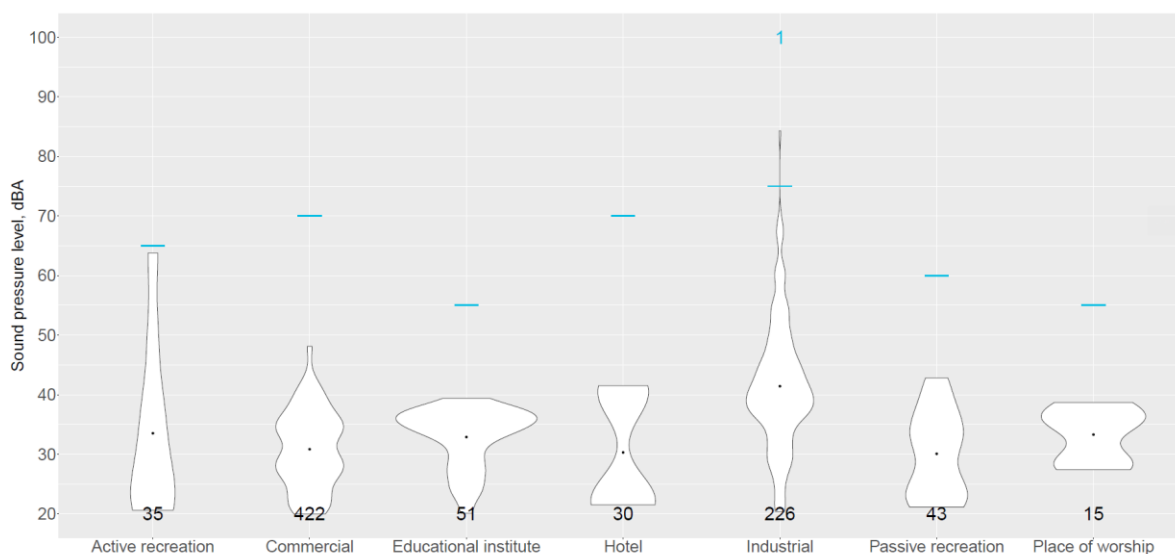
**Figure 3.26** S06.03 – Predicted noise level range at residences compared to NML at each NCA (worst-case)

**Table 3.22** S06.03 – Number of NML exceedances at residences per NCA

NML	Number of residences predicted to experience noise levels above the NML per NCA													
	A	E	F	G	H	I	J	K	L	M	P	Q	R	S
Standard	0	0	0	0	0	0	0	0	0	0	0	0	0	0
OOHW Day	0	0	0	0	0	0	0	0	0	0	0	0	0	0
OOHW Eve	0	0	0	0	0	0	0	0	0	0	0	0	0	0
OOHW Night	12	112	15	1	0	0	0	0	0	0	0	0	0	0
Highly Noise Affected	0	0	0	0	0	0	0	0	0	0	0	0	0	0

### Worst-case impacts at non-residential receivers (S06.03 – trackworks)

Table 3.25 shows the range of predicted noise levels for each non-residential receiver type along with relevant assessment NMLs shown as a blue line. The number of receivers predicted to exceed the NML is also shown in blue.



**Figure 3.27** S06.03 – Predicted noise level range at non-residential receivers compared to the NML

### 3.4.3.7 S07: Construction of stops

Construction works for light rail stops and interchanges would occur concurrently with the track infrastructure works or may be constructed separately depending on the preferred construction methodology.

#### Worst-case impacts per residential NCA (S07.02 – finishing works)

The average experienced noise level at residences within each NCA is predicted to be below the standard hours NML at all NCAs adjacent to stops, except for the Murdoch Street stop (Ermington – NCA-I). Additionally, highly noise affected receivers are anticipated at the following locations:

- John Street stop (Rydalmere/NCA-E)
- Nowill Street stop (Rydalmere/NCA-F)
- River Road stop (Ermington – NCA-H)
- Murdoch Street stop (Ermington – NCA-I)
- Atkins Road stop (Ermington – NCA-J)
- Footbridge Boulevard and Hill Road stops (Wentworth Point – NCA-M)
- Carter Street stop (Carter Street – NCA-R).

Figure 3.28 shows the range of predicted noise levels for each NCA along with relevant assessment NMLs. Table 3.23 shows the number of residences predicted to receive noise levels above the relevant NML and Figure 3.29 shows the number residences per exceedance category during the ICNG standard hours. The results indicate the following:

- During standard hours, most of noise impacts are predicted to be <10 dB at each NCA except for at Ermington (NCA-I) due to the low background noise levels in this area.
- A significant number of 10-20 dB and >20 dB exceedances are predicted during the OOHW day, evening and night periods.

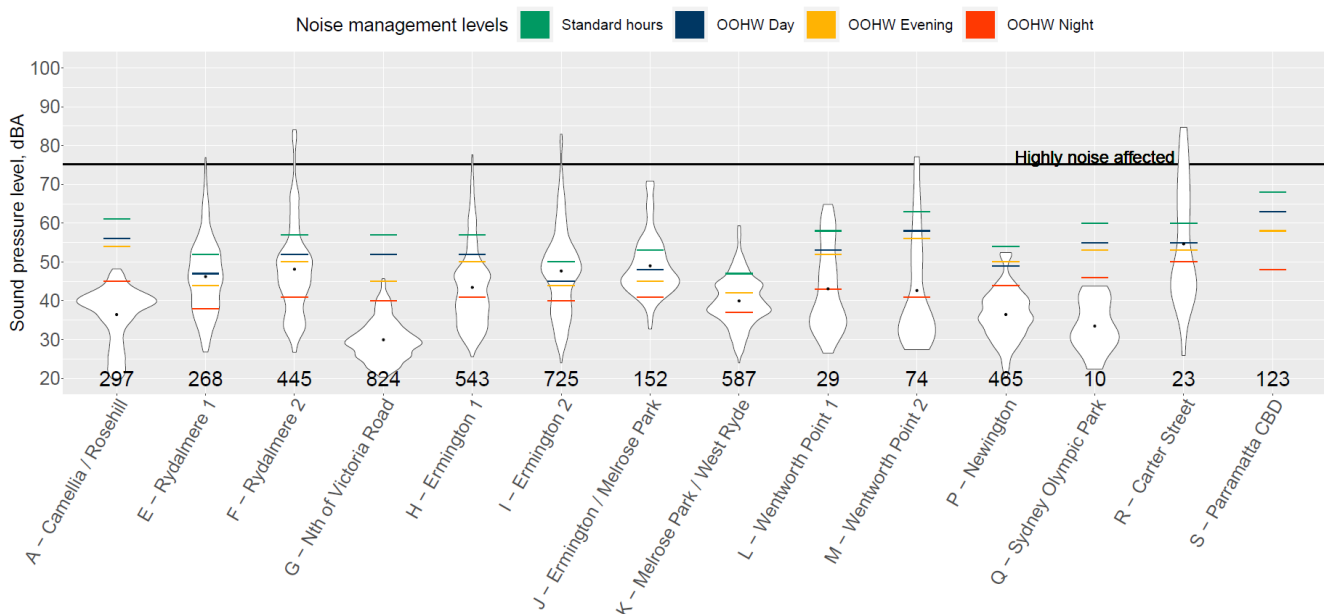
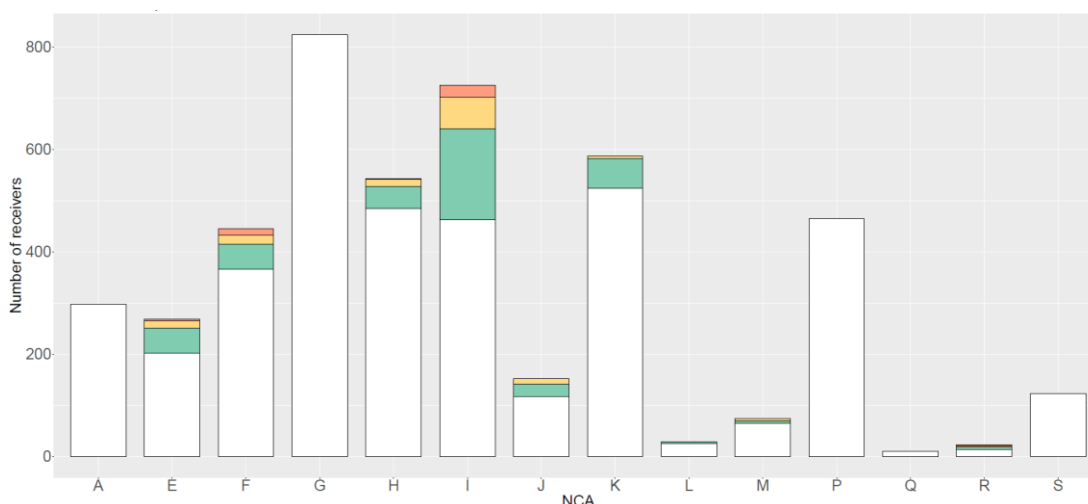


Figure 3.28 S07.02 – Predicted noise level range at residences compared to NML at each NCA (worst-case)



**Table 3.23** S07.02 – Number of NML exceedances at residences per NCA

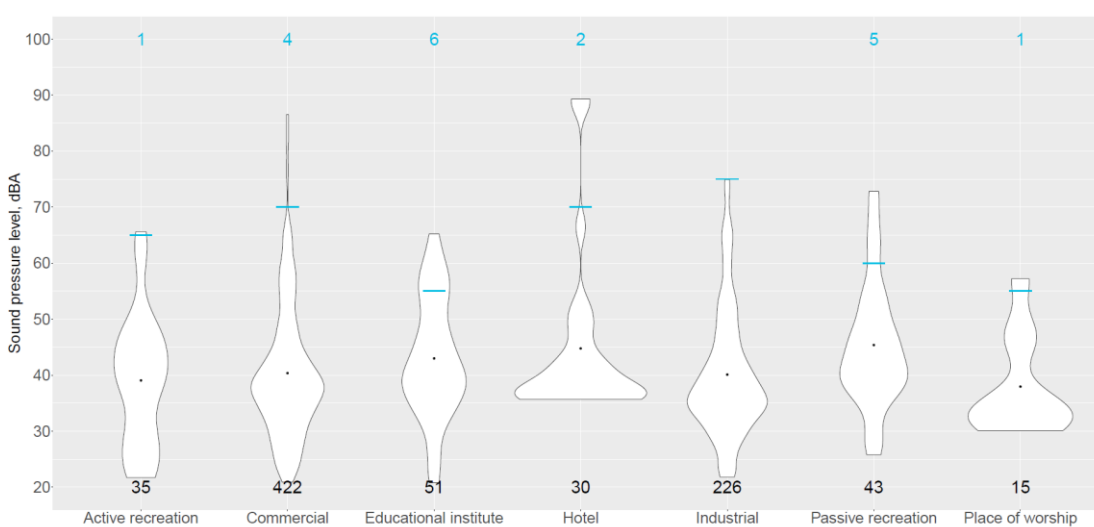
NML	Number of residences predicted to experience noise levels above the NML per NCA													
	A	E	F	G	H	I	J	K	L	M	P	Q	R	S
Standard	0	66	79	0	58	263	35	63	4	9	0	0	9	0
OOHW Day	0	116	123	0	89	438	67	201	7	13	23	0	10	0
OOHW Eve	0	155	159	1	103	460	91	201	7	14	20	0	10	0
OOHW Night	14	206	320	32	282	524	135	377	12	27	41	0	11	0
Highly Noise Affected	0	1	16	0	3	11	0	0	0	3	0	0	4	0



**Figure 3.29** S07.02 – Number of residences per exceedance category during standard hour

### Worst-case impacts at non-residential receivers (S07.02 – use of an excavator)

Figure 3.30 shows the range of predicted noise levels for each non-residential receiver type along with relevant assessment NMLs shown as a blue line. The number of receivers predicted to exceed the NML are numbered in blue. The modelling results indicate that the average experienced noise level is below the NML for all non-residential receiver types. The NML exceedances at key non-residential receivers are listed in section 3.4.2.



**Figure 3.30** S07.02 – Predicted noise level range at non-residential receivers compared to the NML)

### Impacts and duration of each sub-scenario at residences

As the activity sound power level for the concrete works and finishing works are similar, the NML exceedances predicted for both sub-scenarios are also similar. The proportion of NML exceedances for the two sub-scenarios along with the expected duration of each are shown in Figure 3.31. The results indicate:

- S07.02 (finishing works) is anticipated to result in a slightly higher number of NML exceedances than S07.01 (concrete works).
- During all assessment periods, most of the NML exceedances are predicted to be <10 Db.
- The number and extent of NML exceedances during the OOHW day and OOHW evening periods are similar.
- Should high-noise generating work occur during the OOHW night period, it would result in NML exceedances of >20 dB. However, the majority of NML exceedances during this period are predicted to be <10 dB or 10-20 dB. As such, any high-noise intensive equipment would be scheduled during the ICNG standard hours, where possible.

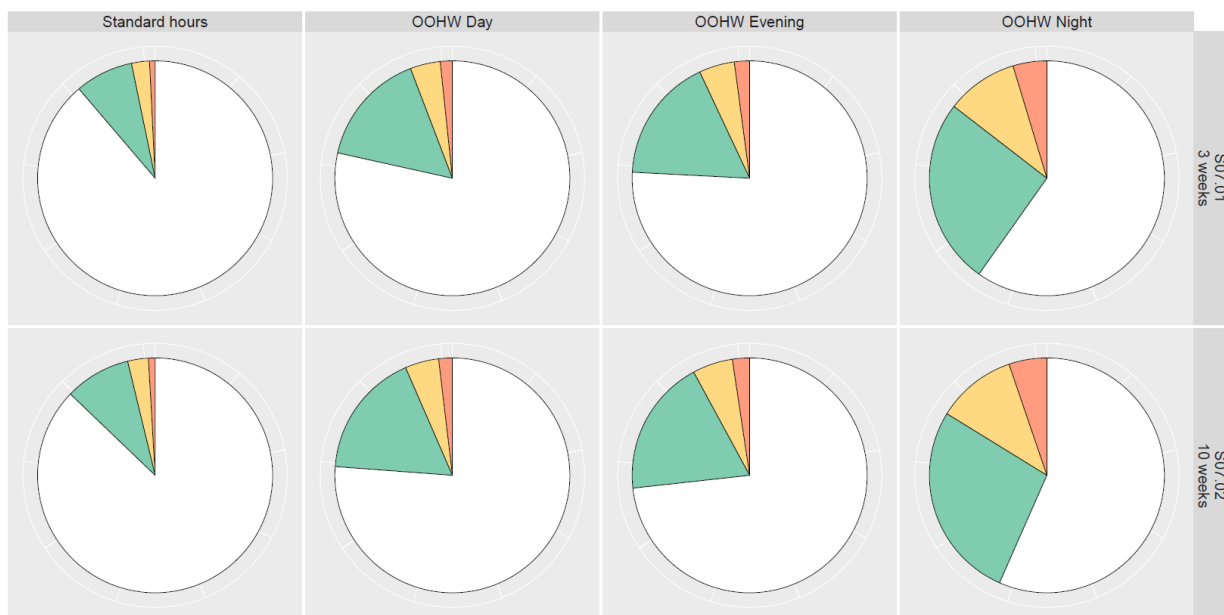


Figure 3.31 S07 – Proportion of NML exceedances at residences for each sub-scenario

### 3.4.3.8 S08: Bridge works

Three new bridges are proposed, being a bridge at Camellia (over Parramatta River), a bridge over Silverwater Road and a bridge at Wentworth Point (over Parramatta River). In Ken Newman Park, a bridge is also proposed to be constructed near the Boronia Street and Spurway Street intersection. It has been assumed that construction works in this area would be similar to the works for the other bridges as a worst-case. In addition, modification works to the existing Holker Busway bridge would be required and the existing bridge at Hill Road would be duplicated to allow for the new light rail track.

#### Worst-case impacts per residential NCA (S08.02 – use of piling rig)

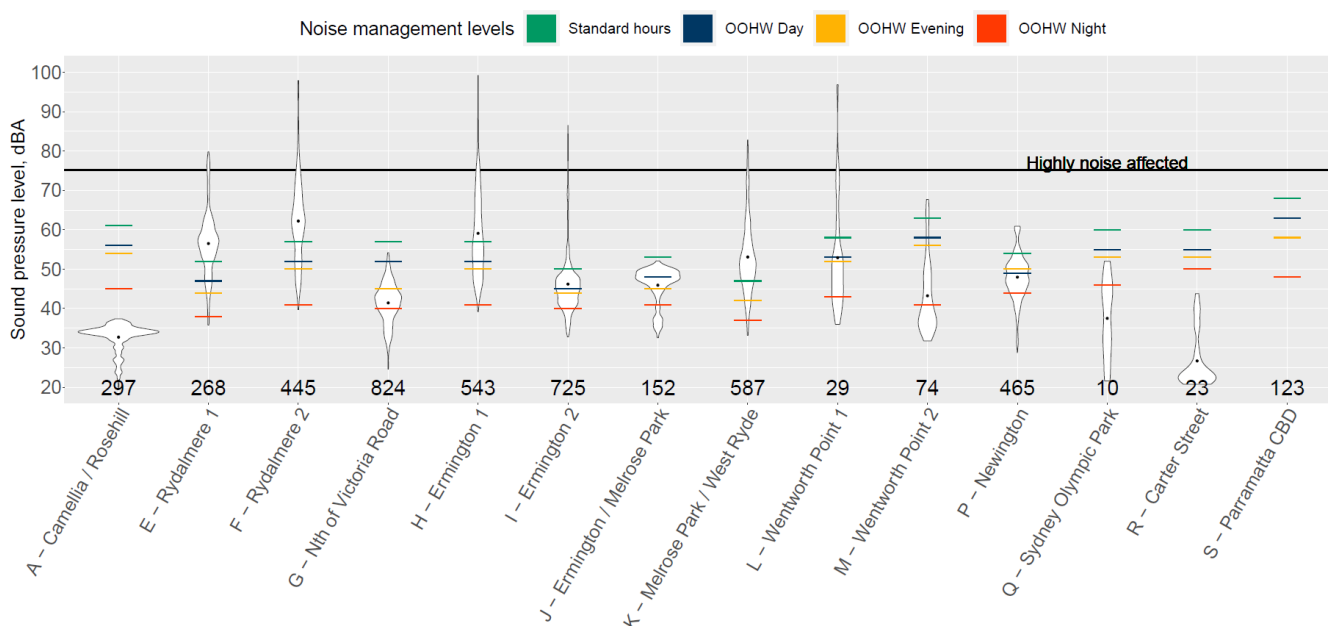
Piling works at bridges (S08.02) is predicted to result in the greatest number of impacts at residential receivers, however the duration of the actual piling works is expected to be relatively short-term (approximately 19 weeks for completion at all locations). Due to the high noise level of a piling rig and the proximity of works to residences, highly noise affected receivers are anticipated in the following areas:

- Rydalmere (NCA-E) near bridge between Camellia and Rydalmere
- Ermington (NCA-F and NCA-H) near bridge over Silverwater Road
- Ermington (NCA-H and NCA-I) near bridge over Ken Newman Park
- Melrose Park/West Ryde (NCA-K) and Wentworth Point (NCA-L) near bridge between Melrose Park and Wentworth Point.

Due to the low background noise levels in Rydalmere, Ermington and Melrose Park/West Ryde, the average noise level for residences within each NCA is predicted to be above the standard hours NML.

Figure 3.32 shows the range of predicted noise levels for each NCA along with relevant assessment NMLs. Table 3.24 shows the number of residences predicted to receive noise levels above the relevant NML and Figure 3.33 shows the number residences per exceedance category during the ICNG standard hours. The results indicate the following:

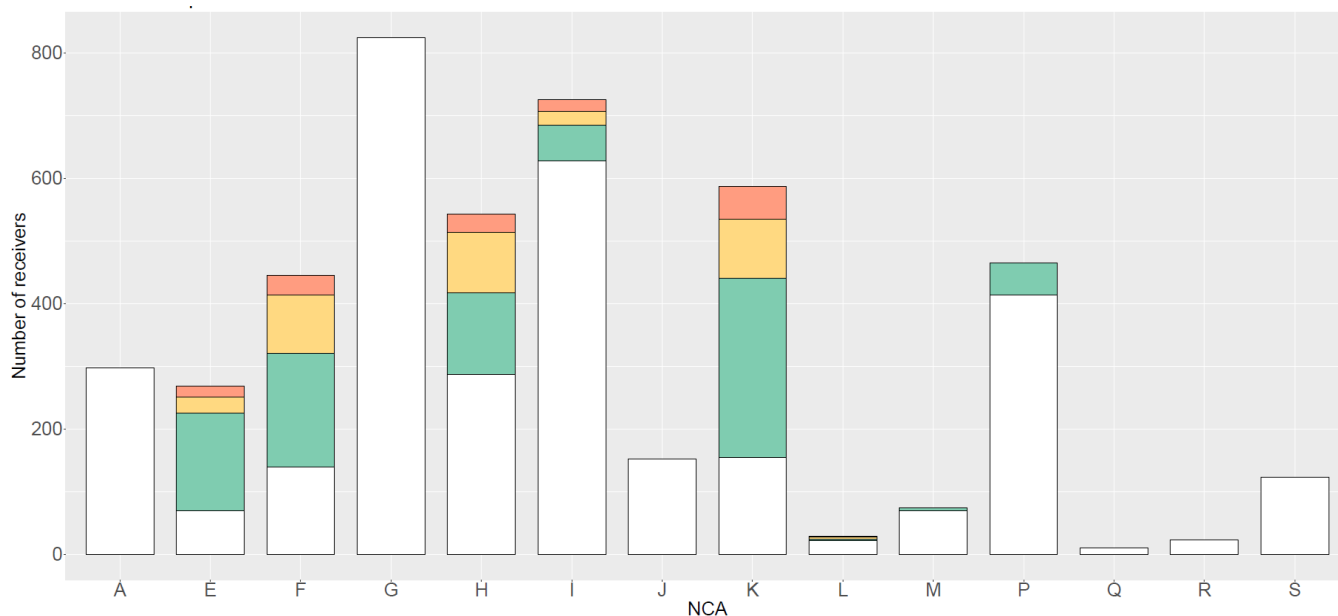
- During the ICNG recommended standard hours, most of the NML exceedances are predicted to be <10 dB at each NCA.
- During ICNG recommended standard hours, the upgrades to the Hill Road and Holker Busway bridges are predicted to result in NML exceedances of <10 dB at Newington (NCA-P).
- During the OOHW day and evening periods, a significant portion of NML exceedances are predicted to be 10-20 dB and >20 dB.
- The majority of impacts during the OOHW night periods are predicted to be 10-20 dB and >20 dB.



**Figure 3.32** S08.02 – Predicted noise level range at residences compared to NML at each NCA (worst-case)

**Table 3.24** S08.02 – Number of NML exceedances at residences per NCA (S01.02)

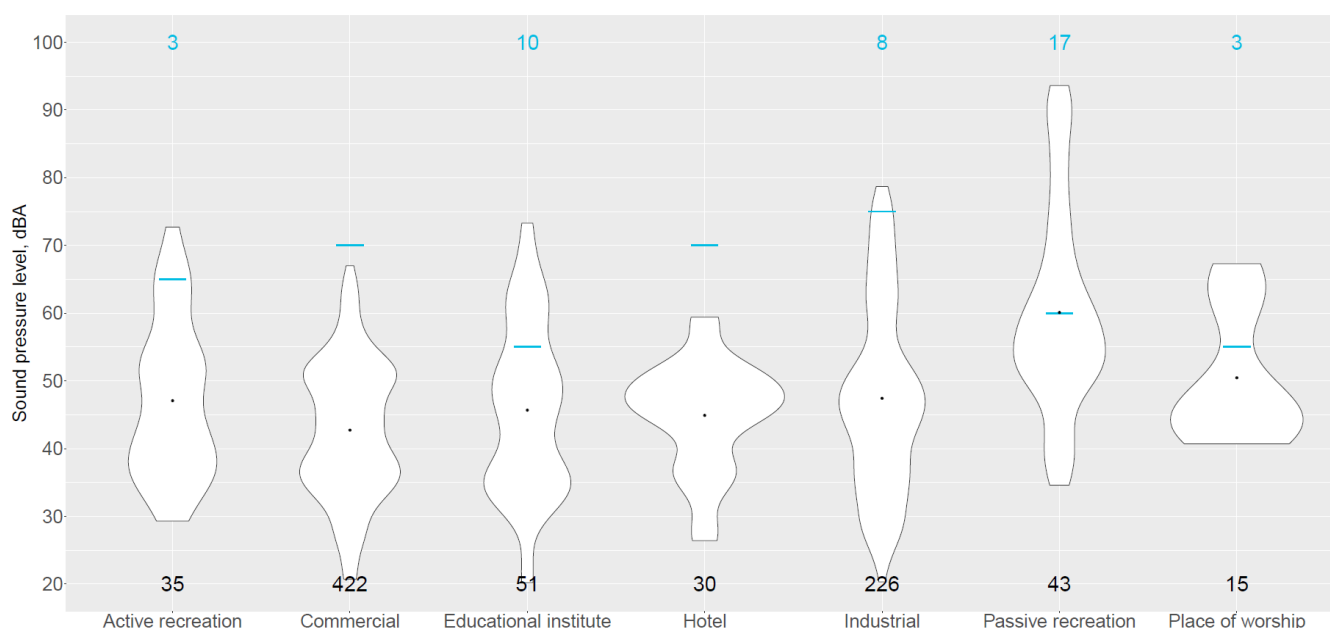
NML	Number of residences predicted to experience noise levels above the NML per NCA													
	A	E	F	G	H	I	J	K	L	M	P	Q	R	S
Standard	0	199	306	0	256	98	0	433	7	5	51	0	0	0
OOHW Day	0	231	353	11	372	334	51	522	8	7	182	0	0	0
OOHW Eve	0	248	384	164	405	404	107	522	11	9	148	0	0	0
OOHW Night	0	264	441	506	536	610	125	572	21	32	351	2	0	0
Highly Noise Affected	0	10	42	0	45	11	0	15	2	0	0	0	0	0



**Figure 3.33** S08.02 – Number of residences per exceedance category during standard hours

### Worst-case impacts at non-residential receivers (S08.02 – use of piling rig)

Figure 3.34 shows the range of predicted noise levels for each non-residential receiver type along with relevant assessment NMLs shown as a blue line. The number of receivers predicted to exceed the NML is numbered in blue. The modelling results indicate that the average experienced noise level is below NML for all non-residential receiver types, except for at passive recreation areas. The NML exceedances at key non-residential receivers are listed section 3.4.2.



**Figure 3.34** S09.02 – Predicted noise level range at non-residential receivers compared to the NML)

### Impacts and duration of each sub-scenario at residences

Noise impacts for all four sub-scenarios are shown in Figure 3.35. The results indicate:

- S08.02 (piling works) is anticipated to result in the greatest number of noise impacts.
- The level and extent of NML exceedances during site establishment (S08.01), construction and installation (S08.03) and concrete works (S08.04) at bridges are anticipated to be similar.
- For non-piling related bridge works during the ICNG recommended standard hours, a relatively small number of receivers are predicted to experience noise levels above the NML.

- The number and extent of NML exceedances during the OOHW day and OOHW evening periods are similar for all sub-scenarios.
- Should high-noise generating work (such as piling) occur during the OOHW night period, it would result in >20 dB exceedances of the NML at a significant number of receivers. The majority of NML exceedances during this period are either predicted to be <10 dB or 10-20 dB. As such, any high-noise intensive equipment would be scheduled during the ICNG standard hours, where possible.
- The activity that would occur for the longest duration (approximately 95 weeks) is predicted to result in the least number of NML exceedances, being construction and installation works (S08.03).

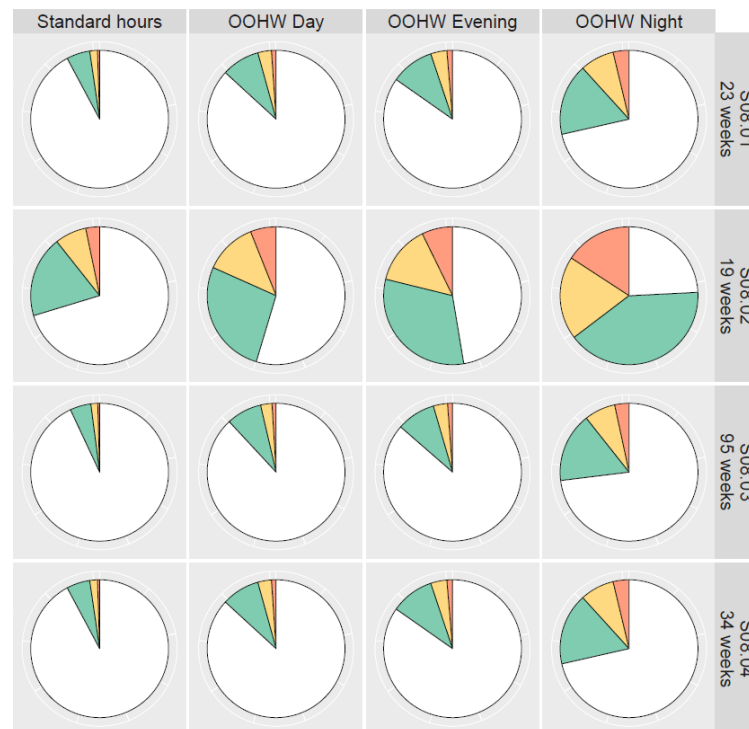


Figure 3.35 S08 – Proportion of NML exceedances at residences for each sub-scenario

### 3.4.3.9 S09: Roadworks and other pavement works (including active transport links)

The road network would be modified in numerous locations (particularly around intersections) to accommodate the track infrastructure and to ensure network management and viability during and following construction.

#### Worst-case impacts per residential NCA (S09.02 – use of rockbreaker)

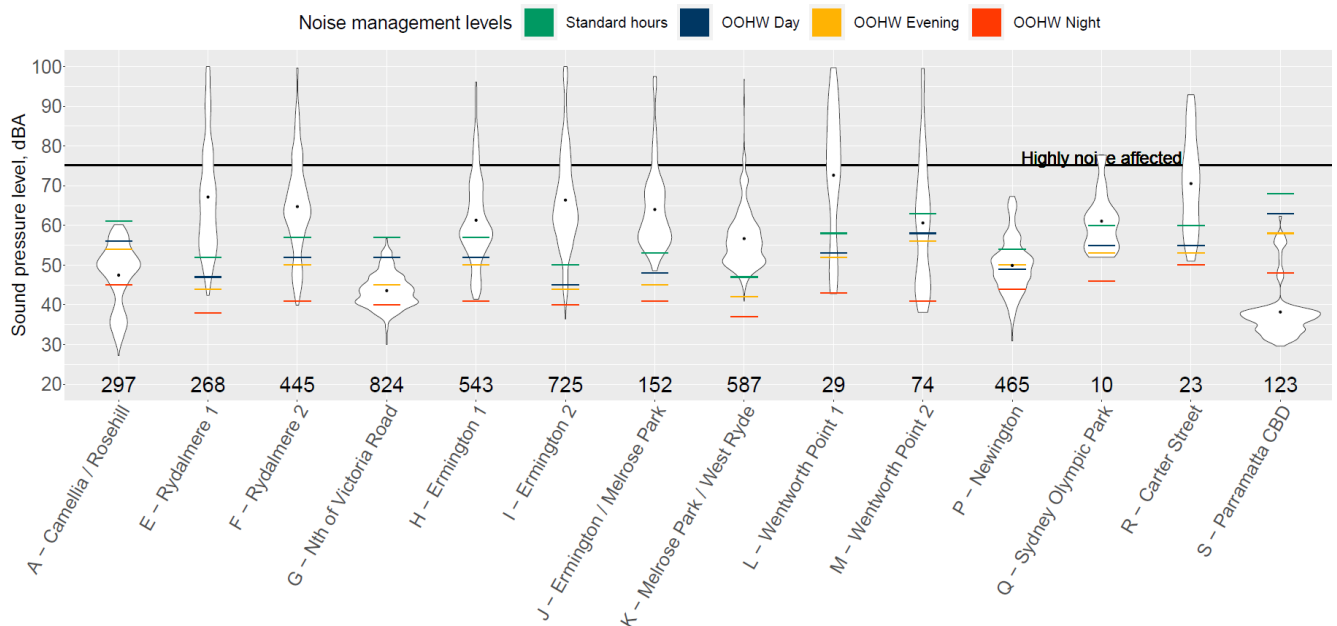
Excavation works with the use of a rockbreaker (S09.02) are predicted to result in the greatest number of NML exceedances at residential receivers, however this impact is expected to be relatively short-term (less than six weeks). Due to the high noise level of a rockbreaker and the proximity of works to residences, the average noise level is predicted to be above the standard hours NML and residences are anticipated to be highly noise affected at all NCAs except for Rosehill- Camellia (NCA-A), North of Victoria Road (NCA-G) and Newington (NCA-P).

As the works would progress in a general linear manner along the road corridor, the worst-case impacts at any one receiver would be expected for a substantially shorter duration than the total duration for the activity.

Figure 3.36 shows the range of predicted noise levels for each NCA along with relevant assessment NMLs. Table 3.25 shows the number of residences predicted to receive noise levels above the relevant NML and Figure 3.37 shows the number residences per exceedance category during the ICNG standard hours. The results indicate the following:

- During standard hours, most of the NML exceedances are predicted to be <10 dB at each NCA except for at Ermington (NCA-I) due to the low background noise levels in this area.
- A significant number of 10-20 dB NML exceedances and >20 dB NML exceedances are predicted during the OOHW day, evening and night periods.

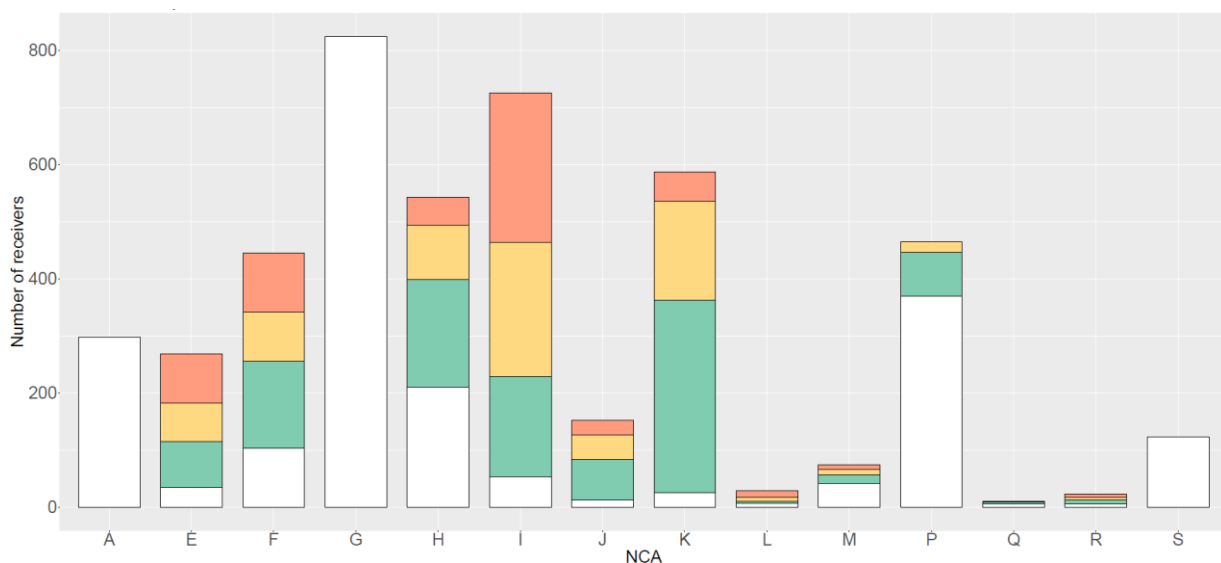
- During OOHW periods, most of the NML exceedances are predicted to be either 10-20 dB or >20 dB, especially at NCAs north of Parramatta River where background noise levels are relatively low.
- Due to the large separation distance between residences and the roadworks at Parramatta CBD (NCA-S), noise levels are not predicted to exceed the NMLs during the ICNG recommended standard hours and OOHW day period.



**Figure 3.36** S09.02 – Predicted noise level range at residences compared to NML at each NCA (worst-case)

**Table 3.25** S09.02 – Number of NML exceedances at residences per NCA

NML	Number of residences predicted to receive noise levels above the NML per NCA													
	A	E	F	G	H	I	J	K	L	M	P	Q	R	S
Std	0	233	342	0	333	672	140	562	22	32	96	5	18	0
OOHW Day	36	257	376	34	447	698	152	586	23	43	231	6	21	0
OOHW Eve	53	264	385	237	468	702	152	586	23	43	200	9	22	1
OOHW Night	203	268	440	613	542	720	152	587	28	68	364	10	23	13
Highly Noise Affected	0	81	119	0	60	199	24	15	14	15	0	1	10	0



**Figure 3.37** S09.02 – Number of residences per impact category during standard hours



### Worst-case impacts at non-residential receivers (S09.02 – use of rockbreaker)

The modelling results indicate that the average experienced noise level is below the NML for all non-residential receiver types, except for at educational institutes, passive recreations areas and hotels (night NML). The impacted non-residential receivers are listed in section 3.4.2.

Figure 3.38 shows the range of predicted noise levels for each non-residential receiver type along with relevant assessment NMLs shown as a blue line. The number of receivers predicted to exceed the NML is numbered in blue. The modelling results indicate that the average experienced noise level is below NML for all non-residential receiver types, except for at passive recreation areas. The NML exceedances at key non-residential receivers are listed in section 3.4.2.

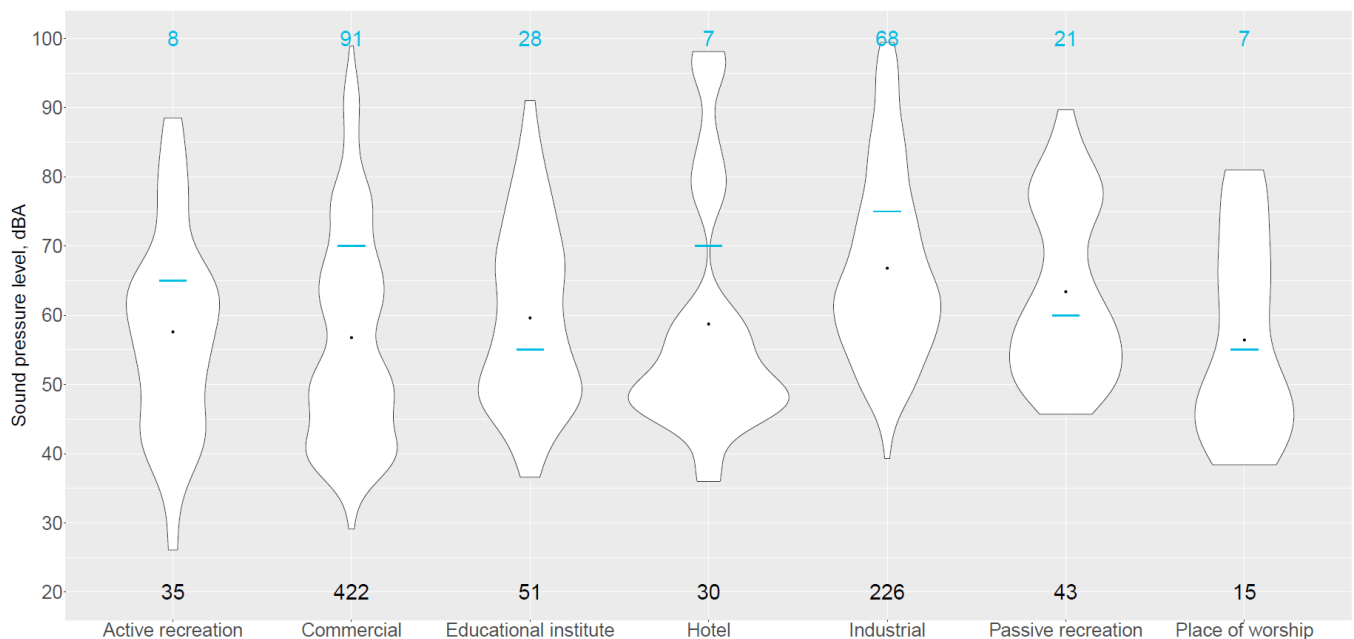


Figure 3.38 S09.02 – Predicted noise level range at non-residential receivers compared to the NML)

### Impacts and duration of each sub-scenario at residences

The proportion of receivers impacted by the works for all four sub-scenarios are shown in Figure 3.39. The results indicate:

- S09.02 (earthworks with rockbreaker) is anticipated to result in the greatest number of noise impacts, followed by:
  - S09.03 (pavement works for approximately 12 weeks)
  - S09.01 (earthworks with no rockbreaker for approximately eight weeks)
  - S09.04 (signage and line-marking for approximately six weeks, where required).
- The number and extent of NML exceedances during the OOHW day and OOHW evening periods are similar for all sub-scenarios.
- Should high-noise generating work (e.g. rockbreaking, pavement works and earthworks) occur during the OOHW night period, it would result in >20 dB NML exceedances at a significant number of receivers. As such, any high-noise intensive equipment would be scheduled during the ICNG standard hours, where possible.

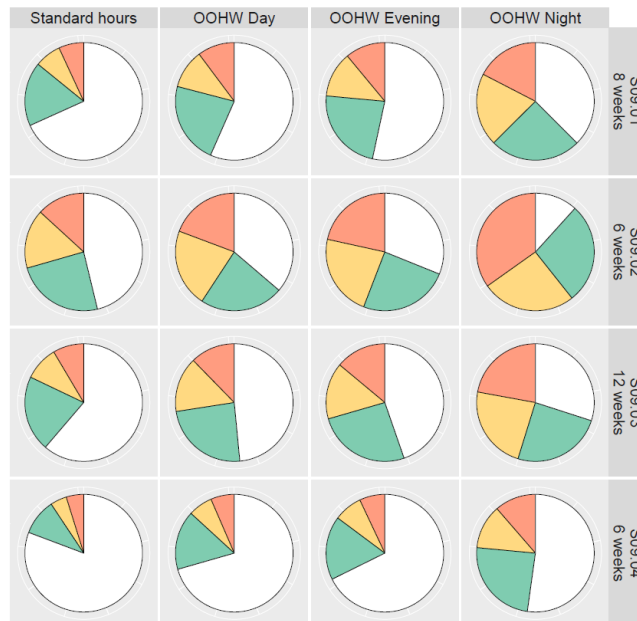


Figure 3.39 S09 – Proportion of NML exceedances at residences for each sub-scenario

### 3.4.4 Utility works

Utilities and services located within the project site include power, potable and recycled water, gas, fuel, wastewater and telecommunications. These assets that would be impacted by construction would be relocated or protected, in consultation with the relevant asset owners and operators. Table 3.26 outlines the existing utilities along the Parramatta Light Rail alignment and the various proposed treatment that may be required.

Indicative construction activities that would occur during services and utilities works include:

- identification of services and utilities by tracing or non-destructive excavation
- construction of new services or utilities alignment by open trenching or non-destructive excavation
- installation of new services (duct, cable, pipe, poles) as appropriate
- reinstatement of the surface
- commissioning of the new services or utility
- removal of the redundant service.

Utilities works may also involve protecting utilities within bridging structures or concrete encasement.

**Table 3.26**      *Indicative critical utility treatment during construction*

Utility	Service provider	Location (suburbs)	Proposed treatment
<b>Water</b>			
Potable water delivery system pipelines	Sydney Water	Camellia, Rydalmere, Ermington, Melrose Park	Protection and relocation. A valve set in Ken Newman Park would also be relocated.
Recycled water pipeline	Sydney Olympic Park Authority	Wentworth Point	Relocation
Potable and recycled water	Sydney Water	Sydney Olympic Park	Relocation
<b>Electricity</b>			
High and low voltage transmission lines	Endeavour Energy	Camellia, Rydalmere, Ermington, Melrose Park	Relocate underground
132 kV electricity transmission line	Ausgrid	Wentworth Point	Protection
High and low voltage transmission lines including 11 kV lines	Ausgrid	Wentworth Point, Sydney Olympic Park, Lidcombe	Relocate both above and underground
<b>Gas and fuel</b>			
High pressure gas mains	Jemena	Camellia, Rydalmere, Ermington, Melrose Park, Wentworth Point, Sydney Olympic Park, Lidcombe	Relocation
High pressure fuel line	Viva Energy Australia	Melrose Park	Protection and relocation

Note: 1. In some locations, there would be a need to remove and replace aged cast iron water mains and replace them with steel.

At this stage, the exact location and equipment required to undertake these works are unknown, however would likely consist of typical ground excavation equipment and compaction equipment to reinstate the surface.

Noise levels at distance from typical equipment required for utility works have been predicted as shown in Figure 3.40. Note should be made that these predictions do not include the acoustic shielding effects of intervening topography or buildings (assume line-of-sight from source to receiver).

The NMLs for standard hours and OOHw are listed in Table 3.2 for residential receivers and Table 3.3 for non-residential receivers. As most of the sensitive receivers in the study area are residential, indicative NMLs are listed in Table 3.27 for the following residential area types:

- urban residential areas with relatively high background noise levels
  - Rosehill/Camellia NCA-A
  - Wentworth Point near Hill Road NCA-M
  - Sydney Olympic Park NCA-Q
  - Carter Street Precinct NCA-R
- suburban residential areas with moderate background noise levels:
  - Rydalmere NCA-F
  - North of Victoria Road NCA-G
  - Ermington NCA-H
  - Wentworth Point near Ferry NCA-L
- suburban residential areas with low background noise levels
  - Rydalmere NCA-E
  - Ermington NCA-I
  - Melrose Park and West Ryde NCA-J and NCA-K
  - Newington NCA-P.

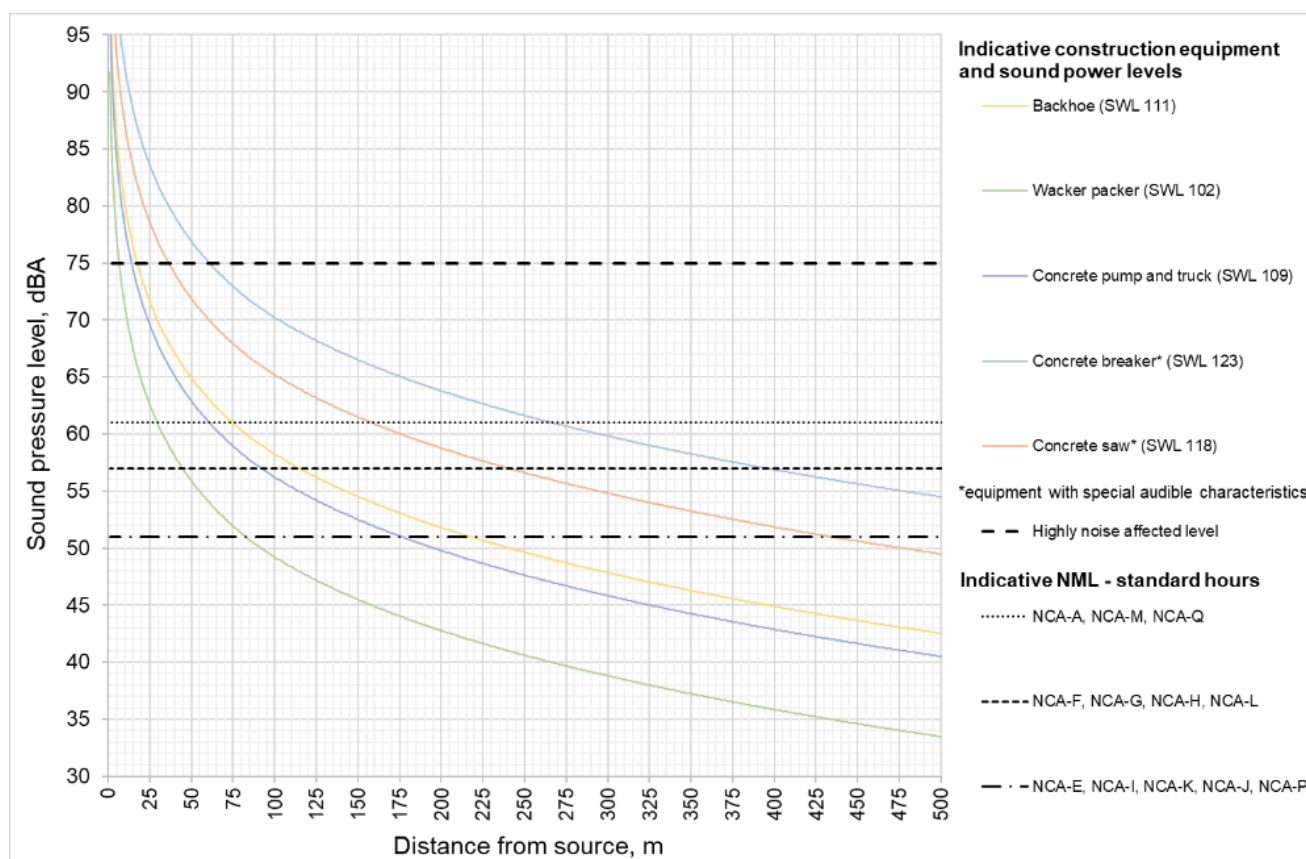


Figure 3.40  $L_{Aeq}$  noise levels at receivers – utility relocation works

The impact distances where NMLs are predicted to be exceeded are listed in Table 3.27 for the various items of equipment associated with utility relocation works.

On typical streets, the nearest residences are generally at a distance of 15 metres to 30 metres from the road. At these distances, all construction equipment except for the wacker packer are anticipated to result in highly noise affected receivers. Noise intensive equipment such as the use of a rockbreaker or concrete saw is anticipated to result in the high noise levels at adjacent residences though would only be a temporary impact.

NMLs during the OOHW night period are in the region of 37 dBA (Melrose Park/West Ryde) to 50 dBA (Carter Street) depending on the RBL in the area. Based on a residential dwelling 25 metres away from construction works, noise levels could range from 63 dBA (wacker packer) to 84 dBA (rockbreaker). As such, exceedances of the night NML are predicted to be >20 dB.

Table 3.27 Impact distances for various items of equipment during standard hours– utility works, metres

Receiver type	NML, dBA	Distance where the NML would be exceeded, metres				
		Backhoe	Wacker packer	Concrete pump and truck	Rockbreaker*	Concrete saw*
<b>Highly noise affected receivers</b>	<b>75</b>	<b>19</b>	<b>8</b>	<b>16</b>	<b>62</b>	<b>38</b>
Urban residences – high RBLs	61	76	31	62	267	159
Suburban residences– moderate RBLs	57	115	46	93	395	241
Suburban residences – low RBLs	51	241	93	196	746	477

Note: 1. Rockbreaker and concrete saw would generally operate for 5 minutes out of a 15 minute period (-5 dB time correction) and would also include a +5 dB correction to account for special audible characteristics.

During construction, noise impacts associated with utility works would be of a temporary nature and would move progressively along the utility service corridor resulting in impacts at particular receivers for only a limited period of time.

To reduce the potential for noise impacts, the use of the following noise intensive equipment would be prioritised during ICNG recommended standard construction works, where possible:

- rockbreaker
- concrete saw.

### 3.4.5 Effectiveness of noise mitigation measures

Measures for reducing noise impacts from construction activities follow three main control strategies:

- first preference and most desirable – reducing the noise at the source
- second preference – reducing the noise in transmission (between source and receiver)
- third preference and least desirable – reducing the noise at the receiver.

The following sections present the justification for implementing at-source and in-transmission mitigation measures as recommended in the project specific mitigation measures presented in section 3.7.3, along with a discussion of the reasonableness or feasibility of the noise control type.

Reducing the noise at the receiver is not considered a reasonable mitigation measure due to temporary nature of construction noise and the number of receivers surrounding the project site.

Additional mitigation measures would be addressed in accordance with the CNVS and would apply for residual noise impacts, subsequent to the incorporation of reasonable and feasible mitigation measures. These additional mitigation measures are discussed in section 3.7.4.

#### 3.4.5.1 Mitigation at the source

The relative effectiveness of various forms of noise control at the source are presented in Table 3.28.

Mitigation at the source should be considered as the most-effective mitigation option, where it is reasonable and feasible. Reducing the noise at the source benefits the greatest number of receivers as it reduces noise emission to the overall environment.

**Table 3.28** Effectiveness of various forms of noise control at the source

Control by	Nominal noise reduction, dB	Mobile plant <sup>1</sup>		Stationary plant <sup>2</sup>	
		Discussion of effectiveness	Reasonable or feasible test	Discussion of effectiveness	Reasonable or feasible test
Alternative construction methodology	Normally 5 to 25 dB (depending on method).	Very effective, where feasible, e.g. less noise intensive piling methods or using hydraulic concrete shears in lieu of hammers/rockbreakers.	Considered reasonable. An alternative construction method may not always be feasible, depending on engineering requirements at each site.	Very effective, where feasible, e.g. use of an electric motor instead of diesel or petrol engine for compressors.	Considered reasonable and feasible, where possible.
Distance (first preference)	Approximately 6 for each doubling of distance.	Very effective when implemented.	Considered reasonable and feasible.	Very effective when implemented.	Considered reasonable and feasible.
Silencing/mufflers (second preference)	Normally 5 to 10 (maximum 20).	Very effective when implemented – expected reduction of up to 10 dB for mobile plant and trucks.  Silenced jackhammers and rockbreakers can reduce noise levels by up to 10 dB to 15 dB.	Considered reasonable and feasible, where possible.	Compressors, pumps and generators can be selected include silencers, if appropriate.	Considered reasonable and feasible, where possible.
Screening (third preference, if required)	Normally 5 to 10 (maximum of 15).	Not generally possible and not effective for mobile plant within large construction areas during early construction works.  Screening can be used once buildings have been erected.	Not considered feasible for mobile plant until buildings have been erected.	If screening is possible for stationary plant, screening can be very effective (e.g. concrete saws, generators, compressors etc.)	Considered reasonable if distance alone cannot provide sufficient attenuation.
Enclosure (fourth preference, if required)	Normally 15 to 25 (maximum 50).	Not generally possible and not effective for mobile plant.	Not considered feasible for mobile plant.	If possible and appropriate, enclosing stationary plant such as generators, pumps, compressors, transformers etc. can be very effective. Effectiveness of the enclosure would depend on the material and design of the enclosure.	Considered reasonable if distance alone cannot provide sufficient attenuation.

Note: 1. Mobile plant refers to equipment such as excavators, dump trucks, bulldozers, loaders, water carts etc. Stationary plant equipment such as refers to generators, compressors, pumps, A/C units etc.



### 3.4.5.2 Controls in transmission (path)

The relative effectiveness of various forms of noise control in transmission are presented in Table 3.29. Once at-source mitigation measures have been investigated, consideration would be given to controlling noise in transmission.

Table 3.29 Effectiveness of various forms of noise control at transmission

Control by	Nominal noise reduction, dB	Mobile plant		Stationary plant	
		Discussion of effectiveness	Reasonable or feasible test	Discussion of effectiveness	Reasonable or feasible test
Shield stationary noise sources such as pumps, compressors, fans etc.	Depends on the location of source and the receiver (normally 5 to 15).	Not applicable.	Not applicable.	Effective when it breaks the line of sight between the source and receiver. Not effective if it does not.	Considered reasonable and feasible, where possible.
Temporary noise barriers	Depends on the location of source and the receiver (normally 5 to 15).	Effective when it breaks the line of sight between the source and receiver. Not effective if it does not.	Considered reasonable and feasible for construction compounds and worksites in close proximity to residences.	Effective when it breaks the line of sight between the source and receiver. Not effective if it does not. Using distance, screening, enclosures, silencers are probably more appropriate and effective mitigation measures.	Considered reasonable and feasible where it can be used effectively.

### 3.4.6 Residual noise levels

The noise levels for works outside the primary project working hours and associated impacts without mitigation have been discussed in section 3.4.3 as the primary project working hours spans across all CNVS assessment periods.

Various forms of at-source and in-transmission mitigation measures would be implemented for the project depending on the specific activity to be undertaken and sensitivity of the time period that the works would occur (the effectiveness of various mitigation measures is discussed in section 3.4.5). Mitigation measures for individual construction activities would be refined during the design development process once a contractor has been selected.

At this stage, it is difficult to predict the reduction in noise levels at a receiver, subsequent to the incorporation of mitigation measures, as there are multiple variables that influence the expected quantity of noise reduction. This includes, but is not limited to:

- the distance between the source and the receiver
- the type of at-source mitigation applied for noise intensive equipment
- the location of the source and receiver relative to any screening objects
- the effectiveness of barriers depending on the height of the source and receiver.

Generally, the implementation of standard and project specific mitigation measures at the source and in transmission could reduce unmitigated noise levels by up to 25 dB. The CNVS additional mitigation measures would then apply for any residual noise impacts, once all reasonable and feasible mitigation measures have been implemented.

The assessment of residual noise levels assumes a 10 dB reduction in noise levels and is considered conservative as it is reasonable to assume that construction noise levels ( $L_{Aeq(15min)}$  and  $L_{Amax}$ ) would be reduced by a minimum of 10 dB, subsequent to the implementation of mitigation measures.

A summary of the total number of residual impacts predicted (collectively for all receiver types and NCAs) is presented in Table 3.30 for the following assessment periods:

- ICNG recommended standard hours
- OOHW Period 1 Day
- OOHW Period 1 Evening
- OOHW Period 2 Night
- when in use for non-residential receivers.

Table 3.11 presents the number of impacts based on unmitigated noise levels for reference.

**Table 3.30** Summary of the total number of exceedances above the NML for each sub-scenario and assessment period – with mitigation

Scenario	Scenario ID	Residential																	Non residential			
		Standard hours				Highly noise affected	OOHW Day				OOHW Evening				OOHW Night							
		No exceed.	< 10 dB	10 - 20 dB	>20 dB		No exceed.	< 10 dB	10 - 20 dB	>20 dB	No exceed.	< 10 dB	10 - 20 dB	>20 dB	No exceed.	< 10 dB	10 - 20 dB	>20 dB	No exceed.	< 10 dB	10 - 20 dB	>20 dB
Demolition, removal and clearing	S01.01	4412	119	28	6	5	4307	187	59	12	4257	220	74	14	3989	377	143	56	831	1	1	-
	S01.02	3905	425	174	61	48	3453	717	264	131	3292	802	312	159	2489	1231	542	303	809	19	4	1
	S01.03	4565	-	-	-	-	4565	-	-	-	4565	-	-	-	4565	-	-	-	828	5	-	-
Compounds (including clearing)	S02.01	4308	197	50	10	6	4117	313	109	26	4054	352	124	35	3439	768	263	95	820	6	4	3
	S02.02	4209	261	80	15	13	3969	400	155	41	3841	483	188	53	3065	1016	324	160	819	3	8	3
	S02.03	4369	155	33	8	3	4209	261	80	15	4148	293	99	25	3699	583	207	76	821	7	2	3
Spoil & ballast	S03.01	4565	-	-	-	-	4565	-	-	-	4565	-	-	-	4565	-	-	-	833	-	-	-
Substations	S04.01	4542	23	-	-	-	4521	42	2	-	4507	52	6	-	4435	99	30	1	832	-	1	-
	S04.02	4540	25	-	-	-	4519	44	2	-	4496	60	9	-	4412	120	31	2	832	-	1	-
Light rail track and public domain works (stabling and maintenance facility to Carter Street)	S05.01	3911	422	140	92	17	3606	565	230	164	3503	619	256	187	2785	968	516	296	784	34	9	6
	S05.02	3439	649	285	192	184	2862	958	462	283	2717	995	509	344	1985	1175	787	618	747	51	25	10
	S05.03	4049	311	152	53	4	3758	494	191	122	3644	544	210	167	3043	851	422	249	792	29	9	3
	S05.04	3526	606	250	183	172	2986	883	449	247	2857	929	483	296	2071	1208	717	569	753	47	25	8
	S05.05	3606	565	230	164	165	3120	791	422	232	2976	871	451	267	2167	1207	669	522	763	42	20	8
	S05.06	4049	311	152	53	4	3758	494	191	122	3644	544	210	167	3043	851	422	249	792	29	9	3
Modifications to existing stabling and maintenance facility	S06.01	4565	-	-	-	-	4565	-	-	-	4565	-	-	-	4565	-	-	-	833	-	-	-
	S06.02	4565	-	-	-	-	4565	-	-	-	4565	-	-	-	4565	-	-	-	833	-	-	-
	S06.03	4565	-	-	-	-	4565	-	-	-	4565	-	-	-	4565	-	-	-	832	1	-	-
	S06.04	4565	-	-	-	-	4565	-	-	-	4565	-	-	-	4565	-	-	-	833	-	-	-
Stops	S07.01	4417	113	32	3	-	4300	189	63	13	4246	223	74	22	3902	450	162	51	826	6	-	1
	S07.02	4393	130	35	7	-	4267	212	68	18	4204	253	83	25	3825	501	176	63	826	6	-	1
Bridges	S08.01	4459	83	23	-	2	4369	146	41	9	4330	174	45	16	4029	365	134	37	828	4	1	-
	S08.02	4078	338	112	37	28	3729	560	200	76	3599	635	235	96	2952	891	474	248	821	6	4	2
	S08.03	4471	74	20	-	-	4399	122	39	5	4359	152	42	12	4078	333	124	30	829	4	-	-
	S08.04	4459	83	23	-	2	4369	146	41	9	4330	174	45	16	4029	365	134	37	828	4	1	-
Roadworks and other pavement works	S09.01	3919	331	130	185	181	3609	490	235	231	3491	571	252	251	2855	915	405	390	766	42	17	8
	S09.02	3221	742	305	297	257	2704	981	454	426	2550	1031	512	472	1795	1180	856	734	709	61	41	22
	S09.03	3747	429	172	217	199	3312	691	287	275	3219	709	337	300	2501	1054	523	487	747	55	18	13
	S09.04	4058	206	78	142	110	3963	305	114	183	3889	356	124	196	3492	554	267	252	799	17	15	2

### 3.4.6.1 Works during primary project working hours

Assuming a conservative level of noise mitigation (10 dB) is applied at the source and path, the residual noise level results indicate that:

- Spoil and ballast recycling works would result in no impact at any receiver location during any assessment period.
- The modifications at the stabling and maintenance facility at Camellia would result in no impacts at residences during any assessment period.
- The construction of light rail stops would not result in any highly noise affected residences.
- A reduction in highly noise affected receivers is predicted during demolition works, compound site works, mainline trackworks, bridge works and roadworks.
- NML exceedances greater than 20 dB are predicted during demolition works, compound site works, mainline trackworks, bridge works and roadworks during the ICNG standard hours. During OOHW day and evening periods, the extent and number of impacts would increase due to the lower NML and the greatest number of impacts are predicted during the OOHW night period when the NML is the lowest. The actual works that would be undertaken during the OOHW night works would be minimal (generally setting up and mobilising) and high-noise generating equipment would be scheduled during the ICNG recommended standard hours, where possible.

The number of receivers predicted to receive noise levels below the NML increases by approximately 50 per cent for trackworks and roadworks and approximately 20 per cent for bridge works with the application of a conservative level of mitigation (10 dB assumed). Standard management and mitigation measures are provided in section 3.7.2 and project specific measures are provided in section 3.7.3 to reduce the potential for impacts at sensitive receivers.

As 10-20 dB and >20 dB NML exceedances are predicted (subsequent to implementing mitigation) during all construction scenarios except for construction works at the stabling and maintenance facility and spoil and ballast recycling, special attention would be given to the management of residual noise impacts. The CNVS additional mitigation measures would apply for any residual noise impacts, once all reasonable and feasible mitigation measures have been implemented and is discussed in further detail in section 3.7.4.

### 3.4.6.2 Works outside the primary project working construction hours – $L_{Aeq}(15min)$

To assess the likely impacts of works outside the primary project working construction hours, the sub-scenarios that have been identified as requiring night work (see Table 3.31) have been assessed against the OOHW night period as a worst-case (night period NMLs are the lowest). These works would not occur over the entire project area and would be limited to construction activities where there is a justification for OOHW night works (see Table 3.5).

The results indicate there would be 10-20 dB NML exceedances and >20 dB NML exceedances for trackworks (S05) and roadworks (S09) during the night period mostly where there are nearby residential areas. Trackworks and roadworks in Camellia would result in no NML exceedances given there is a minimum separation distance of 800 metres between the construction work area and the nearest residences in Rosehill and Rydalmere.

Demolition works at the former freight rail (Sandown) line, modifications to the stabling and maintenance facility at Camellia and spoil and ballast recycling works are predicted to result in no residual NML exceedances at the nearest residential receivers. The night works required at the bridge over Silverwater Road would result in NML exceedances of >20 dB, however is considered a short-term impact.

As background noise levels are higher during the OOHW day and OOHW evening periods (compared to the OOHW night period), impacts during OOHW day and evening periods would be lower. Consideration would be given to prioritising OOHW day and evening works before OOHW night works, where this is possible. Additionally, the use of noise intensive equipment would be scheduled during the ICNG recommended standard hours, where possible. Table 3.31 provides a discussion of the potential noise impacts during the night period for each of the sub-scenarios. Activity specific Construction Noise and Vibration Impact Statements (CNVIS) would be developed for works during the night period with specific activity-based noise mitigation measures to minimise the potential for noise impacts during sensitive time periods.

**Table 3.31** Works that would be required to be undertaken outside the primary project working construction hours

Scenario ID	Construction activity	Construction work area	Noise intensive equipment	Qualitative assessment of potential residual impacts
S01.03	Removal works at the Sandown Line	– Former freight rail (Sandown) line, Camellia	Rail saw	No exceedances predicted at any residences
S03.01	Spoil and ballast recycling	– Grand Avenue compound site, Camellia	Excavator	No exceedances predicted at any residences
S05.03	Concrete works	<ul style="list-style-type: none"> <li>– Macquarie Street turnback facility, Parramatta CBD</li> <li>– South Street and John Street intersection, Rydalmere</li> <li>– Camellia (separation distance of 800 m between works and residences)</li> </ul>	Mobile crane	<p>NCA-A: No exceedances predicted at any residences given there is a 800 m separation distance between works and residences</p> <p>NCA-S: Most affected receivers would be commercial receivers near the construction work area where most of NML exceedances would be 10 - 20 dB. No NML exceedances or &lt;10 dB exceedances are predicted at the nearest residences.</p> <p>NCA-E: 10-20 dB and &gt;20 dB NML exceedances are predicted at residences adjacent to the South Street construction site. No NML exceedances are predicted at residences given there is a 800 m separation distance between trackworks in Camellia and nearest residences in Rydalmere</p> <p>The use of noise intensive equipment would be prioritised during ICNG recommended standard hours where possible, especially the use of the concrete saw.</p>
S05.04	Trackworks		Rail saw, track laying machine, mobile crane	
S06.01	Earthworks	– Modification works at the stabling and maintenance facility	Excavator, vibratory roller	No exceedances predicted at any residences
S06.02	Concrete works (car park and track)		Mobile crane	
S06.03	Trackworks (track only)		Rail saw, ballast regulator, ballast tamper, track laying machine, excavator, mobile crane	
S08.03	Construction and installation	– Bridge over Silverwater Road	Mobile crane	NCA-E: 10-20 dB and >20 dB NML exceedances are predicted at residences adjacent to construction sites. The use of noise intensive equipment would be prioritised during ICNG recommended standard hours where possible

Scenario ID	Construction activity	Construction work area	Noise intensive equipment	Qualitative assessment of potential residual impacts
S09.03	Pavement works	– Minor kerb adjustments at Australia Avenue	Asphalt milling machine	<p>NCA-P and NCA-Q: Most affected receivers would be commercial receivers near the construction work area where most of NML exceedances would be 10-20 dB if they are operating during the night. Impacts at the nearest residences are predicted to be &lt;10 dB or 10-20 dB given the large separation distance between the works and residential areas.</p> <p>NCA-A and NCA-E: No NML exceedances or minor exceedances are predicted at residences given there is a 800 m separation distance between roadworks in Camellia and nearest residences in Rosehill and Rydalmere.</p>
S09.04	Signage and Line Marking	– Finishing works at Hill Road and Holker Street intersection	Line marking plant	



### 3.4.6.3 Potential sleep disturbance impact – LAF<sub>max</sub>

As primary project working hours are proposed to extend into the OOH Night Period 2, a sleep disturbance screening assessment has been undertaken for all construction scenarios. The assessment is based on the worst-case assumption that high noise generating equipment would be used with maximum noise levels for each scenario are summarised in Table 3.8. Additionally, the assessment assumes a conservative 10 dB reduction (based on at-source and path mitigation measures being implemented).

The sleep disturbance screening level is used to identify receivers with the potential for sleep disturbance. Exceedances of this level do not always lead to sleep disturbance or sleep awakenings as there are several contributing factors when considering these impacts (discussed further in Appendix E-2).

The results of the sleep disturbance screening assessment are summarised in Table 3.32, which shows the predicted number of exceedances of the sleep disturbance screening level in each noise catchment area. The assessment is based on the worst-case assumption that high noise generating equipment would be used and assumes a conservative 10 dB reduction (based on at-source and path mitigation measures being implemented). The number of exceedances of the sleep disturbance criteria would be less than shown for the majority of the time, as high noise generating equipment would only be used for a relatively short duration.

Further investigation would be undertaken during the design development process to identify the likelihood of sleep disturbance based on number of events and duration of these works. The potential sleep disturbance impacts at receivers would be similar to those qualitatively discussed in Table 3.31.

The receivers with the potential to experience higher impacts are generally located in Rydalmere and Ermington (noise catchment areas E to J) where background noise levels are relatively low and residences are located close to the project site.

**Table 3.32** Sleep disturbance screening assessment – number of residences exceeding the criteria per NCA

NCA	Suburb /area	Exceedances of the screening criteria				Worst construction scenario
		No exceedance	<10 dB	10 to 20 dB	> 20 dB	
A	Camellia and Rosehill	294	2	0	0	S09.02
E	Rydalmere suburban area 1	47	93	49	79	S09.02
F	Rydalmere suburban area 2	75	113	130	127	S09.02
G	North of Victoria Road	819	5	0	0	S08.02
H	Ermington suburban area 1	88	226	124	109	S08.02
I	Ermington suburban area 2	142	255	146	183	S09.02
J	Ermington and Melrose Park redevelopment area	40	55	32	26	S09.02
K	Melrose Park/West Ryde suburban area	244	239	73	31	S08.02
L	Wentworth Point (near ferry)	5	3	8	13	S09.02
M	Wentworth Point (east of Hill Road)	5	30	21	18	S05.04
P	Newington	413	48	0	0	S09.02
Q	Sydney Olympic Park centre	4	5	1	0	S09.02
R	Carter Street precinct	8	4	6	5	S09.02
S	Parramatta CBD	123	0	0	0	S09.02

### 3.4.7 Indicative residual noise impact map

The implementation of standard and project specific mitigation measures at the source and in transmission could reduce unmitigated noise levels by up to 25 dB. The CNVS additional mitigation measures would then apply for any residual noise impacts, once all reasonable and feasible mitigation measures have been implemented.

In order to provide indicative representation of required additional mitigation measures for the overall project, a 10 dB reduction in construction noise levels has been assumed to represent indicative residual noise levels.

The number of properties requiring mitigation for each construction activity would be determined for each applicable construction period prior to the commencement of construction works. Figure 3.41 shows the receivers requiring additional mitigation during the ICNG standard hours for any construction activity, including those that are highly noise affected. Figure 3.42 shows the required additional mitigation for all construction activities proposed during the OOHW night period.

### 3.4.8 Cumulative noise impacts – due to the project

Cumulative impacts due to various construction activities associated with the project occurring simultaneously would be dependent upon several factors, including:

- a. the intensity and location of construction activities
- b. the type of equipment used by the contractor
- c. existing background noise levels
- d. intervening local structures
- e. the prevailing weather conditions.

The prediction of cumulative noise levels from more than one construction scenario operating close to another scenario within the project site is very complex due to the number of noise sources and possible locations for a particular combination of construction works.

The predicted noise levels provided in section 3.4 are considered to be a worst-case and would decrease as the construction activity moves away from the sensitive receiver. In the event of multiple construction activities happening simultaneously, it is estimated that the worst-case levels provided as part of this assessment would not be affected but may be audible at the receiver for a longer duration.

Given the number of work sites and compounds associated with project it is likely that receivers would, occasionally, be subject to potential cumulative noise impacts from work sites operating concurrently in the same area.





#### Legend

- Project site
- Additional mitigation measures (CNVS) [5349]
- Highly noise affected - PN, V, SN [308]
- Moderately/highly intrusive - PN, V [461]
- No additional mitigation [4580]

Paper Size ISO A4  
 0 0.5 1  
 Kilometres  
 Map Projection: Transverse Mercator  
 Horizontal Datum: GDA 1994  
 Grid: GDA 1994 MGA Zone 56



Transport for NSW  
 Parramatta Light Rail Stage 2 EIS  
 Noise and vibration impact assessment  
**Indicative additional mitigation  
 required at sensitive receivers  
 during ICNG standard hours**

Project No. 12557728  
 Revision No. -  
 Date 28/06/2022

**FIGURE 3.41**





#### Legend

- Project site
- Additional mitigation measures (CNVS) [5349]
- Highly intrusive - PN, V, SN, RO, AA, RP, DR [439]
- Clearly audible/moderately intrusive - PN, V, SN, RO, RP, DR [1535]
- Noticeable - PN [560]
- No additional mitigation [2815]

Paper Size ISO A4  
0 0.5 1  
Kilometres

Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 56



Transport for NSW  
Parramatta Light Rail Stage 2 EIS  
Noise and vibration impact assessment  
**Indicative additional mitigation  
required at sensitive receivers  
during OOHV night period**

Project No. 12557728  
Revision No. -  
Date 28/06/2022

**FIGURE 3.42**



### 3.4.9 Cumulative noise impacts – other major projects

The project is near several major projects that have either recently been constructed, are currently under construction or planned for construction as listed in Table 3.33. The majority of the projects below are State Significant Developments (SSD) unless otherwise noted.

There is potential for cumulative construction noise impacts should construction works associated with any of the major projects listed below occur concurrently with the project in the same area.

**Table 3.33** Major developments near the project

Precinct	Major project	Development status as of October 2022
Parramatta	Parramatta Light Rail Stage 1	Approved 2018
	New Powerhouse Museum	Approved 2021
	Macquarie Street/Marsden Street – Mixed-use development	Approved 2020
	Private hospital and hotel	Preparing EIS
	Western Sydney University – Innovation Hub	Approved 2021
	GQ Parramatta – 12 Hassall Street, Parramatta	Response to Submissions
	Build to Rent 41-43 Hassall Street, Parramatta	Preparing EIS
	Parramatta Public & Arthur Phillip High School redevelopment	Approved 2018
Camellia	Camellia Waste Facility	Approved 2016
	James Hardie Research & Development Facility	Preparing EIS
	Viva Energy Clyde Western Area Remediation Project	Approved 2020
	Central Sydney Industrial Estate and Downer Resource Centre	Approved 2021
	Parramatta Light Rail Stage 1 stabling and maintenance facility	Approved 2018
Wentworth Point	Sydney Olympic Park new high school	Under Assessment
	Residential development at 14-16 Hill Road, Wentworth Point <sup>1</sup>	Approved 2019
	Residential development at 37-39 Hill Road, Wentworth Point <sup>1</sup>	Approved 2017
Sydney Olympic Park	Sydney Olympic Park Metro Station – Over and Adjacent Station Development	Prepare EIS
	Stadium Australia Redevelopment	Approved 2020
	Netball NSW Headquarters	Approved 2014
	Sydney Olympic Park – URBNSURF	Approved 2017
	NSW Rugby League Centre of Excellence	Approved 2018
	Residential Development, 1 & 2 Murray Rose Avenue	Approved 2019
	4 Murray Rose Avenue – Commercial Development	Approved 2017
	2A and 2B Australia Avenue – Sydney Olympic Park	Response to Submissions
	Sydney Olympic Park – Site 8C Commercial Development	Approved 2015
	Sydney Olympic Park – Site 9 Mixed Use Development	Approved 2015
	Sydney Olympic Park – Site 43-44 Mixed Use Development	Approved 2013
	Sydney Olympic Park – Site 67 Mixed Use Development	Approved 2015
	Sydney Olympic Park – Site 68 Mixed Use Development	Approved 2015
	Mixed Use Development – Sites 2A and 2B Sydney Olympic Park	Under Assessment
Carter Street precinct	4-6 Uhrig Road, Lidcombe <sup>1</sup>	Approved 2021
	11A – 13 Carter Street, Lidcombe <sup>1</sup>	Approved 2020

Note: 1. Local Council Development Application

Noise and Vibration Management Plans (NVMP) would be prepared for each individual development to minimise the potential for impacts to nearby sensitive receivers. Furthermore, consultation and coordination would be undertaken with other proponents or applications of other State Significant development and infrastructure works near the project. Reasonable steps would be taken to co-ordinate works to minimise cumulative impacts of noise and vibration and maximise respite for affected sensitive receivers.

Should various projects occur concurrently and/or consecutively within the same general locality, there is potential for 'construction fatigue' due the overall increase duration of noise impacts on sensitive receivers. Projects that may contribute to 'construction fatigue' are listed in Table 3.34 below along with a description of the most-affected sensitive receivers to these projects.

**Table 3.34** *Potential for construction fatigue due to consecutive projects*

Area	Description of project	Most-affected sensitive receivers
Parramatta	<ul style="list-style-type: none"> <li>– Parramatta Light Rail Stage 1</li> <li>– New Powerhouse Museum</li> </ul>	Sensitive receivers within the Parramatta CBD (mainly commercial and educational institutes)
Camellia	<ul style="list-style-type: none"> <li>– Viva Energy Clyde Western Area Remediation Project</li> <li>– Central Sydney Industrial Estate and Downer Sustainable Road Resource Centre</li> <li>– Parramatta Light Rail stabling and maintenance facility</li> <li>– Various future projects associated with the Carter Street Precinct Master Plan</li> </ul>	Sensitive receivers within Rosehill-Camellia
Melrose Park	<ul style="list-style-type: none"> <li>– Various future projects associated Melrose Park North Precinct</li> <li>– Various future projects associated Melrose Park South Precinct</li> </ul>	Mainly residential receivers within Ermington and Melrose Park
Wentworth Point	<ul style="list-style-type: none"> <li>– Residential development at 14-16 Hill Road</li> <li>– Residential development at 37-39 Hill Road</li> </ul>	Mainly residential (generally high-rise) and commercial receivers within Wentworth Point
Sydney Olympic Park	<ul style="list-style-type: none"> <li>– Various approved projects and future projects associated with the Sydney Olympic Park Master Plan 2030</li> </ul>	Mainly residential (generally high-rise) and commercial receivers within Sydney Olympic Park
Carter Street Precinct	<ul style="list-style-type: none"> <li>– 4-6 Uhrig Road, Lidcombe</li> <li>– 11A – 13 Carter Street, Lidcombe</li> <li>– Various future projects associated with the Carter Street Precinct Master Plan</li> </ul>	Mainly residential (generally high-rise) and commercial receivers within Lidcombe (Carter Street Precinct)

The potential cumulative construction impacts associated with the project and other major transport or development projects would be further considered during the design development phase, as construction methodologies are developed. Specific management and mitigation measures that would be implemented to address potential cumulative impacts would include consideration of:

- provision of regular updates to the detailed construction program, construction sites and haulage routes
- identification of key potential conflict points with other major construction projects
- developing mitigation strategies in order to manage conflicts. Depending on the nature of the conflict, this could involve:
  - adjustments to the project's construction program, work activities or construction traffic haulage routes; or adjustments to the program, activities or haulage routes of other construction projects
  - co-ordination of traffic management arrangements between major projects.



## 3.5 Construction vibration assessment

### 3.5.1 Safe working distances for vibration

Vibration is assessed based on the criteria in *Assessing Vibration: A Technical Guideline* (DEC, 2006). Vibration targets for structural damage are provided as screening levels where, if met, further investigation of structural integrity is required to be undertaken. Screening levels for damage to structures as well as human comfort responses are provided in section 3.2.3 as peak particle velocities (PPV).

Safe working distances for human comfort and damage to structures due to vibration intensive equipment are provided in CNVS and reproduced in Table 3.35.

The heritage buildings or structures identified in this assessment should not be assumed to be structurally unsound. Generally, the BS7385 vibration screening criteria for reinforced and unreinforced structures should apply for buildings, including items of heritage significance. The more stringent DIN4150-3 vibration screening criteria of 2.5 millimetres per second only applies to structures deemed to be structurally unsound, subsequent to inspection and investigation. As a conservative approach, the safe working distance to comply with the BS7385 screening criteria has been tripled to identify whether heritage structures near vibration intensive work sites require inspection prior to construction works.

**Table 3.35**      *Vibration safe working distances*

Equipment	Human comfort (AVTG guideline)	Damage to standard structures (BS 7385)	Damage to heritage structures (screening distance)
Vibratory roller (1-2 tonnes)	15 m to 20 m	5 m	15 m
Vibratory roller (2-4 tonnes)	20 m	6 m	18 m
Vibratory roller (4-6 tonnes)	40 m	12 m	36 m
Vibratory roller (7-13 tonnes)	100 m	15 m	45 m
Vibratory roller (13-18 tonnes)	100 m	20 m	60 m
Vibratory roller (>18 tonnes)	100 m	25 m	75 m
Small hydraulic hammer 300 kg (5-12t excavator)	7 m	2 m	4 m
Medium hydraulic hammer 900 kg (12-18t excavator)	23 m	7 m	14 m
Large hydraulic hammer 1600 kg (18-34t excavator)	73 m	22 m	66 m
Pile driver – Vibratory (sheet piles)	20 m	2 m to 20 m	6 m to 60 m
Piling rig – Bored (< 800 mm)	N/A	2 m (nominal)	6 m
Piling rig–Hammer (12t down force)	50 m	15 m	45 m
Jackhammer	Avoid contact with structure	1 m (nominal)	3 m

### 3.5.2 Vibration intensive equipment

The worst- case vibration intensive equipment proposed to be used during construction are identified in Table 3.36. The relevant construction sub-scenarios where each item would be used is also shown along with the adopted safe working distances.

**Table 3.36** Vibration intensive equipment and safe working distances – sub-scenario specific

Equipment	Construction sub-scenarios with vibratory equipment	Human comfort (AVTG guideline)	Damage to standard structures (BS 7385)	Vibration screening distance for heritage structures
Impact piling rig	S08.02 – Bridges piling works	50 m	15 m	45 m
Vibratory roller (10-12 tonnes)	S02.01 – Site establishment of construction compounds S06.01 – Earthworks in the stabling and maintenance facility	100 m	15 m	45 m
Excavator with a breaker attachment	S01.02 – Demolition with breaker S05.02 – Track earthworks with breaker S07.02 – Excavation of stops with breaker S09.02 – Excavation in roadworks with breaker	73 m	22 m	66 m

### 3.5.3 Standard structures within safe working distances

Buildings that fall within the vibration safe working distances, as presented in Table 3.36, during any scenario requiring vibration intensive equipment have been identified. A total of 475 buildings across the study area fall within the area identified as exceeding the vibration screening level for damage to unreinforced structures with a majority of these within NCA-I in Ermington. Further, a total of 822 buildings across the study area fall within the safe working distance for human comfort.

Buildings have been assessed based on the assumption that they are lightweight (unreinforced) structures, however, based on similar building styles in the area, it is likely that most of the identified buildings in Camellia, Wentworth Point, Sydney Olympic Park and the Carter Street precinct would be reinforced structures. Dilapidation surveys would be required prior to construction works to confirm the structural integrity of the identified buildings and refine the vibration management levels based on the investigation.

All buildings identified as exceeding the screening criteria for structural damage and human comfort are shown on Figure 3.43 and Figure 3.44 respectively, along with the number of identified buildings per NCA.



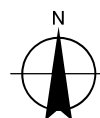


#### Legend

Safe working distance for cosmetic damage to unreinforced buildings (BS 7385)

NCA-B [5]	NCA-I [127]	NCA-Q [21]
NCA-C [16]	NCA-J [39]	NCA-R [12]
NCA-E [71]	NCA-K [11]	NCA-S [14]
NCA-F [65]	NCA-L [21]	
NCA-H [64]	NCA-M [9]	

Paper Size ISO A4  
0 0.5 1  
Kilometres  
Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 56



Transport for NSW  
Parramatta Light Rail Stage 2 EIS  
Noise and vibration impact assessment  
**Identified receivers within safe working distance for cosmetic damage to unreinforced buildings**

Project No. 12557728  
Revision No. -  
Date 24/06/2022

**FIGURE 3.43**



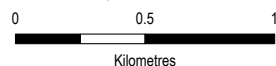


#### Legend

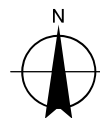
Safe working  
distance for human  
comfort (OH&E  
Vibration Guideline)

NCA-B [17]	NCA-I [231]	NCA-Q [32]
NCA-C [21]	NCA-J [56]	NCA-R [22]
NCA-E [114]	NCA-K [39]	NCA-S [32]
NCA-F [150]	NCA-L [16]	
NCA-H [133]	NCA-M [19]	

Paper Size ISO A4



Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 56



Transport for NSW  
Parramatta Light Rail Stage 2 EIS  
Noise and vibration impact assessment  
**Identified receivers within safe  
working distance for human comfort  
to unreinforced buildings**

Project No. 12557728  
Revision No. -  
Date 01/04/2022

**FIGURE 3.44**



### 3.5.4 Heritage and sensitive infrastructure items within safe working distances

Built heritage items within 100 metres of the construction footprint are listed in section 2.2.2.2 and sensitive infrastructure items are listed in section 2.2.5.5. Heritage items and sensitive infrastructure that fall within the vibration screening distances (see Table 3.36) are presented in Table 3.37.

**Table 3.37** *Heritage items identified within the vibration screening distances*

Equipment	Vibration screening distance for heritage structures	Construction activities with vibratory equipment	Heritage items identified within the vibration screening distance (including potential heritage items)	Sensitive infrastructure items within the vibration screening distance
Impact piling rig	45 m	S08.02 – Piling works at bridges	– None	– Rydalmere Wharf
Vibratory roller (10-12 tonnes)	45 m	S02.01 – Site establishment of construction compounds	– Bulla Cream Dairy (Willowmere) – Ermington Wharf – House at 46 John Street, Rydalmere	– Rydalmere Wharf – Ermington Boat Ramp
		S06.01 – Earthworks at the stabling and maintenance facility	– Tram Alignment, Camellia	– None
Excavator with a rockbreaker attachment	66 m	S01.02 – Demolition works with rockbreaker	– Bulla Cream Dairy (Willowmere) – House at 46 John Street, Rydalmere	– None
		S05.02 – Track earthworks with rockbreaker	– Bicentennial Square and adjoining buildings, Parramatta – Centennial Memorial Clock, Parramatta – Telstra house (former post office), Parramatta – Shop (and potential archaeological site), Parramatta – Horse parapet façade and potential archaeological site, Parramatta – Archaeological site and associated artifacts – Murrays' Building (and potential archaeological site), Parramatta – St John's Parish Hall, Parramatta – Tram alignment, Camellia – House at 46 John Street, Rydalmere – House at 69 South Street, Rydalmere – House at 71 South Street, Rydalmere – Bulla Cream Dairy (Willowmere), Ermington – House at 67 Boronia Street, Ermington – State Abattoir locality, Sydney Olympic Park	– Rydalmere Wharf – Olympic Park Station
		S07.02 – Excavation of stops with rockbreaker	– State Abattoir locality, Sydney Olympic Park	– Olympic Park Station

Equipment	Vibration screening distance for heritage structures	Construction activities with vibratory equipment	Heritage items identified within the vibration screening distance (including potential heritage items)	Sensitive infrastructure items within the vibration screening distance
		S09.02 – Excavation in roadworks with rockbreaker	<ul style="list-style-type: none"> <li>– Telstra house (former post office), Parramatta</li> <li>– House, Parramatta – I655</li> <li>– House, Parramatta – I656</li> <li>– House, Parramatta – I652</li> <li>– House, Parramatta – I654</li> <li>– St John's Parish Hall, Parramatta</li> <li>– Sewage Pumping Station 67, Camellia</li> <li>– Pumping Station, Camellia</li> <li>– Bulla Cream Dairy (Willowmere), Ermington</li> <li>– Ermington Wharf, Melrose Park</li> <li>– State Abattoir locality, Sydney Olympic Park</li> </ul>	<ul style="list-style-type: none"> <li>– Rydalmere Wharf</li> <li>– Ermington Wharf</li> <li>– Sydney Olympic Park Wharf</li> <li>– Olympic Park Station</li> </ul>

Prior to construction works, investigations would be undertaken at these buildings and structures (including a dilapidation survey) to determine if there are any buildings or structures within these sites that are structurally unsound. Should the structure be considered structurally unsound, the DIN-4150-3 vibration criteria would apply unless a structural engineer establishes an alternative vibration management level based on their investigation.

### 3.5.5 Potential archaeological deposits and resources

Two registered AHIMS sites and seven Aboriginal PADs are located within the project site and may contain subsurface Aboriginal objects (refer section 2.2.5.3). Five HAMUs with medium to high potential for State significant archaeology have also been mapped in the project site (refer section 2.2.5.4).

These sites, should they contain Aboriginal objects or archaeological resources located below the surface, have the potential to be directly (through direct contact with heavy machinery) or indirectly impacted (ground vibration causing damage to the item) by vibratory intensive works.

A test excavation program is proposed, prior to construction works, to confirm the presence of Aboriginal objects and non-Aboriginal archaeological resources and their sensitivity to vibratory equipment. As far as reasonably practical, direct and indirect impacts on items and sites of Aboriginal and non-Aboriginal heritage significance would be avoided and would be considered during the design development and construction planning phases of the project.

### 3.5.6 Buried pipework and remediation management infrastructure

There are a number key utilities located within the project site (described in Chapter 7 (Project description – construction) of the EIS), as well as buried infrastructure that forms part of remediation management infrastructure for remediated sites in Camellia and Sydney Olympic Park (described in Chapter 18 (Soils and contamination) of the EIS). Works near this pipework and infrastructure has the potential to cause impacts due to vibration.

Where utilities or remediation infrastructure are encountered which may be considered to be particularly sensitive to vibration, specific vibration goals should be determined on a case-by-case basis during the design development process. Generic vibration goals for cosmetic damage adopted from BS 7385 range from 50 mm/s ppv for plastic pipework to 100 mm/s ppv for steel pipework. Examples of this type of infrastructure would include:

- Water pipes
- Gas and fuel pipelines
- Fibre optic cables
- Ventilation pipework in the Parramatta Light Rail stabling and maintenance facility in Camellia and the leachate management system in Sydney Olympic Park



A conservative screening goal of 25 mm/s has been adopted to determine an appropriated safe working distance for buried pipework and remediated lands infrastructure. Based on the worst-case construction activity, being rockbreaking, the vibration goal could be exceeded within five metres of construction works.

It is anticipated that an acoustic consultant would be engaged by the construction contractor and would liaise with the structure or utility's owner in order to determine acceptable vibration levels to ensure no vibration impacts would occur during the construction period.

## 3.6 Construction road traffic noise

### 3.6.1 Key descriptors

The key noise metrics related to the modelling and assessment of road traffic noise during the construction period are presented in Table 3.38.

**Table 3.38** Key airborne noise metrics – road traffic noise

Metric	Description
$L_{Aeq(15hour)}$	The $L_{Aeq(15hour)}$ represents the cumulative effects of all road traffic noise events occurring in the daytime period from 7am to 10pm.
$L_{Aeq(9hour)}$	The $L_{Aeq(9hour)}$ represents the cumulative effects of all road traffic noise events occurring in the night-time period from 10pm to 7am.
$L_{Aeq(1hour)}$	The busiest 1-hour 'energy average noise level'. The $L_{Aeq(1hour)}$ represents the typical $L_{Aeq}$ noise level from all road traffic noise during the busiest 1-hour of the assessment period (day or night).
$L_{AFMax}$	The highest noise level in dBA measured during the specified time period and is measured using the 'fast' response setting on a sound level meter.

### 3.6.2 Modelling methodology

To assess noise impacts from construction traffic or a temporary reroute due to a road closure, an initial screening test has been undertaken to evaluate whether noise levels would increase by more than 2 dB. Where an increase is 2 dB or less, no further assessment is required. Where noise levels increase by more than 2 dB and noise levels exceed the controlling criterion, then mitigation strategies should be considered to reduce potential noise impacts.

The potential noise impacts from construction related traffic associated with the project have been assessed through a comparison of the estimated pre-construction traffic volumes (2025 volumes without the project) and the peak construction traffic volumes (2025 volumes with the project) along the surrounding road network. The 2025 traffic volumes are considered the most accurate data source for this assessment considerate of the indicative peak in the construction program (section 3.3.1) recent developments (section 2.2.4.2) and cumulative impacts (section 3.4.9) in the study area.

It has been assumed that the increase in noise level at sensitive receivers along major roads such as James Ruse Drive, Victoria Road and Silverwater Road would be negligible during the construction period due to the existing high traffic volumes along these arterial roads.

The pre-construction traffic volumes and during construction traffic volumes are presented in Appendix C-9 for both sub-arterial and local roads.

Calculations have been made using the CoRTN prediction method to estimate the increase in noise level at the nearest sensitive receivers to the impacted roads during the construction period. Where the increase is predicted to be greater than 2 dB, calculations have been undertaken to determine the noise level at the most-affected sensitive receivers and compared against the RNP controlling noise criteria for sub-arterial/collector roads and for local roads.

Note should be made that the traffic volumes used in this assessment are based on information from the current design phase of the project and are subject to change. Further investigation of construction traffic should be undertaken as the design, including traffic modelling of the road traffic network, progresses and the construction methodology is refined.

### 3.6.3 Screening assessment and impacts

The road traffic noise screening assessment is summarised in Table 3.39 for sub-arterial or collector roads and Table 3.40 for local roads, where the increase in noise level has been predicted for each section of road. Where a more than 2 dB increase has been predicted, the distance at which the RNP controlling noise criterion would also be exceeded has been included and whether any residences fall within that distance.

Where noise levels are predicted to increase by more than 2 dB, the increase in noise level has been shaded in blue.

**Table 3.39** RNP screening assessment – sub-arterial and collector roads

Road	Road Section Start	Road Section End	Increase in noise level, dB		Distance where RNP criteria is exceeded, metres		Residences within this distance?
			Day	Night	Day	Night	
South Street	Park Road	John Street	0.1	0.3	-	-	-
South Street	John Street	Patricia Street	0.3	0.8	-	-	-
South Street	Patricia Street	Nowill Street	0.3	0.9	-	-	-
South Street	Nowill Street	Primrose Street	0.3	0.9	-	-	-
South Street	Primrose Street	Fallon Street	0.3	0.9	-	-	-
South Street	Fallon Street	Silverwater Road	0.3	0.9	-	-	-
South Street	Silverwater Road	River Road	1.6	3.5	8	12	Yes
Boronia Street	Spurway Street	Honor Street	0.1	0.2	-	-	-
Boronia Street	Honor Street	Trumble Avenue	0.1	0.2	-	-	-
Boronia Street	Trumble Avenue	Boyle Street	0.1	0.2	-	-	-
Boronia Street	Boyle Street	Murdoch Street	0.1	0.2	-	-	-
Boronia Street	Murdoch Street	Spofforth Street	0.1	0.2	-	-	-
Boronia Street	Spofforth Street	Trumper Street	0.1	0.2	-	-	-
Boronia Street	Trumper Street	Atkins Road	0.1	0.3	-	-	-
Atkins Road	Boronia Street	Hope Street	0.1	0.2	-	-	-
Hope Street	Atkins Road	Hughes Avenue	0.1	0.2	-	-	-
Hope Street	Hughes Avenue	Waratah Street	0.1	0.2	-	-	-
Hope Street	Waratah Street	Wharf Road	0.1	0.3	-	-	-
Wharf Road	Hope Road	Mary Street	0.3	0.9	-	-	-
Wharf Road	Mary Street	Andrew Street	0.3	0.8	-	-	-
Hill Road	Burroway Road	Nuvolari Place	0.2	0.4	-	-	-
Hill Road	Nuvolari Place	Baywater Drive	0.1	0.4	-	-	-
Hill Road	Baywater Drive	Stromboli Strait	0.1	0.3	-	-	-
Hill Road	Stromboli Strait	Bennelong Parkway	0.1	0.3	-	-	-
Hill Road	Bennelong Parkway	Holker Street	0.1	0.3	-	-	-
Spurway Street	Boronia Street	Tristram Street	0.3	0.7	-	-	-
Spurway Street	Tristram Street	Victoria Road	0.3	0.7	-	-	-
Atkins Road	Hope Street	Victoria Road	0.1	0.1	-	-	-
Hughes Avenue	Hope Street	Victoria Road	0.0	0.0	-	-	-

Road	Road Section Start	Road Section End	Increase in noise level, dB		Distance where RNP criteria is exceeded, metres		Residences within this distance?
Wharf Road	Hope Street	Victoria Road	0.4	1.0	-	-	-
Kevin Coombs Avenue	Australia Avenue	Old Hill Link	0.0	0.0	-	-	-
Old Hill Link	Edwin Flack Avenue	Hill Road	0.0	0.0	-	-	-

**Table 3.40** RNP screening assessment – local roads

Road	Road Section Start	Road Section End	Increase in noise level, dB		Distance where RNP criteria is exceeded, metres		Residences within this distance?
			Day	Night	Day	Night	
Grand Avenue	James Ruse Drive	ALDI Access	0.7	0.7	-	-	-
Grand Avenue	ALDI Access	Durham Street	1.1	1.1	-	-	-
Grand Avenue	Durham Street	Thackeray Street	2.8	2.9	68	170	No
Holker Busway	Holker Street	Kevin Coombs Avenue	22.9	20.7	32	53	No
Australia Avenue	Kevin Coombs Avenue	Grand Parade	0.6	0.4	-	-	-
Australia Avenue	Grand Parade	Murray Rose Avenue	0.6	0.4	-	-	-
Australia Avenue	Murray Rose Avenue	Dawn Fraser Avenue	0.5	0.3	-	-	-
Australia Avenue	Dawn Fraser Avenue	Parkview Drive	0.4	0.3	-	-	-
Dawn Fraser Avenue	Australia Avenue	Park Street	2.2	1.4	59	130	No
Dawn Fraser Avenue	Park Street	Showground Road	1.4	0.9	-	-	-
Dawn Fraser Avenue	Showground Road	Olympic Boulevard	1.0	0.6	-	-	-
Dawn Fraser Avenue	Olympic Boulevard	Edwin Flack Avenue	0.1	0.1	-	-	-
Uhrig Road	Edwin Flack Avenue	Carter Street	0.3	0.3	-	-	-
Access Road	Uhrig Road	M4 Motorway	0.2	0.2	-	-	-
John Street	South Street	Antoine Street	3.7	3.9	21	52	Yes
John Street	Victoria Road	Gladys Street	0.0	0.0	-	-	-
Fallon Street	South Street	John Street	3.4	3.5	11	26	Yes
Fallon Street	Primrose Avenue	South Street	3.5	3.7	11	26	Yes
Primrose Avenue	South Street	John Street	2.3	2.4	18	45	Yes
Primrose Avenue	Victoria Road	South Street	1.5	1.6	-	-	-
River Road	Lindsay Avenue	South Street	0.5	0.6	-	-	-
River Road	South Street	Victoria Road	0.4	0.4	-	-	-
Hilder Road	Lindsay Avenue	Tristram Street	1.4	1.5	-	-	-
Hilder Road	Tristram Street	Coffey Street	2.1	2.3	27	64	Yes

The results indicate the RNP criteria for sub-arterial and collector roads is predicted to be exceeded at South Street (Silverwater Road to River Road) during the construction period. This section of road would eventually form part of the bridge construction work area and would be permanently closed to allow for the bridge over Silverwater Road.

The RNP criteria for local roads is predicted to be exceeded along the following sections of road:

- John Street – South Street to Antione Street
- Fallon Street – South Street to John Street
- Fallon Street – Primrose Avenue to South Street
- Primrose Avenue – South Street to John Street
- Hilder Road – Tristram Street to Coffey Street.

### 3.6.4 Sleep disturbance assessment

Sleep disturbance impacts associated with construction traffic are generally associated with maximum noise events due to compression braking and heavy vehicle pass-bys. Existing traffic on all construction haulage routes listed in the section above would include heavy vehicles use on these roads, although local roads would have significantly less heavy vehicle use than sub-arterial and collector roads.

The absolute  $L_{AFMax}$  noise level at residences due to heavy vehicle pass-bys or engine braking would not likely change as a result of additional construction related traffic using public roads, however the frequency of these events would increase during the construction period. The roads where the frequency of maximum noise events associated with heavy vehicles on public roads may double or more during the construction period have been identified as:

- collector roads: South Street, Wharf Road, Hill Road
- local roads: Dawn Fraser Avenue, John Street, Fallon Street, Hilder Road.

### 3.6.5 Efficacy of mitigation measures

The options to reduce noise impacts at sensitive receivers associated with increase of heavy vehicles use on public roads are limited, as the proponent generally has little control over public roads. Also, the use of noise barriers are not considered reasonable or feasible as the impacts are temporary and residents would require access to their driveways on the affected local roads (e.g. Fallon Street, Primrose Avenue and Hilder Road).

Based on a speed limit of 50 kilometres per hour, the reduction of construction related vehicle speeds would reduce the construction related vehicle noise levels by:

- no change for five kilometre per hour reduction
- approximately 1 dB reduction for 10 kilometre per hour reduction
- approximately 2 dB reduction for 15 kilometre per hour reduction.

Potential noise impacts would be managed through management measures that would be confirmed during the construction planning process. These measures would include, but are not limited to:

- Haulage routes would use existing major/arterial roads and sub-arterial/collector roads, where possible before using local roads.
- As far as practicable, heavy vehicle movements would be restricted to standard construction hours on haulage routes that are near to sensitive receivers.
- Traffic management plans and site inductions would cover instruction for operation of vehicles entering and leaving the sites, in order to minimise noise. It is recommended that planned truck marshalling areas, where required, be located away from residences in order to minimise noise impacts from trucks idling nearby.
- Traffic speeds would be reduced to a maximum 40 kilometres per hour and the use of compression brakes should be limited along all collector and local roads in Rydalmere, Ermington and Melrose Park.

## 3.7 Construction noise and vibration mitigation measures

### 3.7.1 Approach

The ICNG acknowledges that due to the nature of construction projects in urban areas it is inevitable that there would be noise impacts near construction sites. The NMLs have been established in accordance with the ICNG to represent the level at which there may be some community reaction to noise. Where the predicted or measured noise level is greater than the NML, the proponent would apply all feasible and reasonable work practices to meet the noise affected level and inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration as well as contact details.

Where the highly noise affected level is exceeded, respite periods (restricting the hours that very noisy activities would occur) may be required. When scheduling respite periods, the following should be taken into account:

- times identified by the community when they are less sensitive to noise (such as before and after school) for works near schools, mid-morning or mid-afternoon for works near residences
- if the community is prepared to accept a longer period of construction in exchange for restrictions on construction time.

For works outside the ICNG recommended standard hours:

- A strong justification would be required for these works.
- The proponent should apply all feasible and reasonable works practices to meet the NML.
- Where all feasible and reasonable practices have been applied and noise is more than 5 dB above the NML, the proponent should negotiate with the community.

A Construction Environmental Management Plan (CEMP) would be prepared during the design development process and implemented through all construction activities. A Noise and Vibration Management Plan (NVMP) would be included in the CEMP to provide the framework for the management and mitigation of potential construction noise and vibration impacts.

Potential impacts would be managed in accordance with the CNVS, which aims to manage noise levels through reasonable and feasible measures. The CNVS provides a process for the development of site or activity specific Construction Noise and Vibration Impact Statements (CNVIS), standard mitigation measures and additional mitigation measures to be implemented based on NMLs.

### 3.7.2 CNVS standard mitigation measures

The CNVS outlines standard management and mitigation measures in section 8.1 that '*shall be applied to mitigate noise and vibration impact where reasonable and feasible*'. These measures would apply to all construction works associated with the project, and can be categorised into management measures, source mitigation measures and path mitigation measures as summarised in Table 3.41. Details of these measures are provided in Appendix F-5.



**Table 3.41** CNVS standard management and mitigation measures

Management measures	Source mitigation measures	Path mitigation measures
<ul style="list-style-type: none"> <li>– Implementation of any project specific mitigation measures required</li> <li>– Implement stakeholder consultation measures</li> <li>– Register of noise and vibration sensitive receivers</li> <li>– Construction hours and scheduling</li> <li>– Construction respite period</li> <li>– Site inductions</li> <li>– Behavioural practices</li> <li>– Monitoring</li> <li>– Attended vibration measurements</li> <li>– Update Construction Environmental Management Plans</li> <li>– Building condition surveys.</li> </ul>	<ul style="list-style-type: none"> <li>– Plan worksites and activities to minimise noise and vibration</li> <li>– Equipment selection</li> <li>– Consideration of allowable noise levels when renting plant and equipment</li> <li>– Use and siting of plant</li> <li>– Non-tonal reversing alarms</li> <li>– Minimise disturbance arising from delivery of goods to construction sites</li> <li>– Construction related traffic</li> <li>– Silencers on mobile plant</li> <li>– Prefabrication of materials off-site</li> <li>– Engine compression brakes.</li> </ul>	<ul style="list-style-type: none"> <li>– Shield stationary noise sources such as pumps, compressors, fans etc.</li> <li>– Shield sensitive receivers from noisy activities.</li> </ul>

All construction works associated with the project would implement these mitigation and management measures, where reasonable and feasible. The responsibility of the use of these measures would fall with the construction contractor and the determination of applicability would be required prior to construction in the development of any NVMP.

### 3.7.3 Project specific mitigation measures

Project specific management and mitigation measures have been recommended based on the analysis of predicted impacts and would be implemented to reduce the number of potentially impacted receivers. Table 3.42 provides details of the project specific mitigation measures and Table 3.43 provides details of the project specific management measures.

**Table 3.42** Recommended project specific mitigation measures

Mitigation measure	Details of the measure	Applicable construction scenario
Compound hoarding	<p>A minimum of 2.4 metre high solid hoarding would be provided around construction compounds located close to residential areas where construction noise is predicted to exceed noise management levels during recommended standard hours, including these compounds currently proposed near sensitive receivers on/around:</p> <ul style="list-style-type: none"> <li>– John Street</li> <li>– Broadoaks Park</li> <li>– Ken Newman Park west and east</li> <li>– Hope Street</li> <li>– Wharf Road</li> <li>– Wentworth Point north</li> <li>– Hill Road north</li> <li>– Dawn Fraser Avenue east and west</li> </ul> <p>The hoarding should be constructed of a material with a minimum surface density of 12 kg/m<sup>3</sup> and gaps along its surface should be minimised or avoided.</p>	S02

Mitigation measure	Details of the measure	Applicable construction scenario
Alternative construction methodologies	<p>Alternative construction methodologies and measures would be explored and implemented where they are reasonable and feasible. This would include the following techniques that have been effective on previous major infrastructure projects:</p> <ul style="list-style-type: none"> <li>– The use of alternative piling methodologies that generate less noise. For example, bored piling should replace impact and vibratory piling methods where feasible.</li> <li>– The use of hydraulic concrete shears instead of rockbreakers.</li> <li>– During demolition works, sequencing works to shield sensitive receivers by retaining building wall elements.</li> <li>– Modifying demolition work sequencing and construction hours to minimise impacts during peak pedestrian times and outdoor activity periods.</li> <li>– The use of portable noise barriers around particularly high-noise generating activities such as concrete saws.</li> <li>– Where feasible, use electric motors in preference to diesel or petrol engine for compressors.</li> </ul>	All
Mitigation at source/silencers	<p>Where it is feasible, at-source noise mitigation methods would be implemented to reduce the noise emission, including:</p> <ul style="list-style-type: none"> <li>– Should impact piling be required, a resilient pad (dolly) would be incorporated between the pile and the hammerhead.</li> <li>– Should rock breaking be required in within 200 metres of residences, a silencer attachment would be attached to the rockbreaker to reduce noise emission.</li> <li>– Exhaust silencers would be fitted on mobile plant (e.g. dozers, compactors, cranes, dump trucks, excavators, graders, loaders etc.).</li> <li>– Engines on compressors/generators would include an exhaust silencer at construction compounds in close proximity to residences. The compressor/generator would be acoustically dampened.</li> <li>– Low noise air conditioning units would be used at construction compounds.</li> </ul>	All
Screening using structures/site sheds	Compound layouts are unknown at this stage. The layout would be planned to use structures and site sheds as screening between noise sources and sensitive receivers, where possible.	S02
Use lower vibration generating items for excavation plant and equipment	Use smaller capacity rockbreakers or concrete crushers/pulverisers instead of larger rockbreakers, where possible.	S01, S02, S05, S06, S07, S08 and S09

**Table 3.43** Recommended project specific management measures

Management measure	Details of the measure	Applicable construction scenario
Development of a NVMP	<p>A Noise and Vibration Management Plan would be prepared as part of the CEMP and implemented during construction. The plan would detail processes, responsibilities and measures to manage noise and vibration and minimise the potential for impacts during construction, aligned with the results of community consultation and the management approach and mitigation measures in <i>Construction Noise and Vibration Strategy</i> (Transport for NSW, 2019).</p> <p>A land use survey would be undertaken prior to the NVMP to ensure all sensitive receivers in the study area are captured at the time of construction.</p>	All
Construction Noise and Vibration Impact Statements	<p>Location and activity specific construction noise and vibration assessments would be undertaken:</p> <ul style="list-style-type: none"> <li>– prior to works with the potential to generate noise levels above 75 dBA and/or exceed relevant human response and cosmetic damage criteria for vibration</li> <li>– prior to works that need to occur outside the primary project working hours</li> <li>– where any changes to heavy vehicle routes affect local roads not considered by the noise and vibration assessment in this report.</li> </ul> <p>The results of the assessments would be documented in construction noise and vibration impact statements. Where potential exceedances are identified, the statements would define feasible and reasonable mitigation and management measures, developed in accordance with the <i>Construction Noise and Vibration Strategy</i> (Transport for NSW, 2019a).</p> <p>The measures would be implemented for the duration of the activity.</p>	All
Community engagement	<p>The community would be engaged to determine their preference and priority for mitigation and management of noise and vibration impacts.</p> <p>Non-residential sensitive receivers (e.g. commercial, schools, places of worship etc.) would also be engaged to understand periods in which they are more sensitive to impacts.</p>	All
Stakeholder engagement	<p>The scheduling of construction works would consider major events at Rosehill Gardens Racecourse and at Sydney Olympic Park. The relevant stakeholders and operators would be consulted to minimise disruptions due to construction activities during major events.</p> <p>The scheduling of construction works would also consider business owners and schools within the Parramatta CBD, Melrose Park, Wentworth Point and Sydney Olympic Park to minimise disruptions.</p>	All
OOHW Protocol	<p>An out-of-hours work protocol would be developed to define the process for considering, approving and managing out-of-hours work that is not regulated by an environment protection licence. The protocol would include implementing feasible and reasonable measures and communication requirements in accordance with the <i>Construction Noise and Vibration Strategy</i> (Transport for NSW, 2019a).</p> <p>Measures would focus on pro-active communication and engagement with potentially affected receivers, provision of respite periods and/or alternative accommodation for defined exceedance levels.</p>	S01, S02, S03, S05, S06, S08 and S09
Construction activities with special audible characteristics	<p>Construction activities with special audible characteristics (high noise impact, intensive vibration, impulsive or tonal noise emissions as defined in the CNVS) would be scheduled during the ICNG recommended standard construction hours, where reasonable and feasible.</p> <p>If the works cannot be completed during the ICNG recommended standard hours, the hierarchy of OOHW (See section 3.7.6) would be considered before night works.</p>	All

Management measure	Details of the measure	Applicable construction scenario
Respite periods	<p>Appropriate respite periods would be identified, in consultation with the community and in accordance with the <i>Construction Noise and Vibration Strategy</i> (Transport for NSW, 2019a), for work:</p> <ul style="list-style-type: none"> <li>– with the potential to result in noise levels above 75 dBA</li> <li>– that need to occur outside the primary project working hours.</li> <li>– when determining appropriate respite, the following would be taken into account: <ul style="list-style-type: none"> <li>– the need to efficiently undertake construction</li> <li>– the communities' preferred noise and vibration management approach</li> <li>– the construction schedules of other major projects in close proximity to the project works.</li> </ul> </li> </ul>	Where highly noise affected receivers are identified (i.e. S01, S03, S05, S07, S08 and S09)
Respite weekend periods	Where construction activities are predicted to exceed noise management levels at sensitive receivers, no work would be permitted in that area one weekend per month, unless it is otherwise agreed by a substantial majority of the sensitive receivers most impacted by the proposed works.	All
Cumulative noise impacts	The potential for cumulative construction impacts would be reviewed during construction planning in consultation with the proponents of other projects. Where the potential for cumulative impacts is identified, feasible and reasonable mitigation and management measures would be developed and included in the noise and vibration management plan.	All
Vibration sensitive receivers	<p>A survey would be undertaken to identify vibration sensitive receivers (including buildings, structures, utilities, remediated lands infrastructure, heritage items or sites and equipment) within 200 metres of the project site. Vibration criteria would be identified based relevant standards or manufacturer data for vibration sensitive equipment. Where vibration criteria are not available for vibration sensitive equipment, generic vibration curves (VC) curves as published in <i>Generic Vibration Criteria for Vibration-Sensitive Equipment</i> (Gordon, 1999) may be adopted as vibration objectives.</p> <p>Appropriate measures would be developed and implemented where the potential for exceedances of the criteria are identified.</p>	S01, S02, S05, S06, S07, S08 and S09
Minimisation of vibration impacts	<p>Vibration generating activities would be managed to minimise the potential for impacts on structures, heritage items and sensitive receivers, including maximising minimum working distances or adopting alternate methods to minimise vibration where minimum working distances cannot be achieved (i.e. potential for damage). Prior to the commencement of vibration-intensive works within the minimum working distances for cosmetic damage, the potential for impacts from alternate methods would be assessed. This would include a more detailed assessment of potentially affected structures to assess their susceptibility to damage from vibration.</p> <p>Where there is potential for damage, alternate methods that generate less vibration would be investigated and substituted where feasible and reasonable.</p> <p>For heritage items, the more detailed assessment would consider the sensitivities of the heritage structure in consultation with a heritage specialist to ensure susceptible heritage fabric is adequately monitored and managed.</p> <p>Where residual risks remain, vibration monitoring would be undertaken. Vibration monitors would provide real-time notification of exceedances of levels approaching cosmetic damage.</p> <p>Any identified vibration-related damage to the items would be rectified, including as recommended by a heritage specialist for heritage items.</p>	S01, S02, S05, S06, S07, S08 and S09

Management measure	Details of the measure	Applicable construction scenario
Dilapidation surveys	<p>Where structures are predicted to exceed the screening criteria for structural damage to buildings or structures, a dilapidation survey would be undertaken prior to any construction works, where appropriate. Where required, the vibration management level for the building would be refined based on the type and condition the of building or structure.</p> <p>For heritage buildings and structures, the surveys would consider the heritage value of the structure in consultation with a structural engineer.</p>	S01, S02, S05, S06, S07, S08 and S09
Potential vibration impacts to archaeological sites	<p>Mitigation measures to avoid direct and indirect impacts to potential or identified archaeological sites are provided in Technical Paper 4 (Preliminary Aboriginal Cultural Heritage Assessment Report) and Technical Paper 6 (Historical Archaeological Assessment), including:</p> <ul style="list-style-type: none"> <li>– consultation with the Aboriginal community to gain a better understanding of potential archaeological deposits</li> <li>– test excavation program for both Aboriginal and non-Aboriginal archaeology</li> <li>– detailed design and construction planning would avoid direct impacts on confirmed items/sites of archaeological significance, as far as reasonably practicable.</li> </ul> <p>To reduce vibration impacts to potential or identified archaeological sites, the following measures would be considered:</p> <ul style="list-style-type: none"> <li>– where possible, vibratory intensive would be avoided within 66 metres of potential archaeological sites</li> <li>– alternate methods that generate less vibration would be investigated and substitute, where reasonable and feasible</li> <li>– vibratory plant size would be reduced.</li> </ul>	S05 and S09
Traffic noise	<p>A Noise and Vibration Management Plan would be developed and would include measures to manage road traffic noise during construction including, but not limited to, the following:</p> <ul style="list-style-type: none"> <li>– Haulage routes should use existing major/arterial roads and sub-arterial/collector roads, where possible before using local roads.</li> <li>– As far as practicable, heavy vehicle movements should be restricted to standard construction hours on haulage routes that are near to sensitive receivers.</li> <li>– The traffic management plan and site inductions should cover instruction for operation of vehicles entering and leaving the sites in order to minimise noise. It is recommended that planned truck marshalling areas, where required, be located away from residences in order to minimise noise impacts from trucks idling nearby.</li> <li>– Traffic speeds should be reduced to a maximum 40 kilometres per hour and the use of compression brakes should be limited along all collector and local roads in Rydalmere, Ermington and Melrose Park.</li> </ul>	All
Early implementation of operational treatments	<p>Consideration would be given to implementing building treatments required to mitigate noise associated with minimising operational noise impacts (i.e. from light rail vehicles and/or road traffic noise) as early as possible in the construction program to reduce construction noise impacts, where reasonable and feasible.</p>	All

### 3.7.4 Additional mitigation measures to manage residual impacts

The implementation of the CNVS standard mitigation measures and project specific mitigation measures outlined above are anticipated to reduce predicted noise levels at surrounding sensitive receivers. However, residual impacts are still predicted. The CNVS provides additional mitigation measures to manage these residual impacts.

To determine the level of mitigation required, the additional mitigation measures matrix listed in Table 9 of the CNVS and provided below in Table 3.41 (noise) and Table 3.42 (vibration) should be applied to the residual noise and vibration levels for all applicable time periods. The details of each additional mitigation measure are provided in Appendix F-6. The required additional measures should be determined for each scenario and location prior to construction in the development of the NVMP.



The additional mitigation measures are summarised below and explained in detail in Appendix F-6:

- **PN** – Periodic Notification
- **V** – Verification monitoring
- **SN** – Specific Notification
- **RO** – Respite Offer
- **AA** – Alternative Accommodation
- **AC** – Alternative Construction methodology
- **RP** – Respite Period
- **DR** – Duration Reduction.

**Table 3.44** Additional mitigation measure matrix for noise impacts (Table 9 of the CNVS)

Construction hours	Receiver perception	dBA above RBL	dBA above NML	Additional mitigation measures <sup>1</sup>
Standard hours	Noticeable	5 to 10	0	-
	Clearly audible	> 10 to 20	< 10	-
	Moderately intrusive	> 20 to 30	> 10 to 20	PN, V
	Highly intrusive	> 30	> 20	PN, V
	75 dBA or greater	NA	NA	PN, V, SN
OOHW Period 1	Noticeable	5 to 10	< 5	-
	Clearly audible	> 10 to 20	5 to 15	PN, RP <sup>2</sup> , DR <sup>2</sup>
	Moderately intrusive	> 20 to 30	15 to 25	PN, V, SN, RO, RP <sup>2</sup> , DR <sup>2</sup>
	Highly intrusive	> 30	> 25	PN, V, SN, RO, RP <sup>2</sup> , DR <sup>2</sup>
OOHW Period 2	Noticeable	5 to 10	< 5	PN
	Clearly audible	> 10 to 20	5 to 15	PN, V, SN, RO <sup>3</sup> , RP <sup>2</sup> , DR <sup>2</sup>
	Moderately intrusive	> 20 to 30	15 to 25	PN, V, SN, RO <sup>3</sup> , RP <sup>2</sup> , DR <sup>2</sup>
	Highly intrusive	> 30	> 25	PN, V, SN, RO <sup>3</sup> , AA, RP, DR

Notes: 1. Additional mitigation measure abbreviations explained in detail in Appendix F-6

2. DR and RP are only applicable for OOHV Evening

3. RO are only applicable for evening hours during OOHV Period 2.

**Table 3.45** Additional mitigation measure matrix for vibration impacts (Table 11 of the CNVS)

Construction hours	Receiver perception	above VML	Additional management measures <sup>4</sup>
Standard hours	Human disturbance	> HVML	PN, V, RO
	Building damage	> DVML	V, AC
OOHW Period 1	Human disturbance	> HVML	PN, V, SN, RO, RP, DR
	Building damage	> DVML	V, AC
OOHW Period 2	Human disturbance	> HVML	PN, V, SN, RO, AA, RP, DR
	Building damage	> DVML	V, AC

Notes: 1. VML refers to vibration management level

2. HVMV is the vibration management level for human disturbance

3. DVML is the vibration management level for cosmetic damage to building or structures

4. Additional mitigation measure abbreviations explained in detail in Appendix F-6.

### 3.7.5 Hierarchy of works outside the ICNG recommended standard hours

Where works are outside the ICNG recommended standard hours are required, the hierarchy of working hours provided shown in Figure 3.45 would be considered in order to minimise impacts:

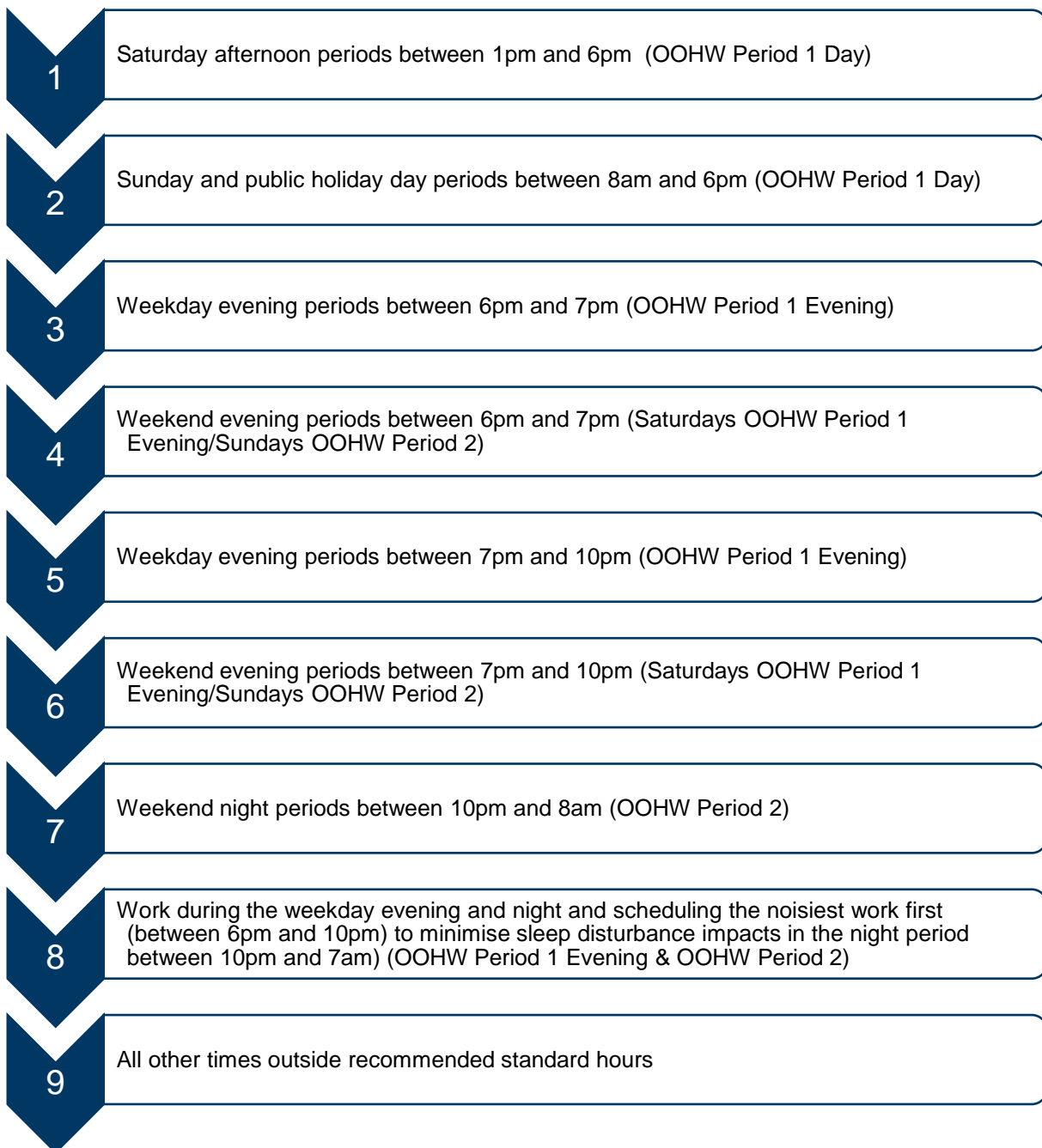


Figure 3.45 Hierarchy of OOHW periods

The hierarchy should be considered and followed wherever feasible to do so, however does not restrict work where reasonable justification can be made to complete works during more stringent OOHW periods.

Note should be made that based on the outcomes of the community consultation, the feedback from the community would take preference over the hierarchy of OOHW periods (e.g. if a shorter construction program duration is preferred from the community).

### 3.7.6 OOHW protocol

Where work is not regulated by an environment protection licence, an out-of-hours work protocol would be prepared to identify the process for considering, managing and approving work outside the primary project working hours (section 3.3.3 for the justification of works outside the primary project working hours). The protocol would be developed once a construction contractor has been selected and would reference the requirements in the CNVS. Some works would be required to be undertaken outside of the primary project working construction hours for safety reasons or to minimise impacts to the road or utilities network

A protocol for out-of-hours works (OOHW) is required to provide guidance for determining the noise levels and potential impacts on acoustic amenity for construction activities that are required to be undertaken outside of the primary project working construction hours. The OOHW protocol would also detail the consultation requirements and approval process to be followed prior to undertaking these works. The approval pathway is determined on a risk-based approach on a case-by-case basis considering the extent and duration of impacts on sensitive receivers. Depending on the risk of the works, an appropriate environmental representative would be assigned to approve the works and the mitigation measures required to reduce the potential impacts.

The protocol would include the following items as a minimum:

- the applicable legislative requirements
- the specification of NMLs applicable to OOHW
- justification of the OOHWs
- details of how to prepare a OOHW application
- the assessment of the potential noise and vibration impacts
- identification of appropriate mitigation measures to be implemented
- procedures for undertaking consultation with the affected community and relevant stakeholders
- procedures for community notifications
- details of the project Environmental Representative (ER)
- details on when monitoring and auditing is required to be completed
- details of how complaints are to be recorded and managed
- details of how non-compliances would be managed and reported.

The OOHW protocol would form part of the NVMP for the project which would be developed as further information is made available regarding the detailed construction methodologies.

### 3.7.7 Incorporation of receiver feedback

#### 3.7.7.1 Parramatta Light Rail Stage 1 consultation

Transport for NSW carried out extensive stakeholder and community consultation as part of the EIS for Parramatta Light Rail Stage 1, which was placed on public exhibition from 23 August 2017 to 23 October 2017. The public exhibition was supported by a program of community and stakeholder engagement activities designed to raise awareness, provide information and answer questions raised by both stakeholder and community members.

During the EIS exhibition period for Parramatta Light Rail Stage 1, a total of 1,267 issues were raised via the various engagement activities from the community and stakeholders where 12 per cent of issues were related to environmental impacts with noise and vibration during construction being a key issue. Where relevant and possible, this receiver feedback has been used to inform the mitigation and management measures in this assessment.

### 3.7.7.2 Parramatta Light Rail Stage 2 engagement

As part of the social impact and outcomes survey (November 2021 to January 2022), a total of 277 survey respondents provided 474 suggestions for the type of measures they wish to see put in place to mitigate potential construction impacts. The most common suggestions were:

- hours of operation:
  - limiting night-time works and the use of noisy machinery
  - undertake drilling during the daytime
  - capitalising on school holiday periods when less people are around
  - planning for heavy vehicle movement to not coincide with peak traffic periods
- noise and vibration measures:
  - implementation of strategies to assist affected residences
  - noise management plans
  - sound barriers and soundproof walls
  - restricting works that generate noise and vibration at night and weekends
  - for project construction to move at a faster pace
  - regular noise level assessments by the type of work
  - providing rebates for property owners who install double glazed glass to mitigate noise.

Feedback from participants in the Hay Your Say survey (May 2022 to July 2022) indicated concern associated with noise from evening and night-time works along with a preference for project construction to move at a faster pace. In particular, evening and night works were identified as a concern (46 per cent of responses) for the Carter Street precinct, Wentworth Point, and Sydney Olympic Park when compared to Rydalmere, Melrose Park, Ermington (38 per cent of responses).

Transport for NSW issued surveys (September to October 2022) to about 7,000 properties located along the project site to understand the community's preference for project-specific mitigation and management measures to reduce potential impacts. The survey results of 257 respondents found:

- 81 per cent would recommend ongoing monitoring and reporting of noise levels to assist with noise mitigation
- 92 per cent would recommend either installation of noise barriers or use of “at source noise measures” such as using smaller or less noisy equipment
- 63 per cent would recommend seeking community agreements to determine the duration of construction works
- 62 per cent would recommend either identified respite periods and minimum respite days or consultation with the community to determine local working hours and respite periods
- 60 per cent would recommend early use of operational controls such as permanent noise walls and property treatments.

Where relevant and possible, the feedback from respondents and receivers has been considered in the selection of mitigation measures for the project and would continue to be considered as the design development and construction planning progresses.

## 4. Operational noise and vibration

Potential operational impacts have been assessed considering the following:

- airborne noise generated by the operation of the light rail vehicles
- operational road traffic noise impacts, including noise generated by vehicles crossing over rail tracks
- ground-borne noise and vibration generated by the operation of the light rail vehicles
- airborne noise associated with the operation of fixed facilities, being the stabling and maintenance facility, traction power substations and light rail stops.

The assessment of noise and vibration impacts associated with the light rail vehicles along the Stage 2 alignment has been separated into two main assessments, being:

- The Stage 2 track between the Sandown Boulevard stop in Camellia and the Carter Street stop in Lidcombe. Detailed modelling has been undertaken to predict noise and vibration levels at sensitive receivers adjacent to the track in section 4.1 and section 4.2.
- The Stage 1 section of track between the Sandown Boulevard stop and the Macquarie Street turnback facility that would be used by Stage 2 light rail vehicles and the operation of the Macquarie Street turnback facility.

### 4.1 Alignment between Sandown Boulevard stop to Carter Street stop (airborne noise)

#### 4.1.1 Overview of railway operations noise sources and key descriptors

This assessment has assumed the light rail vehicles that would be used during operation would be consistent with the light rail vehicle fleet operating on the Stage 1 network. The primary source of airborne noise from light rail vehicles is at the wheel interface where the wheel, bogies, rail and rail support system cause vibration and creates airborne noise.

The speed of the light rail vehicle, the condition of the wheel and rail, the light rail vehicle length, the number of light rail vehicle pass-by events and the design of the light rail vehicle and track influence the airborne noise emitted to the environment. The noise level experienced at a receiver location is largely dependent on the distance from the track to the receiver and the level of acoustic shielding provided by intervening ground terrain or structures, such as buildings and barriers.

Other noise sources associated with light rail vehicles include auxiliary systems on the roof of the light rail vehicle (air conditioning units and power converters) and the use of warning bells. Noise from vehicles crossing over the light rail tracks at intersections has also been considered in this section.

The key noise metrics related to the modelling and assessment of airborne noise from light rail vehicles are presented in Table 3.41.

**Table 4.1** Key airborne noise metrics – operation

Metric	Description
$L_{Amax,95\%}$	The 'typical maximum noise level' for a train pass-by event. In rail noise assessments, $L_{Amax}$ refers to the maximum noise level not exceeded for 95% of rail pass-by events and is measured using the 'fast' response setting on a sound level meter.
$L_{Aeq(15hour)}$	The $L_{Aeq(15hour)}$ represents the cumulative effects of all the train noise events occurring in the daytime period from 7am to 10pm.
$L_{Aeq(9hour)}$	The $L_{Aeq(9hour)}$ represents the cumulative effects of all the train noise events occurring in the night-time period from 10pm to 7am.
$L_{Aeq(1hour)}$	The busiest 1-hour 'energy average noise level'. The $L_{Aeq(1hour)}$ represents the typical $L_{Aeq}$ noise level from all the train noise events during the busiest 1-hour of the assessment period.

Metric	Description
L <sub>AE</sub> or SEL	The 'Sound Exposure Level', which is used to indicate the total acoustic energy of an individual noise event. This parameter is used in the calculation of L <sub>Aeq</sub> values from individual noise events.
L <sub>AFMax</sub>	The highest noise level in dBA measured during the specified time period and is measured using the 'fast' response setting on a sound level meter.

## 4.1.2 Light rail vehicle operational noise trigger levels

A summary of the operational noise trigger levels for the assessment of the light rail vehicles is presented in Table 4.2 and is based on guidance from the RING. Commercial premises (e.g. public buildings, exhibition areas, cafes, bars, retail shops, offices and restaurants) do not require assessment under the requirements of the RING, however an assessment noise goal of L<sub>Aeq(1hour)</sub> 60 dBA has been adopted to identify any potential noise impacts to these receivers. Further details regarding the derivation of the light rail vehicle operational noise trigger levels are provided in Appendix E-3.

Where the project results in rail noise levels exceeding the noise trigger levels, the noise assessment is to identify mitigation measures with the objective of reducing airborne noise, to below the trigger levels, where feasible and reasonable. The RING requires noise to be assessed at project opening and for a future design year typically taken to be ten years after opening. For this project the two timeframes assessed are the at-opening scenario in 2030 and a future scenario based on forecasts for operations in 2040.

**Table 4.2** Airborne light rail vehicle noise trigger levels – RING

Sensitive land use	Day	Night
Residential, mixed-use developments and hotels	60 L <sub>Aeq(15 hour)</sub> and 80 L <sub>Amax</sub>	50 L <sub>Aeq(9 hour)</sub> and 80 L <sub>Amax</sub>
Schools, educational institutions and child care centres	40 L <sub>Aeq(1hour)</sub> internal or 50 L <sub>Aeq(1hour)</sub> external (when in use)	
Places of worship	40 L <sub>Aeq(1hour)</sub> internal or 50 L <sub>Aeq(1hour)</sub> external (when in use)	
Open space – passive use	60 L <sub>Aeq(15 hour)</sub> external (when in use)	
Open space – active use	65 L <sub>Aeq(15 hour)</sub> external (when in use)	

## 4.1.3 Methodology overview

Noise modelling was undertaken using SoundPLAN 8.2 to predict the effects of light rail traffic noise during operation. The *Nordic Prediction Method for train noise* (Ringheim, 1996) was used for modelling L<sub>Aeq</sub> and L<sub>Amax</sub> noise levels and is consistent with the prediction method used for Stage 1.

The design of the project, the buildings adjacent to the light rail track and the local ground terrain were digitised to develop a 3D representation of the project and the study area. The modelling includes the contribution of noise from the light rail vehicles, noise diffracting around buildings and barriers and noise reflecting off nearby buildings.

A summary of the modelling methodology is presented below and is discussed in further detail in Appendix C-3:

- Determined representative light rail vehicle noise levels for the project consistent with the Parramatta Light Rail Stage 1.
- Determined representative speeds for the light rail vehicles on the up and down track based on the speed profile from the Sandown Boulevard stop to the Carter Street stop. The modelled light rail vehicle speeds for the up and down track are shown in Figure 4.1 below and shown in detail in Appendix C-3. The speed profile assumes 14 stops and is considered a more conservative assessment than the potential for 16 stops. A minimum speed of 20 kilometres per hour has been used and is considered conservative as noise from auxiliary systems are anticipated to be the dominant noise source at speeds of 20 kilometres per hour and below.

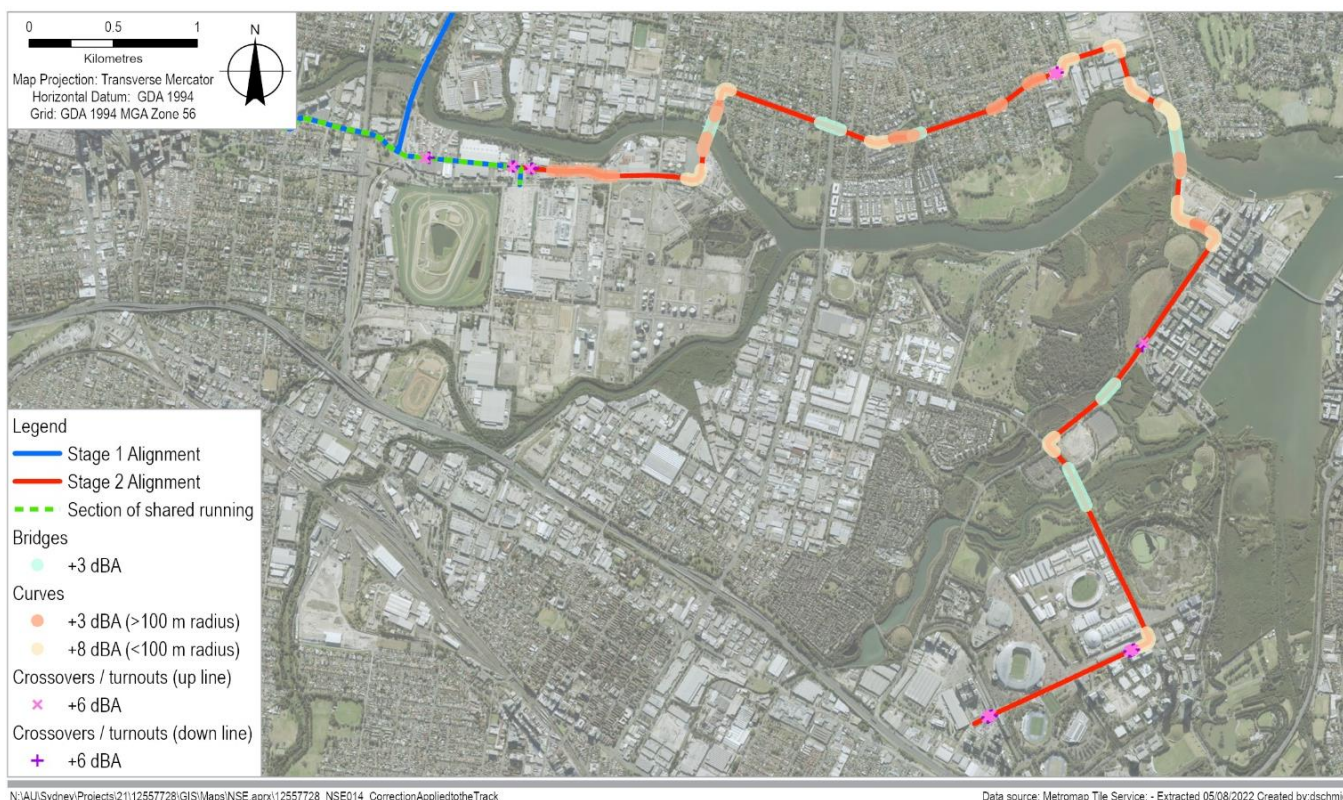


- The application of at-source noise corrections to account for the following:
  - rail surface discontinuities (crossovers and turnouts)
  - structure-radiated noise from rail bridges
  - wheel squeal and flanging noise at curves.

These corrections are shown in Figure 4.2 below and are described in detail in Appendix C-3. Note should be made that the primary source of noise from light rail is at the wheel and rail interface as a result of surface roughness on the wheel and or rail track, where the degree of surface irregularities has a proportional effect on the airborne noise generated. As the maintenance of the wheel and rail track surface conditions would influence the noise performance of the system, it is integral that the light rail vehicle wheel and rail roughness conditions would be maintained to prevent excess noise, as assumed in this assessment.



**Figure 4.1** *Modelled light rail vehicle speeds (Sandown Boulevard stop to Carter Street stop)*



**Figure 4.2** Corrections applied to the track (Sandown Boulevard stop to Carter Street stop)

#### 4.1.3.1 Light rail vehicle service frequency

Light rail services for the up and down track would be consistent with the servicing requirements for Parramatta Light Rail Stage 1, commencing at 5am and operating until 1am. The operational noise assessment of light rail vehicle operations requires the consideration of the frequency of light rail vehicle movements during the day (7am to 10pm) and night (10pm to 7am) periods, as well as the peak one-hour period. The frequency of light rail vehicle movements is presented in Table 4.3 and the light rail vehicle volumes used in the noise model are presented in Appendix C-3.

Note should be made that the up and down track between the Macquarie Street turnback facility and the stabling and maintenance facility at Camellia would be shared by both the Stage 1 and Stage 2 light rail vehicles. As such, the light rail vehicle volumes along this section are anticipated to be double that of the remainder of the Parramatta Light Rail Stage 2 track. The noise model includes the section of track between the Sandown Boulevard and Carter Street stops. The potential for increase in noise and vibration impacts from the section of track between the Macquarie Street turnback facility and the Sandown Boulevard stop (existing Stage 1 track) due to the increase in frequency of light rail vehicle movements associated with Stage 2 is assessed separately in section 4.3.1.

**Table 4.3** Light rail vehicle service frequency (minutes)

Service	Time	Service frequency (minutes)	
		At-opening (2030)	10 years after opening (2040)
Early morning	5am to 7am	10	10
AM peak	7am to 9am	7.5	6
Inter-peak	9am to 4pm	7.5	7.5
PM peak	4pm to 7pm	7.5	6
Evening	7pm to 11pm	10	10
Night	11pm to 1am	15	15



## 4.1.4 Predicted light rail vehicle airborne noise levels

Detailed noise modelling has been undertaken using SoundPLAN 8.2 to calculate noise levels at all sensitive receivers within 150 metres of the nearest track as receivers outside of this distance are predicted to receive noise levels well below the noise trigger levels. The purpose of modelling light rail vehicle operations is to compare the predicted noise levels with the airborne noise trigger levels in Table 4.2 and identify areas where additional mitigation measures need to be considered.

Noise levels have been calculated for all floors and facades of sensitive receivers and include a +2.5 dB correction to account for façade reflection. No façade corrections have been applied to open area receivers modelled at 1.5 metres above ground level. An assessment of airborne light rail vehicle rail noise levels has been undertaken for the opening (2030) and future scenarios (2040) for the project.

Calculated  $L_{Aeq}(9hr)$ ,  $L_{Aeq}(15hr)$ ,  $L_{Aeq}(1hr)$  and  $L_{Amax,95\%}$  noise levels at each sensitive receiver are provided in Appendix G-4. Noise levels have been calculated for all floors and facades and the noise levels for the worst-case floor and façade are presented. Noise contour plots of the predicted  $L_{Aeq}(9hr)$ ,  $L_{Amax,95\%}$  and  $L_{Aeq}(1hr)$  noise levels are provided in Appendix G-1, Appendix G-2 and Appendix G-3, respectively.

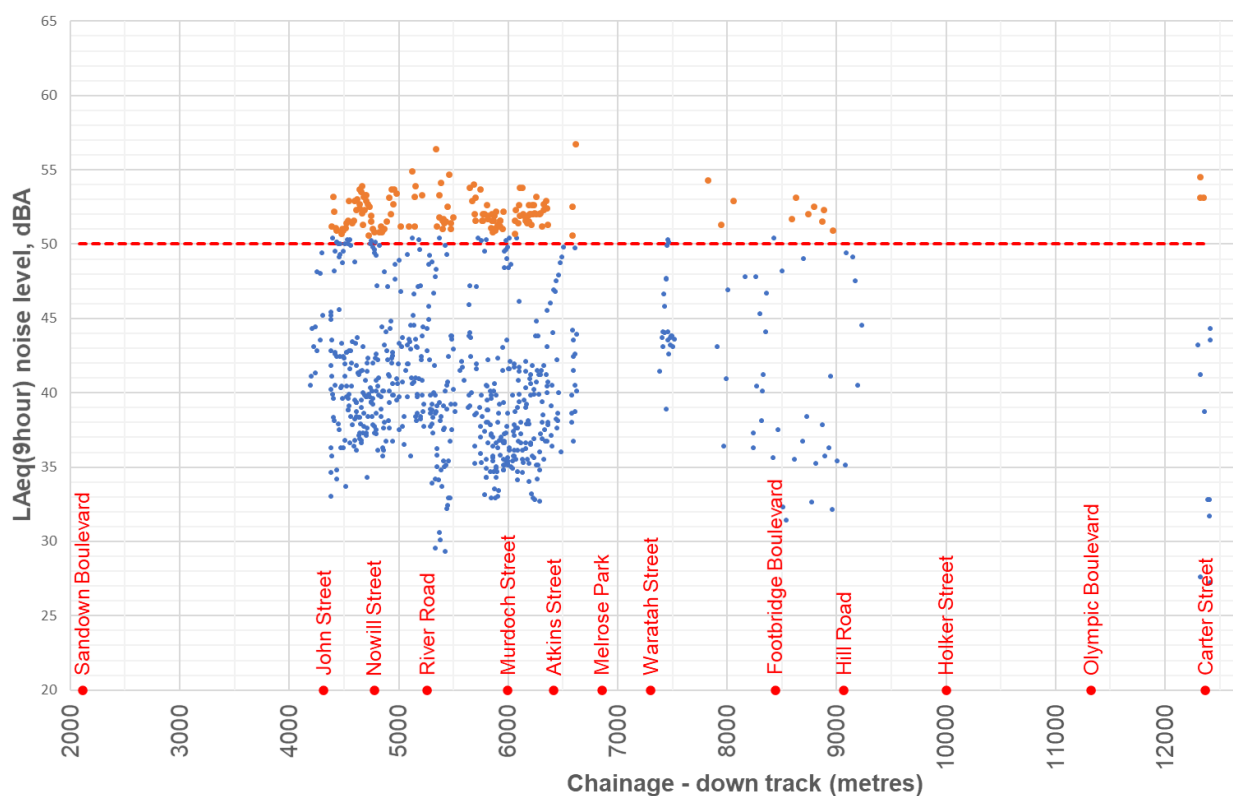
### 4.1.4.1 Noise impacts at residential land uses

A scatter plot of the  $L_{Aeq}(15hour)$  noise levels,  $L_{Aeq}(9hour)$  noise levels and  $L_{Amax}(95\%)$  noise levels at residences are presented in Figure 4.3, Figure 4.4 and Figure 4.5, respectively (based on the 2040 future scenario where light rail vehicle volumes are at their maximum as a worst-case).

The values shown in blue are residences that are predicted to experience noise levels below the relevant trigger level, and value shown in orange are residences that are predicted to experience noise levels above the relevant trigger level.



**Figure 4.3**  $L_{Aeq}(15hour)$  noise levels at residences – 2040 future scenario



**Figure 4.4** *L<sub>Aeq(9hour)</sub> noise levels at residences – 2040 future scenario*



**Figure 4.5** *L<sub>AMax(95%)</sub> noise levels at residences – 2040 future scenario*

A summary of the range of predicted operational noise levels for each NCA along with the number of receivers identified as receiving noise levels above the relevant trigger level is presented in Table 4.4. Exceedances of the trigger levels have been shaded in blue.

Receivers would qualify for mitigation under the following cases:

- $L_{Aeq(15hr)}$  60 dBA **and**  $L_{max(95\%)}$  80 dBA noise trigger levels are exceeded; or
- $L_{Aeq(9hr)}$  50 dBA **and**  $L_{max(95\%)}$  80 dBA noise trigger levels are exceeded.

The noise modelling results indicate that no residential receivers have been identified as qualifying for mitigation consideration as  $L_{max(95\%)}$  80 dBA noise levels are not exceeded at any residential receiver location.

**Table 4.4** Summary of operational noise levels from light rail vehicles at residences

NCA	Day – $L_{Aeq(15hr)}$		Night – $L_{Aeq(9hr)}$		Max – $L_{Amax(95\%)}$		Receivers qualifying for mitigation
	Range	Receivers above 60 dBA	Range	Receivers above 50 dBA	Range	Receivers above 80 dBA	
E	38 - 58	0	33 - 53	14	47 - 76	0	0
F	39 - 58	0	34 - 54	35	49 - 78	0	0
H	34 - 61	1	29 - 56	21	44 - 80	0	0
I	37 - 60	0	33 - 55	63	46 - 79	0	0
J	41 - 61	1	36 - 57	3	51 - 80	0	0
K	43 - 55	0	39 - 50	0	56 - 70	0	0
L	41 - 59	0	36 - 54	3	52 - 78	0	0
M	36 - 58	0	31 - 53	7	53 - 77	0	0
R	32 - 59	0	27 - 55	3	49 - 80	0	0
<b>All</b>	<b>32 - 61</b>	<b>2</b>	<b>27 - 57</b>	<b>149</b>	<b>44 - 80</b>	<b>0</b>	<b>0</b>

#### 4.1.4.2 Noise impacts at non-residential receivers

Noise levels have been predicted to non-residential receivers within the study area. The noise modelling results presented in Table 4.5 indicate the following (exceedances of the adopted trigger levels are shaded in blue):

- Noise levels at all educational institutes, active recreation areas and passive recreations areas are predicted to be below the noise trigger levels.
- Noise levels at the Novotel Sydney Olympic Park (hotel – Q055), Ibis Budget, Sydney Olympic Park (hotel – Q057) are predicted to be above the  $L_{Aeq(9hr)}$  noise trigger level of 50 dBA. However,  $L_{Amax(95\%)}$  noise levels are predicted to be below 80 dBA and as such, these receivers do not qualify for mitigation.
- The  $L_{Aeq(1hr)}$  60 dBA adopted noise goal for commercial buildings is predicted to be exceeded at two buildings, namely:
  - NSW Rugby League Centre, Sydney Olympic Park (Q012)
  - retail/office buildings at 4 Dawn Fraser Avenue Sydney Olympic Park (Q023).

Commercial receivers do not qualify for noise mitigation consideration under the requirements of the RING. As such, no mitigation has been recommended for commercial receivers that are predicted to experience noise levels above  $L_{Aeq(1hr)}$  60 dBA, when assessed externally.

**Table 4.5** Summary of operational noise levels from light rail vehicles at other sensitive land uses

NCA	Trigger level	Day – $L_{Aeq(15hr)}$ When in use $L_{Aeq(1hr)}$		Night – $L_{Aeq(9hr)}$		Max – $L_{Amax(95\%)}$		Receivers qualifying for mitigation
		Range	Exceed.	Range	Exceed.	Range	Exceed.	
Educational institute	$L_{Aeq(1hr)}$ 50 dBA	38 - 48	0	-	-	-	-	0
Active recreation	$L_{Aeq(1hr)}$ 65 dBA	26 - 54	0	-	-	-	-	0
Industrial	N/A	36 - 72	0	-	-	-	-	N/A

NCA	Trigger level	Day – L <sub>Aeq(15hr)</sub> When in use L <sub>Aeq(1hr)</sub>		Night – L <sub>Aeq(9hr)</sub>		Max – L <sub>AMax(95%)</sub>		Receivers qualifying for mitigation
		Range	Exceed.	Range	Exceed.	Range	Exceed.	
Commercial	L <sub>Aeq(1hr)</sub> 60 dBA	34 - 64	2	-	-	-	-	N/A
Hotel	L <sub>Aeq(15hr)</sub> 60 dBA L <sub>Aeq(9hr)</sub> 50 dBA	43 - 59	0	38 - 53	2	53 - 76	0	0
Mixed use	L <sub>Aeq(15hr)</sub> 60 dBA L <sub>Aeq(9hr)</sub> 50 dBA	30 - 48	0	38 - 43	0	39 - 61	0	0

## 4.1.5 Consideration of future rezoning and master plans

### 4.1.5.1 Developments in urban growth areas

Developments approved prior to the date of the project should be considered as the design progresses once detailed plans for these developments are known. Where information has been made available, approved developments adjacent to the project have been included in the noise modelling. Where the project is predicted to result in noise levels that exceed the RING noise trigger levels, then the project would be required to investigate potential mitigation options.

Developments approved subsequent to the approval of the project and adjacent to the future light rail alignment would be required to consider noise and vibration mitigation at their development through the use of appropriate acoustic design measures. Development for any of the following purposes on land adjacent the light rail would be required to take the *Development near rail corridors and busy roads – interim guideline* (DoP, 2008) into account before development under Clause 87 to the Transport and Infrastructure SEPP where the consent authority considers development is likely to be adversely affected by rail noise or vibration:

- building for residential use
- a place of public worship
- a hospital
- an educational establishment or childcare centre.

Additionally, residential developments would be required to ensure the following internal noise levels defined in the Clause 87 of the Transport and Infrastructure SEPP can be met:

- in any bedroom in the residential accommodation – 35 dBA at any time between 10pm and 7am
- anywhere else in the residential accommodation (other than a garage, kitchen, bathroom or hallway) – 40 dBA at any time.

### 4.1.5.2 Operational noise contours at Camellia town centre and Melrose Park

The L<sub>Aeq(9 hour)</sub> and L<sub>AMax(95%)</sub> operational noise contours have been provided in Figure 4.6 and Figure 4.7 for the areas adjacent to the light rail alignment where future urban growth areas have been identified, namely:

- Camellia town centre
- Melrose Park North and South precincts.

These future growth areas would generally consist of mixed-use land, including high-rise residential buildings, open spaces, commercial buildings and educational institutes.

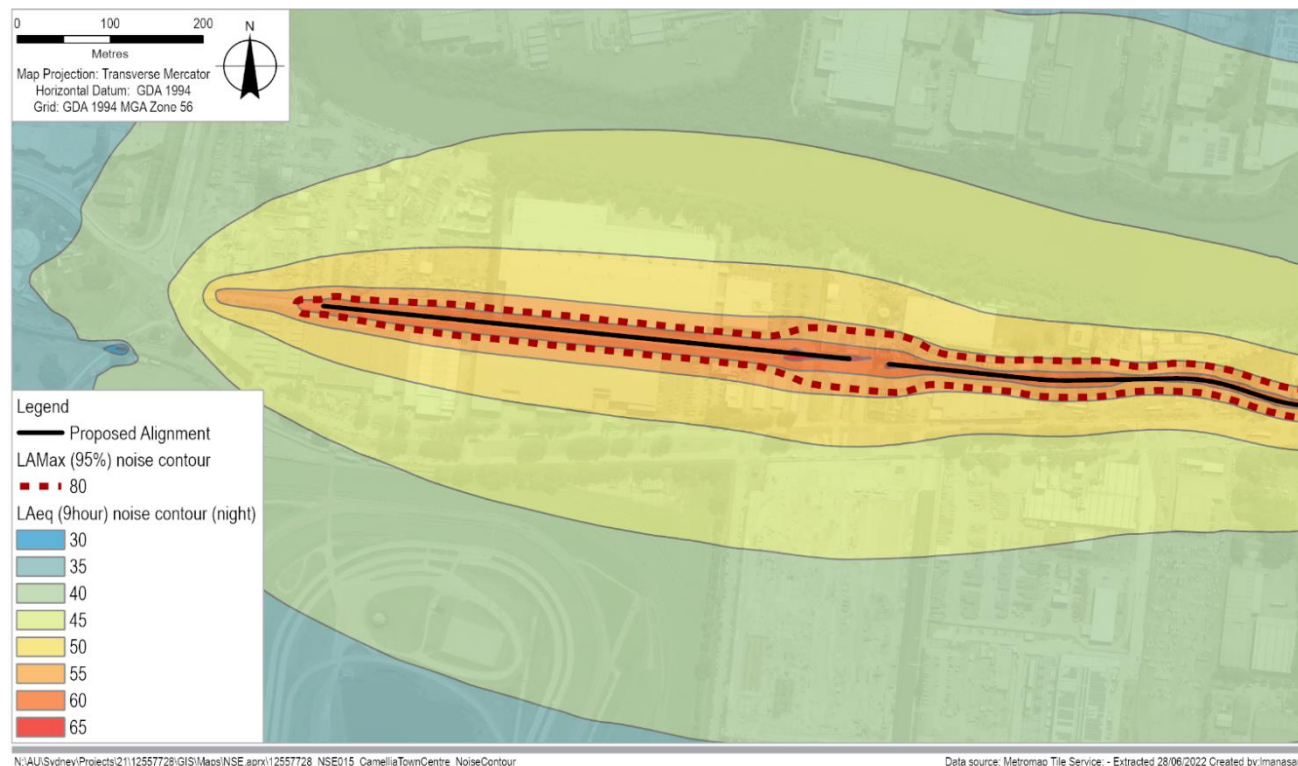
The presented noise contours are based on the following assumptions:

- L<sub>Aeq(9hour)</sub> and L<sub>max(95%)</sub> noise contours are shown as receivers qualifying for mitigation and are generally controlled by the L<sub>Aeq(9hour)</sub> and L<sub>max</sub> trigger levels
- noise contours are at 4.5 metres above ground level (generally representative of the worst-case storey for a multi-storey development)
- noise contours include a +2.5 dBA correction to account for façade-reflection.

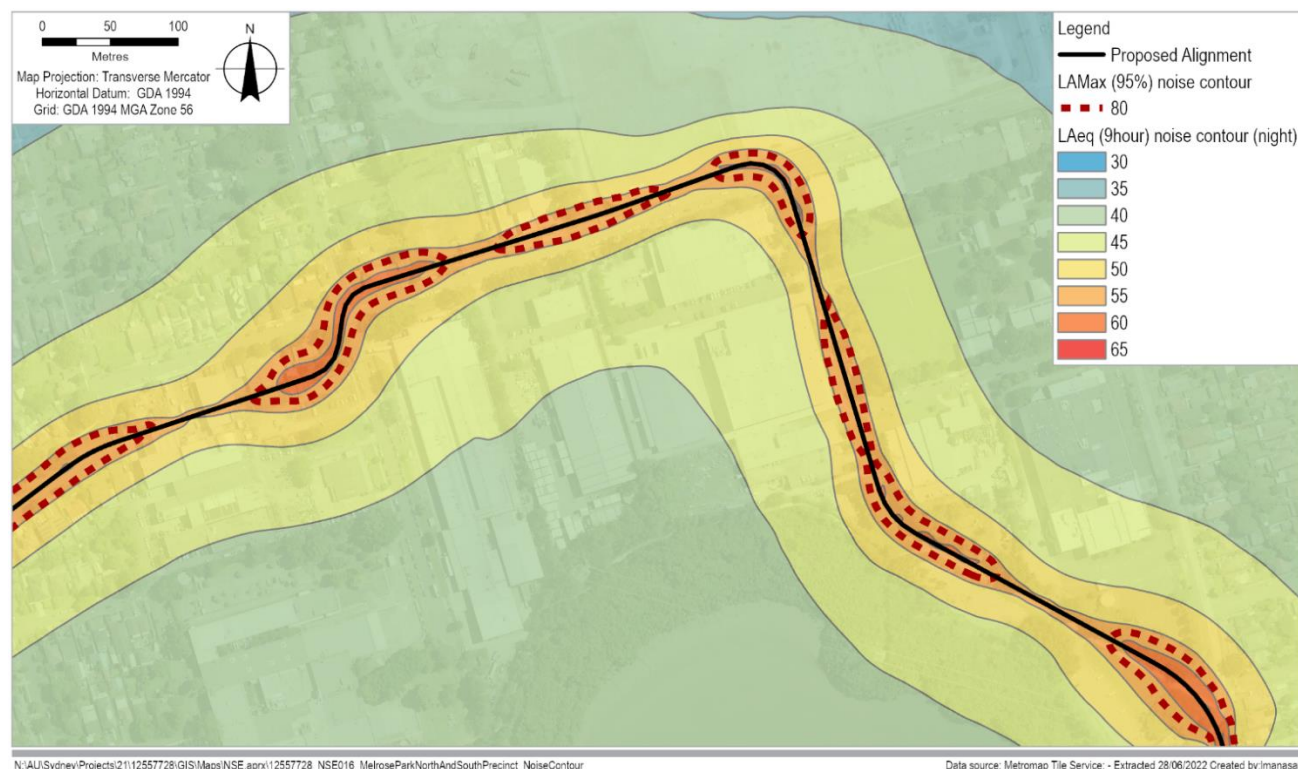


Based on the results of the modelling, the following conclusions can be made:

- the  $L_{Aeq}(9\text{ hour})$  and  $L_{Amax}(95\%)$  residential noise trigger levels are predicted to be exceeded at a distance of approximately 25 metres from the nearest rail track at the Camellia town centre
- the  $L_{Aeq}(9\text{ hour})$  and  $L_{Amax}(95\%)$  residential noise trigger levels are predicted to be exceeded at a distance of up to 25 metres from the nearest rail track at Melrose Park.



**Figure 4.6** Camellia town centre –  $L_{Aeq}(9\text{hour})$  and  $L_{Amax}(95\%)$  noise contours, dBA



**Figure 4.7** Melrose Park North and South Precincts --  $L_{Aeq}(9\text{hour})$  and  $L_{Amax}(95\%)$  noise contours, dBA

To protect the acoustic amenity of future sensitive receivers adjacent to the light rail in the Camellia town centre and the Melrose Park Northern and Southern precincts, the following mitigation strategies can be adopted:

- Development Applications adjacent to the light rail track should be conditioned to ensure the building is adequately designed to comply with the requirements of the Transport and Infrastructure SEPP
- develop a separation distance between the light rail track and potential sensitive receivers to be included as a planning control in the relevant council development control plans (DCP), if required.

#### 4.1.6 Special events at Sydney Olympic Park and Rosehill Gardens Racecourse

The project would interact with two special event precincts being, Sydney Olympic Park and Rosehill Gardens Racecourse. Special event services would be required to supplement the existing transport services (bus and heavy rail) transporting customers to and from the events. The level of event-related transport services would vary, based on the expected crowd of the event.

Special events services would typically be required during the evening on weekends and could also occur on weekdays. These services could extend into the night period should the events finish after 10pm.

To assess the potential increases in operational noise levels during special events, the following assumptions have been made:

- during special events, there would be a three-minute headway for light rail vehicle movements
- two hours of special event light rail vehicle operations could occur during the day period (7am to 10pm)
- one hour of special events light rail vehicle operations could occur during the night period
- during a one-hour period there could be up to 20 movements on either the up or down track.

The assumed light rail vehicle volumes during the day, night and hourly periods are shown in Appendix C-3. An assessment has been performed of potential increases in noise levels due to higher light rail vehicle traffic volumes during special events. Based on the assumed light rail vehicle traffic numbers, the following increases in rail noise levels during special events are anticipated:

- 1 dB increase in day period  $L_{Aeq(15hr)}$  noise levels
- 2 dB increase in night period  $L_{Aeq(9hr)}$  noise levels
- 4 dB increase in hourly daytime  $L_{Aeq(1hr)}$  noise levels for the opening scenario
- 3 dB increase in hourly daytime  $L_{Aeq(1hr)}$  noise levels for the future scenario
- 5 dB increase in hourly night-time  $L_{Aeq(1hr)}$  noise levels for the opening and future scenarios
- no change in  $L_{AFmax}$  noise levels.

Table 4.6 provides a qualitative description of human responses to change in noise levels.

**Table 4.6** *Change in noise levels, human response*

Difference	Human response
Difference of 1-2 dB	Generally imperceptible by the human ear
Difference of 3-4 dB	Generally considered noticeable
Difference of 5 dB	Generally considered significant

The increase in the frequency of light rail vehicle pass-bys would increase  $L_{Aeq}$  noise levels at residential receivers. This increase would be limited to the peak periods of special events only and would not affect  $L_{AFmax}$  noise levels. As such, there would be no increase to the number of residences qualifying for mitigation as a result of special events.

Special events are likely to occur during times when other sensitive receiver types (commercial buildings, schools, child-care centres, offices etc.) would not be in use, being the evenings, nights and weekends. The increase in  $L_{Aeq}$  noise levels at other sensitive receivers during these services are considered acceptable in the context of the short and temporary nature of these services.

## 4.1.7 Sleep disturbance impacts

### 4.1.7.1 Overview of sleep disturbance trigger levels

The current literature concerning sleep disturbance due to noise indicates that the following characteristics could influence sleep disturbance:

- the number of events heard distinctly above the background level
- the emergence of these events (transient or gradual events)
- the highest noise level of the events.

When developing the *Night Noise Guidelines for Europe* (WHO, 2009), the World Health Organisation (WHO) European office concluded that there is sufficient evidence to indicate night noise is related to sleep disturbance and disturbed sleep is associated with several adverse effects on health. The WHO recommended an external target of  $L_{Aeq(8hour)}$  55 dBA (night period) for airborne noise. The  $L_{Aeq}$  descriptor (the energy average level of a noise signal over a given period) accounts for the number and level of the louder events over a given time period and by itself is an inadequate predictor of the potential of a varying noise to disturb sleep.

The  $L_{Amax}$  descriptor addresses the maximum noise level due to individual pass-by events and provides a way to account for potential disturbance from such events. For the purpose of this assessment, maximum noise events associated with light rail vehicle movements and warning bells have been compared against the RING noise trigger level of  $L_{Amax}$  80 dBA.

### 4.1.7.2 Light rail vehicle movements

Maximum noise levels at residences are predicted to range from  $L_{Amax}$  39 to  $L_{Amax}$  80 dBA depending on the proximity to the rail alignment. The highest noise levels are predicted to occur at NCA-J (Ermington and Melrose Park), NCA-K (Melrose Park and West Ryde) and NCA-L (Wentworth Point). The number of maximum noise events at the most-affected receivers during the night period are anticipated to be up to 26 events during normal operation and up to 42 events during special events.

$L_{Amax}$  noise levels during the night period are predicted to be below the RING noise trigger level of  $L_{Amax}$  80 dBA at all residences.

### 4.1.7.3 Warning bells on light rail vehicles

The warning bells fitted on the light rail vehicles would only be used in the event of emergencies or where the driver considers there is a danger to public safety. It is understood that warning bells would not be used as part of normal rail operations and not be used at level crossings or approach or departing stops.

The RING does not require assessment of warning bells where their use is only in emergency situations and as such, an assessment of warning bells has not been included in the noise modelling.

Warning bells are directional (facing the front of the light rail vehicle) and can give rise to noise levels of up to  $L_{AFmax}$  77 dBA at 10 metres in front of the light rail vehicle. Maximum noise levels to the side of the light rail vehicle would generally be 7 dBA less than in front of the light rail vehicle. Given the closest residence is located approximately 10 metres from the nearest rail track, noise levels are anticipated to be below the RING noise trigger level of  $L_{Amax}$  80 dBA.

Due to the distinctive nature of the warning bell sound, it is likely to be noticeable at residences immediately adjacent to rail track if it were to be sounded. However, the infrequent use of the warning bells would result in negligible impacts.

## 4.2 Alignment between Sandown Boulevard stop to Carter Street stop (ground-borne noise and vibration)

Vibration and ground-borne noise from the operation of rail infrastructure can adversely affect sensitive receivers located near a rail line. Vibration can cause buildings, windows and other fixtures to shake; contribute to annoyance and impacts on residents and other land uses; and interfere with vibration-sensitive equipment. Vibration can also be regenerated as ground-borne noise inside a building.

Building damage is unlikely to occur from rail vibration; however, annoyance can occur at significantly lower vibration levels, which are often only slightly higher than the limits of human perception. The light rail vehicle source vibration levels (refer to section 4.2.4 and Appendix C-4) are significantly lower than the structural damage criteria (see Appendix E-3). Therefore, structural damage impacts from light rail vehicle operations are not expected and are not discussed further.

### 4.2.1 Overview of vibration sources and key descriptors

This assessment has assumed the light rail vehicles that would be used during operation would be consistent with the existing light rail vehicle fleet which operates on the Parramatta Light Rail Stage 1 light rail network. The primary source of ground-borne noise and vibration from light rail vehicles is at the wheel-rail interface where the wheel-track interactions generate ground-borne vibration.

The speed of the light rail vehicle, the wheel and rail roughness, the light rail vehicle and rail dynamic characteristics, such as rail isolation stiffness, and the intervening ground conditions influence the ground-borne vibration transmitted to the environment. The magnitude of the resultant ground-borne noise generated inside a sensitive receiver is dependent on both the distance and geological characteristics between the track to the receiver as well as the additional losses at the building foundation and potential amplifications inside the structure.

The key metrics related to the modelling and assessment of ground-borne noise and vibration from light rail vehicles are presented in Table 4.7.

**Table 4.7** Key airborne noise metrics – operation

Metric	Description
dBV	Measure used to express ground-borne vibration as a decibel, using a reference vibration velocity of 1 nm/s. A level of 100 dBV corresponds to a vibration level of 0.1 mm/s (rms).
Ground-borne rail noise	Ground-borne vibration from rail movements re-radiated internally within a structure as noise.
L <sub>ASmax</sub>	The highest noise level in dBA measured during a specified time period using the 'slow' response setting on a sound level meter.
L <sub>ASmax,95%</sub>	The slow weighted maximum noise level not exceeded for 95% of rail pass-by events.
Vibration dose value (VDV)	As defined in BS6472 – 1992, the vibration dose value is given by the fourth root of the integral of the fourth power of the frequency weighted acceleration. The dose value reflects the total cumulative exposure of vibration from pass-by events during a given time period.  The estimated vibration dose value (eVDV) can be used as a screening method for intermittent vibrations with crest factors (ratio of peak to rms value of a signal) below 6. The eVDV can be calculated using the following formula:  $eVDV = 0.07 \times V_{rms} \times t^{0.25} \text{ m/s}^{1.75}$ where t is the pass-by duration in seconds and V <sub>rms</sub> is the root mean square of vibration velocity (mm/s).
V <sub>rms</sub>	Root mean square of vibration velocity (mm/s).

## 4.2.2 Summary of vibration targets

### 4.2.2.1 Human comfort

The RING refers to *Assessing vibration: A technical guideline* (AVTG) (DEC, 2006) for applicable vibration criteria relevant to train operations. The AVTG provides vibration criteria that, if exceeded, have the potential to adversely affect the amenity of occupants inside buildings as it may affect their quality of life or working efficiency.

Human comfort impacts are experienced at levels well below those that can damage or affect a structure and its contents. The preferred and maximum values recommended by the AVTG are expressed in terms of the cumulative vibration dose value (VDV) and provided in Table 4.8. The estimated VDV (eVDV) calculation methodology outlined in AVTG is considered appropriate for vibration sources with crest factors less than six (such as light rail vehicles) and has been used for comparison against the criteria.

The 'preferred values' for intermittent vibration from AVTG are recommended as trigger levels by the RING for the purposes of initiating an assessment of feasible and reasonable mitigation measures.

Table 4.8 Human comfort intermittent vibration limits

Receiver type	Period	Intermittent vibration dose value (m/s <sup>1.75</sup> )	
		Preferred value	Maximum value
Residential	Day (7am and 10pm)	0.2	0.4
	Night (10pm and 7am)	0.13	0.26
Offices, schools, educational institutes, and places of worship	When in use	0.4	0.8
Workshops	When in use	0.8	1.6

### 4.2.2.2 Vibration sensitive equipment

ASHRAE Handbook Chapter 48 Sound and Vibration Control (ASHRAE, 2021) provides criteria for sensitive equipment, noting that specific values from equipment manufacturers should be sought where possible. The ASHRAE criteria for vibration sensitive equipment over the frequency range of 8 to 80 Hz can be summarised in Appendix E-2.

Details regarding the presence of sensitive equipment at individual sensitive receivers is unknown at this stage of the design development process. Predicted maximum peak vibration velocities (and eVDV values) in each NCA are provided in section 4.2.5.

## 4.2.3 Summary of ground-borne noise targets

Operational ground-borne noise is assessed in accordance with the RING. The ground-borne noise trigger levels are provided in Table 4.9. As the proposed development in a new rail line, the absolute levels in Table 4.9 are applicable to the project.

The RING notes that the above trigger levels are *“relevant only where ground-borne noise levels are audible and are of a higher level than airborne noise levels from rail operations”*. Other receivers sensitive to ground-borne noise such as theatres or medical facilities have not been identified in the study area.

**Table 4.9** Ground-borne noise trigger levels

Sensitive land use	Time of day	Internal noise trigger levels, dBA
	Development increases existing rail noise by 3 dB or more <b>and</b> resulting rail noise level exceeds:	
Residential	Day (7am-10pm)	40 L <sub>ASmax</sub>
	Night (10pm-7am)	35 L <sub>ASmax</sub>
Schools, educational institutes, places of worship	When in use	40–45 L <sub>ASmax</sub>

## 4.2.4 Summary of modelling methodology

Ground-borne noise and vibration modelling was undertaken based on the methodology outlined in the US Federal Transit Administration's (FTA) *Transit Noise and Vibration Impact Assessment Manual* (FTA, 2018) and guidance provided in *ISO 14837-1 Mechanical vibration – Ground-borne noise and vibration arising from rail systems* (ISO, 2005).

A summary of the modelling methodology presented below and is discussed in further detail in Appendix C-4.

- Determined representative light rail vehicle and track isolation vibration levels for the project consistent with the Parramatta Light Rail Stage 1 design documentation for ground-borne noise and vibration.
- Determined representative speeds for the light rail vehicles on the up and down track based on the speed profile from the Sandown Boulevard stop to the Carter Street stop. The modelled light rail vehicle speeds for the up and down track are shown in Figure 4.1 above and shown in detail in Appendix C-3.
- Determined representative ground attenuation rates corresponding to geometrical damping and material losses through the soil.
- Determined conservative transfer functions for ground-to-building transmission and structural amplification.
- Applied at-source vibration corrections to account rail surface discontinuities (crossovers and turnouts). These corrections are shown in Figure 4.2 above and are described in detail in Appendix C-3.
- Calculated estimated vibration dose value and ground-borne noise levels at sensitive receivers. The eVDV calculations have been based on the worst-case 2040 special event light rail vehicle volumes.

## 4.2.5 Predicted vibration levels and impacts

The maximum predicted vibration dose values within each NCA are provided in Table 4.10. The maximum predicted estimated vibration dose values and peak particle velocities are also provided by each receiver type in Table 4.11.

The results indicate that the eVDV values are compliant with the criteria provided in Table 4.8 for all NCAs and receiver types. The highest predicted eVDV levels at residential receivers during worst-case special event operations in the design year (2040) are typically an order of magnitude lower than the day and night time 'preferred values' in Table 4.8.

Highest predicted peak particle velocities range from 0.09 millimetres per second at industrial receivers to 0.0018 millimetres per second (or 1.8 micrometres per second) at educational institutes. While the presence of vibration sensitive equipment at these sensitive receivers is currently unknown, a PPV of 1.8 micrometres per second is below the most stringent criteria Appendix E-3 for vibration sensitive equipment. The predicted PPV values are also well below the structural damage criteria.

Therefore, human comfort or structural ground-borne vibration impacts from the project are not anticipated.



**Table 4.10** Predicted maximum estimated vibration dose values in each NCA

NCA	Maximum eVDV day, m/s <sup>1.75</sup>	Maximum eVDV night, m/s <sup>1.75</sup>
B	0.027	0.019
C	0.029	0.021
E	0.031	0.022
F	0.012	0.009
H	0.033	0.023
I	0.016	0.011
J	0.042	0.030
K	0.037	0.027
L	0.011	0.008
M	0.009	0.007
Q	0.015	0.010
R	0.018	0.013

**Table 4.11** Predicted maximum estimated vibration dose values and peak particle velocity by receiver type

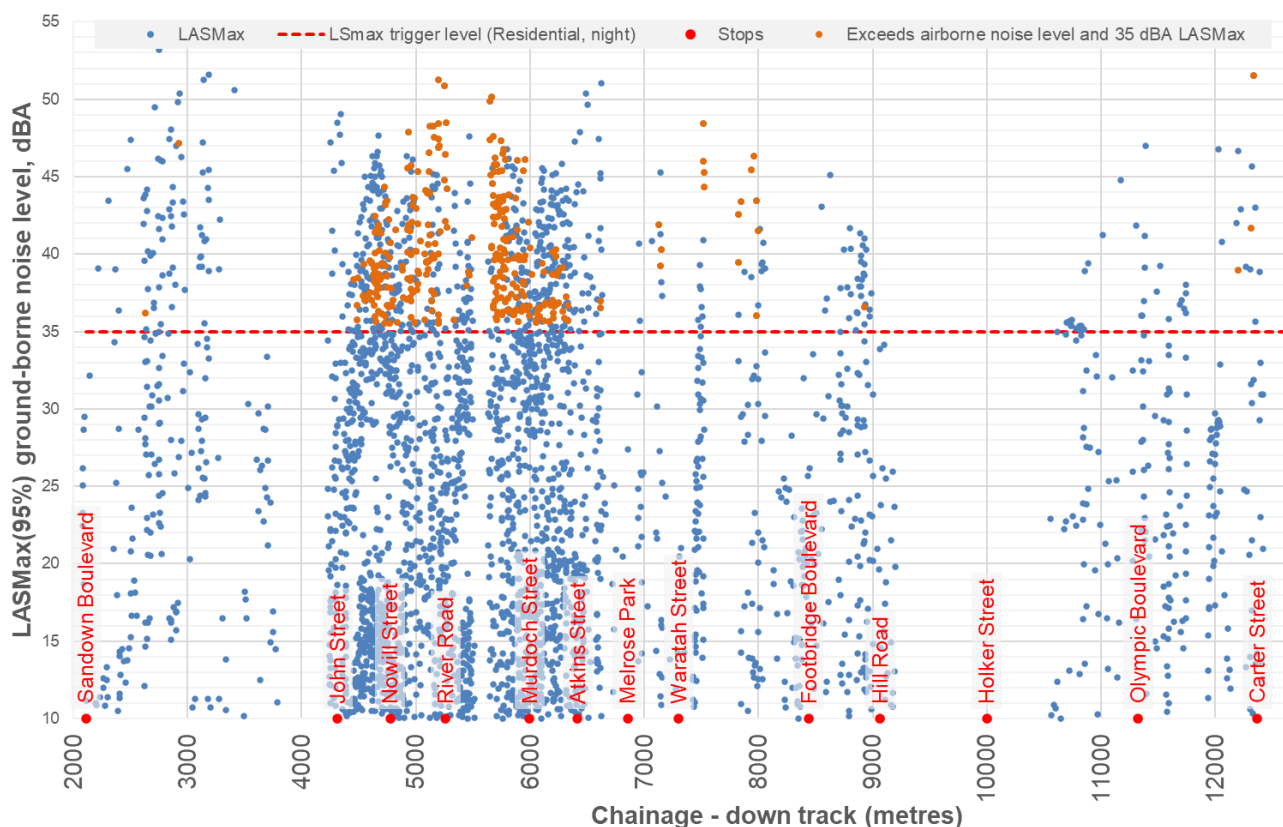
Receiver type	Maximum eVDV day, m/s <sup>1.75</sup>	Maximum eVDV night, m/s <sup>1.75</sup>	Maximum PPV, mm/s
Industrial	0.0418	0.0300	0.0990
Commercial	0.0146	0.0105	0.0329
Residential	0.0370	0.0266	0.0917
Educational institute	0.0007	0.0005	0.0018
Mixed use	0.0003	0.0002	0.0006
Non-sensitive	0.0114	0.0082	0.0324
Hotel	0.0059	0.0042	0.0154

## 4.2.6 Predicted ground-borne noise levels and impacts

Ground-borne noise levels at sensitive receivers are shown in Figure 4.8. Each point on the figure represents a sensitive receiver façade. The results from the ground-borne noise predictions are compared with the maximum airborne noise levels predicted at each façade<sup>1</sup>.

Where ground-borne noise levels are predicted to be greater than the airborne noise levels, a comparison against the relevant trigger levels in Table 4.9 has been undertaken.

<sup>1</sup> Corrected to internal noise levels using the methodology outlined in Appendix C-3-2.



**Figure 4.8** Predicted ground-borne noise levels at sensitive receivers

Sensitive receivers with facades qualifying for consideration of mitigation are shown in orange in Figure 4.8. A total of 129 residential receivers are predicted to exceed the night-time ground-borne noise trigger levels, where the ground-borne noise level also exceeds the airborne noise level. The exceeding sensitive receivers are shown with a pink outline in Figure 4.9 through to Figure 4.12. The receivers qualifying for mitigation consideration are primarily located adjacent to the alignment between John Street and Melrose Park (Chainage 4000 to 7000). Based on the modelling results, ground-borne noise impacts were not identified at distances greater than 50 metres from the track.

The qualifying facades are generally located towards the back of the property away from the track alignment. These facades would typically be shielded from airborne noise levels and therefore trigger a ground-borne noise exceedance under the RING (as ground-borne noise levels would exceed the airborne noise levels when assessed internally).

Ground-borne noise mitigation measures are discussed in section 4.6.2.

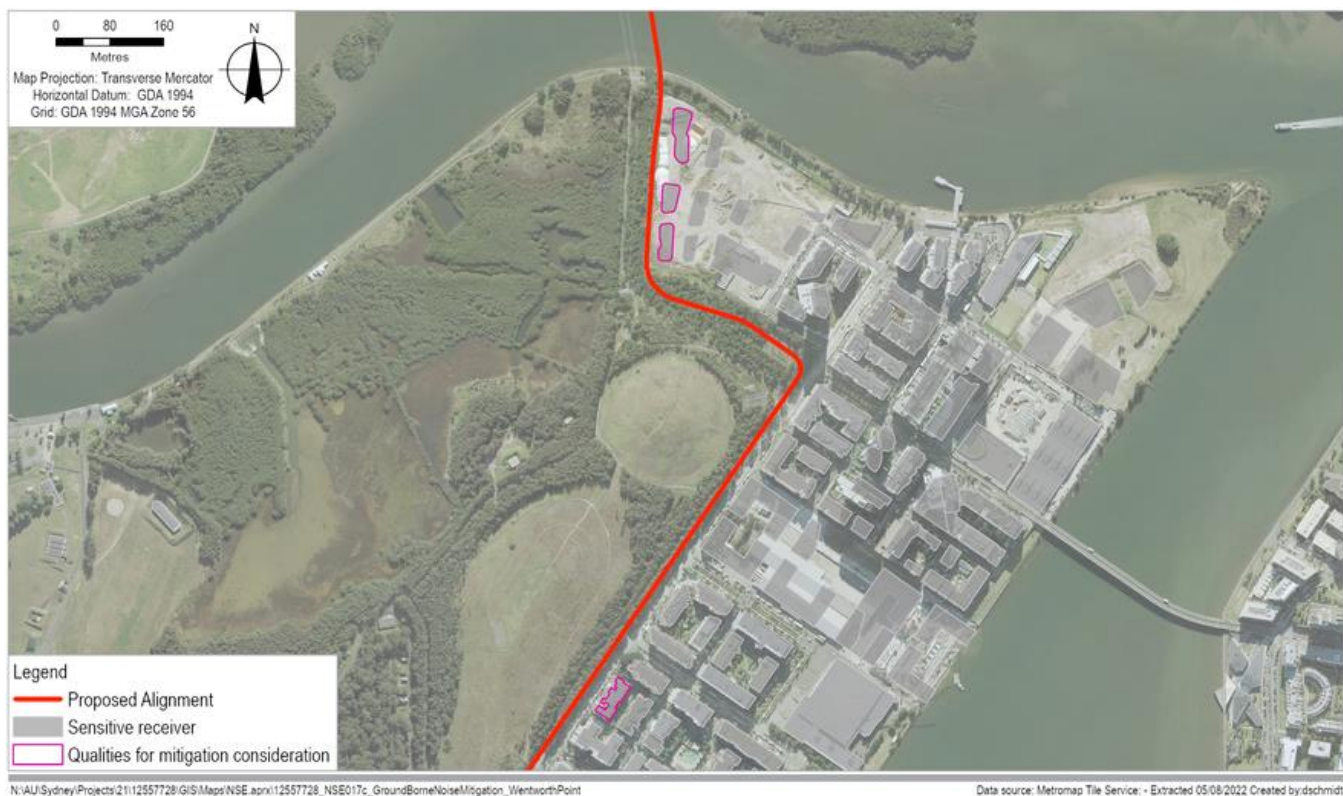


**Figure 4.9** Receivers qualifying for ground-borne noise mitigation consideration – Rydalmere

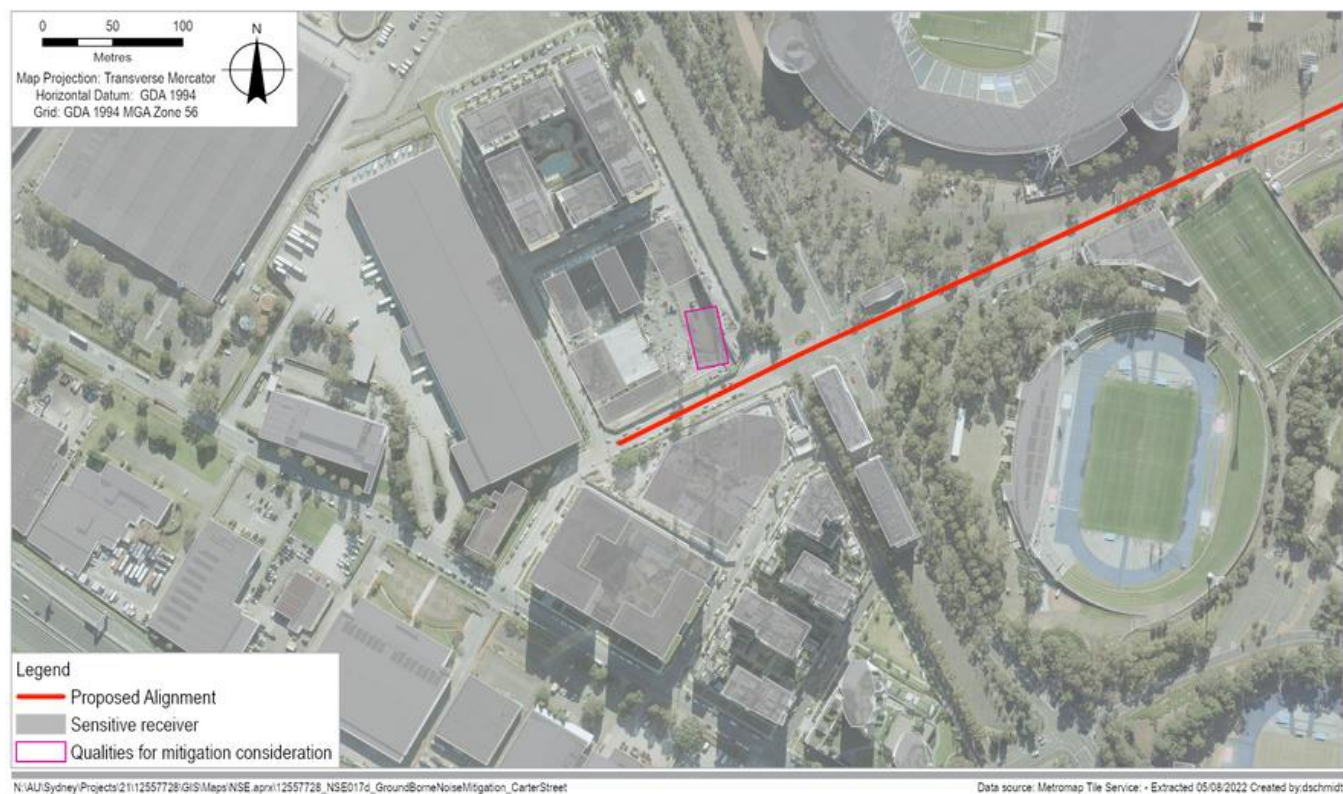


**Figure 4.10** Receivers qualifying for ground-borne noise mitigation consideration – Ermington





**Figure 4.11** Receivers qualifying for ground-borne noise mitigation consideration – Wentworth Point



**Figure 4.12** Receivers qualifying for ground-borne noise mitigation consideration – Carter Street

## 4.3 Alignment between turnback facility and Sandown Boulevard stop

The Parramatta Light Rail Stage 2 light rail vehicles would operate along a section of the Parramatta Light Rail Stage 1 alignment (between the Macquarie Street turnback facility and the turn-off to the stabling and maintenance facility at Camellia) and would stop at three stops, being Parramatta Square, Robin Thomas (on Harris Street) and Tramway Avenue. The track immediately adjacent to the proposed Macquarie Street turnback facility in the Parramatta CBD would be constructed as part of Stage 1, and the frequency of light rail vehicle movements along this section of track would double as a result of the Stage 2 project.

Noise and vibration assessments have been undertaken as part of the Parramatta Light Rail Stage 1 environmental approval and post-approval phases of the project. The assessments did not consider the doubling of light rail vehicle movements as a result of the operation of the Stage 2 project.

### 4.3.1 Airborne noise – existing Parramatta Light Rail Stage 1 alignment

A review of the predicted results as part of the Parramatta Light Rail Stage 1 post-approval design documentation relating to noise and vibration has been undertaken with the following corrections applied to identify whether any additional receivers would qualify for mitigation due to the doubling of light rail vehicle movements:

- +3 dB ( $10 \cdot \log(2)$ ) correction applied to all  $L_{Aeq}(15\text{hour})$ ,  $L_{Aeq}(9\text{hour})$  and  $L_{Aeq}(1\text{hour})$  noise levels at receivers adjacent to the track between the Macquarie Street Terminus and Sandown Boulevard stop due to a doubling of light rail vehicle movements
- no correction applied to  $L_{Amax}(95\%)$  noise levels as the frequency of light rail vehicle movements would not alter this parameter.

The sensitive receivers qualifying for consideration for mitigation are listed in Table 4.12. The qualifying receivers are shown for the Parramatta Light Rail Stage 1 light rail vehicle movements only and the Parramatta Light Rail Stage 1 and Stage 2 light rail vehicle movements, cumulatively. The assumed façade transmission loss for sensitive receivers with internal noise trigger levels is also listed in the table.

**Table 4.12** Number of receives qualifying for mitigation – Parramatta Light Rail Stage 1 and Parramatta Light Rail Stage 1 and 2

Receiver type	Assumed façade transmission loss, dB	Trigger Level		Parramatta Light Rail Stage 1 only		Parramatta Light Rail Stage 1 + Stage 2	
		External	Internal	Parramatta CBD	Rosehill & Camellia	Parramatta CBD	Rosehill & Camellia
Child care centre	10	-	40 $L_{Aeq}(1\text{hour})$	1	1	1	1
Educational institute	10 to 20	-	40 $L_{Aeq}(1\text{hour})$	10	0	12	0
Medical (other than hospitals)	-	60 $L_{Aeq}(1\text{hour})$	-	2	0	3	0
Place of worship	10	-	40 $L_{Aeq}(1\text{hour})$	4	0	4	0
Residential	-	60 $L_{Aeq}(15\text{hour})$ 50 $L_{Aeq}(9\text{hour})$ 80 $L_{Amax}(95\%)$	-	1	0	1	0
<b>All</b>				<b>18</b>	<b>1</b>	<b>21</b>	<b>1</b>

The three additional sensitive receivers that would now qualify for noise mitigation are listed below:

- Pre-Uni New College Parramatta – 3 Barrack Lane, Parramatta (educational institute)
- PM Counselling Services – 153 George Street, Parramatta (medical)
- Arthur Phillip High School – 80 -100 Macquarie Street (educational institute).

For the residential receiver qualifying for mitigation (189 Macquarie Street, Parramatta), it is recommended that any at-property treatment applied considers Stage 2 light rail vehicle movements (i.e. a 11 dB exceedance of the external noise trigger level rather than 8 dB). For other non-residential sensitive receivers with internal noise trigger levels, a detailed investigation of each property should be conducted to determine if the actual façade performance is consistent with the façade transmission loss assumed in the assessment.

### 4.3.2 Airborne noise – Macquarie Street turnback facility

A new turnback facility would be built between the existing Church Street/Macquarie Street curve to the intersection of Macquarie Street and Marsden Street intersection, consisting of approximately 130 metres of new track, including a turnout and a crossover.

The most-affected sensitive receivers to this new section of track are retail and restaurants located directly south of the turnback facility, with the closest building being approximately five metres to the south of the crossover. As these noise sensitive receiver types are not covered in the RING, guidance has been taken from Australian Standard AS2107 (Australian Standards, 2016) to determine an assessment noise goal for these receiver types.

Based on a speed of 30 kilometres per hour on both the up and down track, and a +6 dB correction applied at the crossover, the predicted noise levels at the most-affected receivers are listed in Table 4.13 and compared against the 2017 design sound levels.

**Table 4.13** Airborne noise levels at the most-affected receivers to the turnback facility

Location	External noise level	Transfer function	Internal noise level	AS2017 design sound level
Restaurant to the south	L <sub>Aeq</sub> (1hour) 63 dBA	Windows closed	43 dBA internal	50 dBA
		Windows open	53 dBA internal	50 dBA
Retail shops to the north	L <sub>Aeq</sub> (1hour) 60 dBA	Windows closed	40 dBA internal	50 dBA
		Windows open	50 dBA internal	50 dBA

Notes: 1. 20 dBA assuming attenuation through closed standard windows/doors with gaps  
 2. 10 dBA assuming open windows/doors  
 3. AS2017 specifies a range of 40 to 50 dBA for restaurants. 50 dBA has been adopted as the noise goal as existing noise levels are high in the Parramatta CBD.

Noise levels are predicted to exceed the AS2017 noise goal with windows open at the restaurant directly to the south. Existing noise levels in the Parramatta CBD have been measured to be L<sub>Aeq</sub>(1hour) 70 dBA during the day and L<sub>Aeq</sub>(1hour) 69 during the night with L<sub>Amax</sub> levels of 79 dBA during the day period based on noise monitoring undertaken at Arthur Phillip High School (monitoring location BG10 for Parramatta Light Rail Stage 1).

As such, the measured existing noise levels in the Parramatta CBD are already above the predicted L<sub>Aeq</sub> and L<sub>Amax</sub> noise levels for light rail vehicle operations. Whilst the project would introduce a new noise source to the environment, the potential noise impacts are likely to be limited to whether the light rail noise would be clearly audible or intrusive above existing CBD and road traffic related noise sources. In view of the above, no noise mitigation has been recommended as commercial receivers do not qualify for mitigation under the requirements of the RING. As existing noise levels (due to pedestrians and road traffic) are well above the noise level of the light rail vehicles, the noise from the light rail vehicles would not be considered intrusive and would rather form part of the background and ambient noise environment.

Commercial receivers located west of the crossover section of the turnback facility are predicted to experience noise levels significantly below the noise levels predicted above as the light rail vehicle speeds would be lower and the additional noise due to the crossover would not be as prevalent.



### 4.3.3 Ground-borne noise and vibration – Alignment between Parramatta CBD and Sandown Boulevard stop (Stage 1 track)

A review of the predicted results as part of the Parramatta Light Rail Stage 1 post-approval design documentation relating to ground-borne noise and vibration has been undertaken to identify whether any additional receivers would qualify for mitigation due to the doubling of light rail vehicle movements. Ground-borne noise is assessed using the  $L_{A\text{Smax}}$  noise descriptor based on a single light rail vehicle pass-by. For the receivers adjacent to the Stage 1 section of track between the Parramatta CBD and Sandown Boulevard stop, the predicted  $L_{A\text{Smax}}$  noise levels would not change as a result of the increase in service frequency due to the operation of the Stage 2 light rail vehicles.

Ground-borne vibration levels are assessed using the eVDV descriptor and would increase due to a doubling of light rail vehicle service frequency. The predicted eVDV levels at sensitive receivers adjacent to the Stage 1 section of track between the Parramatta CBD and Sandown Boulevard stop due to light rail vehicle movements are significantly below the criteria, with the most-affected residential receivers receiving vibration levels of 0.01 to 0.02  $\text{m/s}^{1.75}$  compared to a vibration criterion. In view of this, ground-vibration levels are not anticipated to exceed the vibration criteria at any sensitive receiver adjacent to the Stage 1 section of track to be used by the Stage 2 light rail vehicles.

### 4.3.4 Ground-borne noise and vibration – Macquarie Street turnback

For the restaurants and retail shop buildings fronting the Macquarie Street turnback facility, airborne noise levels are anticipated to be the dominant noise source and above the ground-borne noise levels. For receivers setback more than eight metres from the track that do not have a façade exposed to the track, ground-borne noise levels are anticipated to be below  $L_{A\text{Smax}}$  45 dBA. the  $L_{A\text{Smax}}$  noise level is predicted to be below the AS2107 noise goal of 50 dBA for retail shops and restaurants, and as such further assessment has not been deemed necessary.

## 4.4 Fixed facilities

### 4.4.1 Stops (PA systems)

Public address (PA) systems are proposed for each light rail stop (see Figure 1.2 for locations) to provide emergency announcements and to augment the functionality of the Passenger Information Display systems in the event of significant delays or disruptions to the services. Provided the PA systems are designed appropriately, the duration and infrequency of announcements would unlikely significantly contribute to the overall  $L_{Aeq(15\text{min})}$  noise levels at receivers. The volume on PA systems would typically be automatically adjusted to account for the ambient noise level with the use of sensors. Software would automatically reduce the announcement volume when ambient noise levels are low, whilst balancing an adequate level of audibility for light rail vehicle customers at the stops. When noise levels are higher, the PA volume would also adjust accordingly. These self-adjusting systems are particularly important for periods with the most potential for annoyance, such as during the night-time.

Due to the close proximity of receivers to the stops, it would also be important that PA systems are designed to minimise noise spill from the stop platform, even where self-adjustment is incorporated. It is considered that the PA systems at stops can be readily designed to comply with the NPfI intrusiveness and sleep disturbance noise trigger levels at all locations. The infrequent nature of the announcements is anticipated to result in minimal subjective noise impacts at all stops. Notwithstanding the above, where residential receivers are in close proximity to stops, the proposed location and operation of the PA systems should be reviewed during the design development process to ensure potential noise impacts are minimised. The airborne noise trigger levels for light rail stops are presented in Table 4.14 along with a qualitative assessment of potential impacts at the nearest residential receivers. Further detail regarding the derivation of the trigger levels for stops is provided in Appendix E-3.

**Table 4.14** Airborne noise trigger levels and qualitative assessment of impacts from light rail stops

Light rail stop	L <sub>Aeq</sub> (15min) Intrusiveness noise level (RBL + 5 dB)	L <sub>A</sub> F <sub>max</sub> sleep disturbance criteria	Nearest residences	Approx. distance to nearest receivers	Discussion of potential noise impacts
Sandown Boulevard	52	62	Oak Street	300 m	The nearest existing residential receivers are sufficiently distant that noise impacts are not anticipated. Consideration should be given to the future receivers in the Camellia town centre once residential planning zones are known.
John Street	38	52	Antoine Street South Street	20 m	The nearest residential receivers have line-of-sight to the stops and are located within 25 metres. There is potential for temporary annoyance should PA announcements be audible within residential dwellings. However, impacts are considered minimal due to the infrequency of announcements.
Nowill Street	41	52	South Street	15 m	
River Road	41	52	Hilder Road	20 m	
Murdoch Street	40	52	Boronia Street	15 m	
Atkins Road	41	52	Hope Street	25 m	
Melrose Park	41	52	Hughes Avenue	200 m	The nearest existing residential receivers are sufficiently distant that noise impacts are not anticipated. Consideration should be given to the future receivers in the Melrose Park North and South precincts once residential planning zones are known.
Waratah Street	37	52	Wharf Road	125 m	
Footbridge Boulevard	41	52	Hill Road	25 m	The nearest residential receivers have line-of-sight to the stops and are located within 25 metres. There is potential for temporary annoyance should PA announcements be audible within residential dwellings. However, impacts are considered minimal due to the infrequency of announcements.
Hill Road	41	52	Hill Road	25 m	
Holker Street	44	54	Blaxland Road	350 m	The nearest existing residential receivers are sufficiently distant that noise impacts are not anticipated. Consideration should be given to the Novotel and Ibis hotels directly south of the Olympic Boulevard stop.
Olympic Boulevard	46	56	Australia Avenue	500 m	
Carter Street	50	60	Uhrig Avenue	10 m	The nearest residential receivers have line-of-sight to the stops and are located within 25 metres. There is potential for temporary annoyance should PA announcements be audible within residential dwellings. However, impacts are considered minimal due to the infrequency of announcements.

## 4.4.2 Traction power substations

The major noise sources at traction power substations are the rectifier transformer, auxiliary transformer, approximately 10 indoor A/C units and approximately 10 outdoor A/C units. As the transformers and indoor A/C units are housed inside buildings, the dominant noise sources would be the outdoor A/C condensing units as noise emission from the enclosed mechanical plant would be negligible. To predict noise emission from the substations to the nearest sensitive receivers, a sound power level of  $L_{Aeq}$  80 dBA has been assumed at each substation location (see Figure 1.2 for locations).

Noise levels have been predicted to the nearest sensitive receivers to each substation and compared against the project noise trigger level established based on the acoustic requirements of the NPfI. The modelling methodology is described in detail in Appendix C-5 and the derivation of the project noise trigger levels for fixed facilities is detailed in Appendix E-3. Table 4.15 below presents the noise modelling results and indicates that compliance is predicted at all the nearest sensitive receiver locations.

**Table 4.15** Airborne noise trigger levels and predicted noise modelling results for substations

Traction power substation reference and location	NCA	Nearest sensitive receivers	Receiver type	Nearest receiver	Project noise trigger level	Predicted noise level, dBA
A Camellia	C	Camellia (future)	Urban residences	N/A	40	38
		Industrial	Industrial	C017	68	38
B Rydalmere	E	Rydalmere	Suburban residences	E036	38	28
			Industrial receivers	E035	68	35
C Melrose	J	Ermington	Industrial	J024	68	44
			Suburban residences	J039	38	31
D Wentworth	M	Wentworth Point	Suburban residences	M021	38	18
E Sydney Olympic Park	R	Lidcombe (Carter Street)	Urban residences	R039	43	40

## 4.4.3 Stabling and maintenance facility

### 4.4.3.1 Proposed modifications

The stabling and maintenance facility is located at 6-8 Grand Avenue, Rosehill within the Clyde Industrial Area and east of Rosehill Gardens Racecourse. The surrounding receivers are generally industrial or commercial receivers and the nearest existing residential receivers are located west of James Ruse Drive, over 800 metres from the boundary of the site. Future residential land uses are proposed under the Camellia Master Plan with indicative residential land use areas identified approximately 40 metres to the north of the facility.

The stabling and maintenance facility is being constructed as part of Parramatta Light Rail Stage 1 to initially accommodate 13 light rail vehicles. The facility will include the following:

- a stabling and maintenance facility, including a workshop containing five servicing tracks to carry out light rail vehicle inspections
- an automotive train wash plant and sanding plant for replenishing light rail vehicle sand boxes and for testing sanding equipment
- a wheel lathe
- an Operations Control Centre (OCC), including offices and administration functions
- parking for approximately 88 cars.

The proposed modifications to the existing facility to expand its capacity for Stage 2 (within the same boundary of the facility) include:

- six new stabling tracks and associated infrastructure for the increased fleet of light rail vehicles
- a new car park
- a new access road on the eastern side of the site.

A review of the predicted results as part of the Parramatta Light Rail Stage 1 post-approval design documentation relating to airborne noise and vibration associated with the stabling and maintenance facility has been undertaken, noting the predicted levels do not consider the capacity expansion due to Stage 2 operations. The following sections provide a qualitative assessment of the anticipated impacts at sensitive receivers based on the findings of the previous assessment.

The location of the stabling and maintenance facility and the nearest future residential receivers are shown in Figure 4.13.



Figure 4.13 Location of the stabling and maintenance facility and nearest residential receivers

#### 4.4.3.2 Airborne noise levels at sensitive receivers

A qualitative assessment of potential airborne noise impacts due to the increased operations of the facility is presented in Table 4.16. It is anticipated that the predicted noise levels would comply with the operational noise trigger levels at all existing receivers with a significant margin. However, the predicted noise levels at the future residential receivers at the Camellia town centre are predicted to exceed the operational noise goals during the Stage 1 operations of the facility and are expected to increase by up to 3 dB during Stage 2 operations.

The assessment indicates that noise levels at the potential future residential receivers in the proposed Camellia town centre may be above the adopted noise goal during the evening and night periods. There is no requirement to meet the noise goals at future potential future receivers, however noise impacts to these receivers should be considered during the design development process for the project and during the planning of the Camellia town centre.

Noise mitigation options have been considered in section 4.6.3.3 to identify feasible measures that could be implemented to reduce the noise levels at the Camellia town centre.

**Table 4.16** Qualitative assessment of potential noise impacts associated with modification works to the stabling and maintenance facility

Address	Receiver type	Approximate distance (m)	Noise goal	Qualitative assessment of potential impacts
2B Grand Avenue, Rosehill	Residential	745	52 Day 48 Evening 46 Night	Noise level of the existing facility is predicted to be below 30 dBA at all residences west of James Ruse Drive. As a conservative assumption, the modifications to the stabling and maintenance facility could increase noise levels by a maximum of 3 dB. As such, noise levels once Stage 2 is operational is expected to comply with the noise goal at all residences to the west of James Ruse Drive.
43 Oak Street, Rosehill	Residential	875		
3-5 Weston Street, Rosehill	Residential	870		
Camellia town centre (future)	Residential (future)	40	58 Day 48 Evening 43 Night	<p>The results indicate that compliance is predicted during the day period, however the following exceedances are predicted:</p> <ul style="list-style-type: none"> <li>– 1 dB above the evening period noise goal</li> <li>– 5 dB above the night period noise goal</li> </ul> <p>At the proposed Camellia town centre, the evening and night noise levels are expected to be controlled by noise from stationary light rail vehicles on the external stabling roads and light rail vehicles entering/exiting the facility.</p> <p>Assuming the noise experienced at this future receiver is dominated by light rail vehicle movements, the modifications to the stabling and maintenance facility could increase noise levels by 3 dB, resulting in noise levels of 52 dBA during the evening period (4 dB exceedance) and 51 during the night period (8 dB exceedance).</p>
1C Grand Avenue, Camellia	Educational	500	48 (when in use)	The noise level of the existing facility is predicted to be 15 dBA or more below the relevant noise goal at all existing non-residential receivers surrounding the facility. As a conservative assumption, the modifications to the stabling and maintenance facility could increase noise levels by a maximum of 3 dB. As such, noise levels once Stage 2 is operational is expected to comply with the noise goal at the existing non-residential receivers surrounding the facility.
11C Grand Avenue, Rosehill	Commercial	65	65 (when in use)	
James Ruse Drive (Rosehill Gardens Racecourse)	Commercial	640	65 (when in use)	
10 Colquhoun Street, Rosehill	Industrial	10	68 (when in use)	
10 Colquhoun Street, Rosehill	Industrial	60	68 (when in use)	
10 Grand Avenue, Rosehill	Industrial	95	68 (when in use)	
15 Grand Avenue, Rosehill	Industrial	40	68 (when in use)	



#### **4.4.3.3 Sleep disturbance**

A sleep disturbance impact assessment of the following potential maximum noise events:

- light rail vehicle warning bell testing
- light rail vehicle road horn testing
- brake air releases from light rail vehicles in the stabling area
- light rail vehicle moving over turnouts and rail joints at 10 kilometres per hour at the worst-case locations within the facility.

The modelling results indicated that  $L_{AFmax}$  noise levels would be well below the sleep disturbance noise goals at all existing residences in Camellia and Rosehill. At the future potential residential receivers in the Camellia town centre, noise from turnouts were predicted to be equal to the indicative sleep disturbance noise goal, being  $L_{AFmax}$  53 dBA with all other maximum noise events predicted to easily comply.

The modifications to the stabling and maintenance facility would result in an increase in frequency of light rail vehicle movements in and out of the facility, however it is not expected that the predicted  $L_{AFmax}$  noise levels would change as no noise sources would be any closer to future residences.

#### **4.4.3.4 Ground-borne noise and vibration**

Based on the proposed operations and distances to sensitive receivers, vibration and ground-borne noise at surrounding receivers generated by operational activities within the stabling and maintenance facility were not deemed to be significant and no further assessment was provided. The modifications to the existing facility associated with the project are anticipated to result in negligible ground-borne noise and vibration impacts at sensitive receivers.

### **4.5 Operational road traffic noise**

#### **4.5.1 Changes to road traffic network**

The project would operate within the existing street environment for much of its alignment, necessitating several changes to roadway configuration, road network infrastructure and local traffic circulation and access, resulting in a redistribution of traffic on the local road network. A summary of the proposed road configuration changes is presented in Table 4.17 along with a description of how the proposed change has been assessed in this report.

The key changes to the road configuration that have the potential to result in a noticeable increase in road traffic noise levels at adjacent sensitive receivers are at South Street, Rydalmere (between John Street and Silverwater Road) and at Boronia Street, Ermington (between Spurway Street and Atkins Road) where the reconfiguration of the road to allow for the centre running light rail track would result in the eastbound lanes moving closer to the residences to the north of both roads.

The purpose of the following assessment is to identify where operational road traffic noise impacts could occur as a result of the project, and where further investigation or assessment may be required against the RNP and Transport for NSW guidelines.

**Table 4.17**      *Proposed road configuration changes*

Location	Physical works required	Road traffic noise impact
Parramatta CBD		
Macquarie Street between Marsden and Church Streets	Reconfigure roadway for two light rail tracks	Redistribution of traffic to Church Street and George Street (sub-arterial roads) and nearest receivers are commercial. Not considered an impact and has not been assessed further.
Camellia		
Grand Avenue between just west of Durham Avenue to just east of 35 Grand Avenue	Reconfigure roadway for two light rail tracks and active transport link.	No existing nearby residences. Future sensitive receivers in the Camellia town centre would be required to comply with the requirements of the Infrastructure SEPP 2022.
Access to 37 Grand Avenue	Two light rail tracks on western side and shared path on either side of tracks.	
Rydalmere		
Antoine Street, intersection with John Street	Light rail tracks and John Street stop adjacent to the western side of John Street.	Roads would not move closer to residences as a result of the reconfiguration of the road. Increase in road traffic noise levels have been assessed based on the forecast 'no build' and 'build' traffic volumes to check for a greater than 2 dB increase.
South Street	Reconfigure roadway for centre running light rail tracks.	Noise modelling has been undertaken to determine the increase in noise level based on forecast 'no build' and 'build' traffic volumes and change in road configuration to check for a greater than 2 dB increase at nearby residences.
Ermington		
South Street	Reconfigure roadway for centre running light rail tracks.	Due to eastbound lane moving closer to residences to the north, noise modelling has been undertaken to determine the increase in noise level based on forecast 'no build' and 'build' traffic volumes and change in road configuration to check for a greater than 2 dB increase at nearby residences.
South Street between River Road and Silverwater Road	Silverwater bridge abutment and centre running light rail tracks.	This section of road would be closed as a result of the bridge over Silverwater Road. Traffic would be diverted north or south of River Road. No traffic volumes have been provided for River Road, however, a greater than 2 dB increase is not anticipated. Traffic volumes are not anticipated to increase by 1.6 times (equal to a 2 dB increase) as a result of the road closure and as such no noise impacts are expected.
Hilder Road at Ken Newman Park	Light rail tracks and River Road stop west of Hilder Road.	Hilder Road would be permanently closed at the light rail track. Traffic would be diverted to Lindsey Avenue or Coffey Street. No traffic volumes have been provided for Hilder Road, however, a greater than 2 dB increase is not anticipated. Traffic volumes are not anticipated to increase by 1.6 times (equal to a 2 dB increase) as a result of the road closure and as such no noise impacts are expected

Location	Physical works required	Road traffic noise impact
Boronia Street	Reconfigure roadway for centre running light rail tracks.	Due to eastbound lane moving closer to residences to the north, noise modelling has been undertaken to determine the increase in noise level based on forecast 'no build' and 'build' traffic volumes and change in road configuration to check for a greater than 2 dB increase at nearby residences.
<b>Melrose Park</b>		
Atkins Road, between Hope Street and Boronia Street	Crossing by light rail. Construct Atkins Road stop east of Atkins Road at rear of private properties.	Roads would not move closer to residences as a result of the reconfiguration of the road. Increase in road traffic noise levels have been assessed based on the forecast 'no build' and 'build' traffic volumes to check for a greater than 2 dB increase.
Hughes Avenue between light rail alignment and Hope Street	Construct light rail tracks on west side of Hughes Avenue, crossing Hughes Avenue and Hope Street at new signals.	
Hope Street, between Hughes Avenue and Waratah Street	Construct light rail tracks and new Melrose Park stop on northern side of Hope Street.	
<ul style="list-style-type: none"> <li>– Waratah Street at Mary Street</li> <li>– Wharf Road at Waratah Street</li> </ul>	Reconfigure roadway for centre running light rail tracks and active transport link.	Roads would not move closer to residences as a result of the reconfiguration of the road. Increase in road traffic noise levels have been assessed based on the forecast 'no build' and 'build' traffic volumes to check for a greater than 2 dB increase.
<b>Wentworth Point</b>		
<ul style="list-style-type: none"> <li>– Hill Road</li> <li>– Hill Road between Stromboli Strait and Bennelong Parkway</li> <li>– Hill Road west of Bennelong Parkway</li> </ul>	Light rail tracks on western side and on road bicycle lanes in both directions and minor reconfiguration of the road to allow for the light rail track.	Roads would not move closer to residences as a result of the reconfiguration of the road. Increase in road traffic noise levels have been assessed based on the forecast 'no build' and 'build' traffic volumes to check for a greater than 2 dB increase.
<b>Sydney Olympic Park</b>		
<ul style="list-style-type: none"> <li>– Holker Busway south of Hill Road</li> <li>– Australia Avenue</li> <li>– Dawn Fraser Avenue between Australia Avenue and Olympic Boulevard</li> <li>– Dawn Fraser Avenue between Olympic Boulevard and Edwin Flack Avenue</li> <li>– Showground Road between Grand Parade and Murray Rose Avenue</li> <li>– Murray Rose Avenue between Showground Road and Olympic Boulevard.</li> </ul>	<p>Reconfigurations of roads to allow for light rail track, shared paths, stops and facilitates integration with the new Sydney Metro West Station.</p> <p>To facilitate integration and new Sydney Metro West station.</p>	Roads would not move closer to residences as a result of the reconfiguration of the road. Increase in road traffic noise levels have been assessed based on the forecast 'no build' and 'build' traffic volumes to check for a greater than 2 dB increase, where data has been provided.
<b>Lidcombe</b>		
<ul style="list-style-type: none"> <li>– Uhrig Road between Edwin Flack Avenue and Stockyard Boulevard</li> </ul>	Uhrig Road reconfigured for centre running light rail tracks, Carter Street stop and separated cycleway on either side.	The slight reconfiguration of Uhrig Road is considered to be insignificant and would result in a negligible difference in road traffic noise levels (less than a 2 dB increase).

## 4.5.2 Summary of operational road traffic noise criteria

The RNP notes that an increase of 2 dB or less (build scenario compared to the no-build scenario) represents a minor impact that is considered barely perceptible to the average person.

Where a greater than 2 dB increase in road traffic noise is predicted and the controlling noise criteria (see Table 4.18) is predicted to be exceeded at adjacent sensitive receivers, a road traffic noise assessment should be undertaken with consideration to the *Noise Criteria Guideline* (Transport for NSW, 2015a) and *Noise Mitigation Guideline* (Transport for NSW, 2015b) during the design development process.

**Table 4.18** Road traffic noise criteria at residences, dBA

Development type	Day 7am to 10pm	Night 10pm to 7am
Existing residence affected by <b>additional traffic</b> on existing freeways/arterial/sub-arterial roads generated by land use developments	60 Leq(15hr)	55 Leq(9hr)
Existing residence affected by <b>additional traffic</b> on existing local roads generated by land use developments	55 Leq(1hr)	50 Leq(1hr)

## 4.5.3 Overview of noise modelling methodology

A detailed discussion of the noise modelling methodology is provided in Appendix C-9.

The potential noise impacts associated with changes in noise levels along public roads as a result of the project have been assessed through comparison of the no-build traffic volumes and the 'build' traffic volumes along the surrounding road network. Traffic volumes are based on traffic modelling data for 2031 and assumes the Sydney Metro West project is operational.

Calculations have been made using the CoRTN prediction method to estimate the increase in noise level at the nearest sensitive receivers to the impacted roads during the operational period.

Where a greater than 2 dB increase is predicted and the RNP controlling noise criteria is exceeded, mitigation strategies have been recommended to reduce potential noise impacts.

## 4.5.4 Screening assessment

The forecast 'no build' and 'build' traffic volumes along road network for 2031 are presented in Appendix C-7. Calculations have been undertaken using the CoRTN prediction method to identify whether any sections of road are predicted to increase by more than 2 dB as a result of the project based on the traffic volumes alone. The predictions in Table 4.19 indicate that no section of road is predicted to increase by more than 2 dB based on the forecast traffic volumes.

Note should be made that sections of road where minor realignment would be required or where vehicle would cross over the rail tracks have been assessed in section 4.5.5 and section 4.5.6.

**Table 4.19** RNP screening assessment for local road network

Street type	Road	Greatest increase in noise level, dB	
		Day	Night
Sub-arterial/collector road	South Street, Rydalmere	+0.1	+0.1
Sub-arterial/collector road	Boronia Street, Ermington	+0.1	+0.1
Sub-arterial/collector road	Atkins Road, Ermington	+0.3	+0.3
Sub-arterial/collector road	Hope Street, Melrose Park	+0.0	0.0
Sub-arterial/collector road	Wharf Road, Melrose Park	+0.1	+0.1
Sub-arterial/collector road	Hill Road, Wentworth Point	-0.1	-0.1
Sub-arterial/collector road	Spurway Street, Ermington	0.0	0.0
Sub-arterial/collector road	Hughes Avenue, Ermington	0.0	0.0
Sub-arterial/collector road	Kevin Coombs Avenue, Sydney Olympic Park	0.0	0.0
Sub-arterial/collector road	Old Hill Link, Sydney Olympic Park	-0.1	-0.1
Local road	Grand Avenue, Camellia	+0.2	+0.2
Local road	Australia Avenue, Sydney Olympic Park	+1.2	+1.2
Local road	Dawn Fraser Avenue, Sydney Olympic Park	+0.1	+0.1
Local road	Uhrig Road, Lidcombe	+0.1	+0.1
Local road	John Street, Rydalmere	+1.0	+1.0

## 4.5.5 Vehicles crossing over rail tracks

Vehicles travelling in a general perpendicular direction over the rail tracks has the potential to cause maximum noise events as the impact of wheels of the vehicle on the embedded rail track cause a 'repeated bump' noise that occurs for approximately one second as each vehicle crosses the track.

To determine indicative noise levels from these events, noise measurements were undertaken at the intersection of High Street and Botany Street, Randwick where the existing Sydney CBD and South East Light Rail crosses through the intersection. The noise measurement methodology and results are summarised in Appendix C-9. The conclusions of the measurements are summarised below.

- A correlation between vehicle speed and maximum noise levels was identified, where higher vehicle speeds resulted in higher noise levels, however further investigation is required to confirm this correlation.
- $L_{A_{fmax}}$  noise levels from vehicle pass-bys (light and heavy vehicles) were measured to be approximately 5 to 7 dB louder at the intersection with vehicles travelling over the rail track compared to an intersection with no rail track.
- Over a one second period (approximate duration of a single vehicle crossing the rail track), the  $L_{Aeq}$  noise level of a pass for a vehicle crossing the rail track is approximately 4 dB louder when compared to a vehicle pass-by that is not crossing the rail track.
- When comparing the sound exposure level (SEL) of a vehicle pass-by that is crossing a light rail track to the SEL of a vehicle not crossing a light rail track, a +0.6 dB increase in noise level was observed. It can be concluded that an increase of up to 0.6 dB could be experienced at residences adjacent to an intersection where vehicle cross the track. Where most vehicles travel perpendicular to the track, the increase in noise level would be higher than when most vehicles travel parallel to the track.
- The sound power level of a vehicle crossing over the track can range from approximately 100 dBA to  $L_{A_{fmax}}$  110 dBA, depending on the type of vehicle and its speed.

Further studies would be undertaken during the design development process to include more data points for heavy vehicles and cars travelling at various speeds over the rail tracks to refine the modelling assumptions used in this assessment.



The locations where vehicles would cross over the rail tracks are presented in Table 4.20. The vehicles crossing over rail tracks on South Street and Boronia Street have been assessed as part of the SoundPLAN noise modelling discussed in section 4.5.6.

For all other intersections where vehicles would cross the rail track, the  $L_{Aeq(15\text{hour})}$  and  $L_{Aeq(9\text{hour})}$  noise levels could increase by up to 0.6 dB at the most-affected sensitive receivers. Based on the calculated increase in road traffic noise levels presented in Table 4.20 for Hope Street, Hill Road, Australia Avenue and Dawn Fraser Avenue, noise levels at these intersections are not predicted to increase by more than 2 dB when taking into account the forecast traffic volumes and potential increase in  $L_{Aeq}$  noise levels where vehicles would cross the rail track. Note should be made that  $L_{Amax}$  noise levels could increase by approximately 5 to 7 dB at these intersections depending on the type of vehicle and its speed.

**Table 4.20** *Modelled intersections – vehicles crossing over rail tracks*

Suburb	Light rail street	Road intersection/Location	Comments
Rydalmere	South Street	John Street	Included in the $L_{Aeq}$ and $L_{Amax}$ noise assessment in Section 4.5.6.
		Primrose Avenue	
Ermington	South Street	River Road	
		Hilder Road	
	Boronia Street	Spurway/Broad Oaks Street	
		Trumble Avenue	
		Murdoch Street	
		Spofforth Street	
		Trumper Street	
	Hope Street	Hughes Avenue	
Wentworth Point	New Road	Hill Road	$L_{Aeq(15\text{hour})}$ and $L_{Aeq(9\text{hour})}$ noise levels could increase by up to 0.6 dB as a result of vehicles crossing the light rail track.
	Hill Road	Burroway Road	
Sydney Olympic Park	Australia Avenue	Dawn Fraser Avenue	Based on the increase in road traffic noise levels in Table 4.19, the increase in noise levels would be less than 2 dB.
	Dawn Fraser Avenue	Olympic Boulevard	
		Edwin Flack Avenue	

## 4.5.6 Reconfiguration of South Street and Boronia Street

### 4.5.6.1 $L_{Aeq(15\text{ hour})}$ and $L_{Aeq(9\text{hour})}$ noise levels

Sections of South Street and Boronia Street would require minor reconfigurations as a result of the project, where the eastbound lanes would move closer to residences to the north of South Street and Boronia Street to allow for a centre-running light rail track. Additionally, there are various intersections along South Street and Boronia Street where vehicles would cross over the rail tracks.

Acoustic modelling was undertaken using SoundPLAN 8.2 noise modelling software to predict indicative 'no build' and 'build' road traffic noise levels at the first row of residences fronting South Street and Boronia Street based on 2031 traffic volumes. The noise modelling parameters are discussed in detail in Appendix C-9 along with traffic volumes used in the noise modelling. Where vehicles could cross over the rail tracks, a +4 dB correction has been applied to a 10 metre section of road to account for the potential increase in noise. This is considered conservative as most vehicles would be driving parallel to the light rail tracks rather than perpendicular.

The noise model has not been validated against the measured road traffic noise levels undertaken in November/December 2021 as simultaneous traffic counts were not undertaken during the monitoring period and the local traffic flows could be considered atypical compared to a period with no COVID related restrictions.

The road and light rail track interface (definition design) is shown in Figure 4.14 and Figure 4.15 for South Street and Boronia Street, respectively.





**Figure 4.14** Road and light rail track interface – South Street, Rydalmere



**Figure 4.15** Road and light rail track interface – Boronia Street, Ermington

The results of the noise modelling (presented in Table 4.21) indicate that 32 receivers are predicted to experience an increase in noise level greater than 2 dB and receive noise levels above the RNP controlling noise criteria for residences adjacent to collector roads, being  $L_{Aeq(15\text{hour})}$  60 dBA for the day period and  $L_{Aeq(9\text{hour})}$  55 dBA during the night period. All identified receivers are located north of South Street and Boronia Street where the eastbound lane would move closer to the residences to allow for the centre-running light rail track.



**Table 4.21** Summary of noise modelling results against RNP noise criteria – South Street and Boronia Street

NCA	Number of receivers that exceed the RNP criteria (>2.0 dB and exceeds controlling criteria)		Range of noise levels – L <sub>Aeq</sub> (period), dBA		Location of receivers
	Day period	Night period	Day period	Night period	
E	1	1	63	58	North of South Street, Rydalmere
F	18	18	64 to 67	59 to 62	North of South Street, Rydalmere
I	12	13	64 to 70	60 to 66	North of Boronia Street, Ermington
All	31	32	63 to 70	60 to 66	-

When comparing the 2031 “No Build” results to the December 2021 monitoring results of Logger I at 55 Boronia Street (see Table C.5), the modelled results (L<sub>Aeq</sub>(15hour) 65 dBA and L<sub>Aeq</sub>(9hour) 60 dBA) are significantly higher than the measured results (L<sub>Aeq</sub>(15hour) 56 dBA and L<sub>Aeq</sub>(9hour) 50 dBA). Although comparing the 2031 “No Build” traffic volumes to the 2021 measured road traffic noise levels is not considered analogous, a difference of approximately 9 dB would not be expected from an increase in traffic volumes alone and would require further investigation during the design development process to determine the cause of this discrepancy.

During the design development process (once the final road configuration has been confirmed and designed), a road traffic noise assessment would be undertaken taking into account the following:

- simultaneous noise monitoring and traffic count data for South Street, Boronia Street and side streets to validate the noise model in accordance with the *Model Validation Guideline* (Transport for NSW, 2018)
- a review of the forecast traffic volumes for the year opening and year opening + 10 years
- vehicles crossing over the rail track using traffic volumes forecast for the side streets
- the 3-dimensional road and light rail interface and local topography
- assessment against the requirements of the *Road Noise Policy* (DECCW, 2011) with consideration to the *Noise Model Validation Guideline* (Transport for NSW, 2018), *Noise Criteria Guideline* (Transport for NSW, 2015a) and *Noise Mitigation Guideline* (Transport for NSW, 2015b).

#### 4.5.6.2 L<sub>A</sub>F<sub>max</sub> noise levels – sleep disturbance impacts

The RNP provides a literature review for the assessment of sleep arousal due to traffic noise however does not set a sleep disturbance assessment criterion. Sleep disturbance impacts are likely to be dependent on the following:

- maximum noise level of an event
- number of occurrences
- duration of the event
- level above background or ambient noise levels.

The *Environmental Noise Management Manual* (ENMM) (RTA, 2001) recommends that an assessment of maximum noise levels should include a calculation of the maximum noise levels, the extent to which the maximum noise levels for individual vehicle pass-bys exceed the L<sub>Aeq</sub> for each hour of the night, and the number of maximum noise events. Additionally, the ENMM advises that the maximum noise level can be used as a tool to prioritise and rank mitigation strategies, however, should not be applied as a decisive noise criterion for the selection of mitigation treatments.

At locations where road traffic is continuous rather than intermittent, the L<sub>Aeq</sub>(9hr) (night) target noise levels should sufficiently account for sleep disturbance impacts. However, where the emergence of L<sub>Amax</sub> over the ambient L<sub>Aeq</sub> is equal to or greater than 15 dB, the L<sub>Aeq</sub>(9hr) criteria may not sufficiently account for sleep disturbance impacts. In this case a maximum noise event is defined as any pass-by for which the L<sub>Amax</sub> noise level exceeds L<sub>Aeq</sub> (1hr) noise level by more than 15 dB and where the L<sub>Amax</sub> noise level is greater than 65 dBA.

Road traffic noise levels were monitored at the façade at one location along Boronia Street, Ermington and also along Hope Street, Ermington (provided for reference) during the monitoring period and the number of maximum noise events due to pass-bys have been calculated. The  $L_{Amax}$  and  $L_{Aeq(1hr)}$  noise levels during the night-time period (10pm to 7am) at these locations are summarised in Table 4.22.

**Table 4.22** Summary of logged maximum noise levels, dBA

Noise monitoring location	NCA	L <sub>Amax</sub> range		L <sub>Amax</sub> – L <sub>Aeq(1hr)</sub> range		Average L <sub>max</sub> traffic events per night (7 days)
		Min	Max	Min	Max	
55 Boronia Street, Ermington	I	65	75	15	40	38
9 Hope Street, Ermington	J	65	70	15	39	56

Noise modelling has been undertaken to assess  $L_{Amax}$  maximum noise levels where the road alignment is proposed to change along South Street and Boronia Street. The increase in maximum noise levels due to vehicles crossing over light rail tracks, described in section 4.5.6.1, have been accounted for in the modelling.

The receivers predicted to experience noise levels above 65 dBA are likely to be those directly adjacent to the road, however, the number of events experienced each night is dependent on the type and speed of vehicles travelling perpendicular to the tracks and cannot be predicted in the noise modelling.

Table 4.23 provides a summary of the noise modelling results, showing an increase in the  $L_{max}$  noise level on both the northern and southern sides of the road in all locations, with the northern side expected to experience a more significant increase due to the reduction of distance to the road alignment. While a majority of the predicted noise levels are dominated by the vehicle pass-by level, some residences close to intersections may experience increased maximum noise events due to the cars crossing perpendicular to the rails.

Due to the large increase in noise levels on the northern side of both South Street and Boronia Street, a detailed traffic noise assessment is recommended to be undertaken during the design development process for these sections of the road alignment.

**Table 4.23** Difference in  $L_{max}$  noise levels at South Street and Boronia Street due to the project

NCA	No. of receivers predicted to experience $L_{AFMax}$ levels >65 dBA	Average $L_{AFMax}$ difference – “No Build’ vs Build’		Dominant $L_{AFmax}$ noise source	
		Residences north of the road	Residences south of the road	Vehicle crossing over light rail track	Heavy vehicle pass-by
NCA-E	29	+2.6	+0.2	3 receivers	26 receivers
NCA-F	48	+5.8	+1.0	2 receivers	46 receivers
NCA-I	83	+3.8	+0.7	7 receivers	80 receivers

## 4.6 Effectiveness of mitigation measures

The recommended mitigation measures below are based on information available at the time of the assessment. As the operation of Stage 1 is expected to commence in 2024, compliance noise and vibration measurements would be undertaken and measured noise levels would be compared to predicted noise levels. The outcomes of the compliance noise and vibration monitoring would be taken into account during the design development process of the project and where appropriate, adjustments would be made to the key assumptions in this report and the selection of mitigation measures.

A discussion of potential noise and vibration mitigation options is provided in the following sections.

## 4.6.1 Airborne noise mitigation options

### 4.6.1.1 Railway operations

The results of the noise modelling indicate that no residential receivers are predicted to qualify for consideration for noise mitigation as the RING trigger levels are not predicted to be exceeded. Regardless, feasible and reasonable noise mitigation measures would be explored in the design development process taking into account the following (taken from Appendix 6 of the RING):

*“A **feasible** mitigation measure is a noise-abatement measure that can be engineered and is practical to build, given project constraints such as safety, maintenance and reliability requirements. It may also include options such as amending operational practices (e.g. changing timetable schedules) to achieve noise reduction.*

*Selecting **reasonable** measures from those that are feasible involves judging whether the overall noise benefits outweigh the overall adverse social, economic and environmental effects, including the cost of the abatement measure. To make such a judgement, consider the following.*

- noise impacts
- noise mitigation benefits
- cost effectiveness of noise mitigation
- community views”

Generally, source control measures are the most effective option as they benefit the greatest number of receivers. However, if only a few isolated receivers are predicted to exceed the RING trigger levels, property treatments at the receiver would be the most appropriate mitigation strategy to reduce potential airborne noise impacts, as shown in Table 4.24.

Table 4.24 Property treatment noise controls

Control option	Estimated noise benefit	Reasonableness and feasibility
Property treatment (mechanical ventilation to allow windows to be closed – in accordance with the Building Code of Australia requirements).	Compared to open windows, a 10 to 15 dB reduction in noise levels would be expected when assessed internally assuming standard glazing (Rw 20 to 25).	Considered reasonable and feasible if only one or a few receivers are predicted to exceed the RING trigger levels.  During the design development process, further noise modelling should be undertaken to confirm the number of receivers qualifying for noise mitigation.

Control measures in transmission, such as noise barriers, have not been considered as most of the trackform would be embedded rail allowing pedestrian and vehicle access across the tracks. The installation of a noise barrier parallel to the embedded track would prevent pedestrian and vehicle access across the track.

Potential source noise mitigation options are described in Table 4.25 along with comments regarding the reasonableness and feasibility of the control measure. The design of the trackform to reduce airborne noise levels would be investigated in further detail during the design development process.

Note should be made that based on the requirements to reduce ground-borne noise and vibration to sensitive receivers, highly resilient and very highly resilient trackforms may be required at various locations along the alignment. This is likely to be considered where ground-borne noise impacts are predicted between the John Street stop and Melrose Park stop. As highly resilient trackforms have the potential to increase airborne noise levels, any ground-borne noise mitigation controls would also be considered in the design development process in the assessment of airborne noise from the track.

**Table 4.25** Source control measures

Element	Control option	Estimated noise benefit	Reasonableness and feasibility	Further investigation during design development?
Trackform	Use of non-embedded trackforms (e.g. ballast track)	Up to $L_{Aeq}$ 3 dB.	Generally not feasible where embedded trackform has been specified due to access requirements for pedestrians and vehicles.  There may be designated areas where ballast track would be used.	Yes
	Incorporating absorption in the track design	Up to $L_{Aeq}/L_{Amax}$ 2 dB.	May be feasible to incorporate absorption/vegetated trackforms in certain areas.	
	Vegetated trackforms		There may be potential issues regarding wear and maintenance and therefore may not be suitable in many locations.	
Light rail vehicle design	Reduction in light rail vehicle speed	A 20% reduction in speed would reduce $L_{Amax}$ noise levels by 2.5 dB and $L_{Aeq}$ noise levels by 1.5 dB.	Not feasible as the light rail vehicle speed, frequency and length are essential to meet the service frequency and capacity demands for the project.	No
	Reduction in light rail vehicle frequency	No change to $L_{Amax}$ $L_{Aeq}$ 1 dB for 20% reduction $L_{Aeq}$ 2 dB for 35% reduction.		
	Reduce light rail vehicle length	No change to $L_{amax}$ $L_{Aeq}$ 3 dB for halving light rail vehicle length.		
Maintenance	Minimise wheel and rail roughness	Depends on whether rail roughness or wheel roughness dominates the system. The assessment assumes the wheel and rail is adequately maintained and as such, there would be no noise 'benefit' from proper maintenance.  Excessive noise from wheel and rail irregularities due to poor maintenance could be significant.	The specification for operations would include requirements for maintaining the rail surface and train wheel condition in accordance with the relevant standards.	Yes
	Permanent track and/or on-board lubrication systems	Excessive noise from wheel and rail irregularities due to poor maintenance could result in excessive noise in the range of:  Approx. 5 dB for $L_{Aeq}$ and Approx. 8 dB for $L_{Amax}$ at curves <sup>1</sup>	Reasonable and feasible at tight curves along the project alignment and at the stabling and maintenance facility at Camellia.	Yes

Note: 1. Based on compliance measurements undertaken at CSLER, excluding one compliance noise measurement location where noise levels increased subsequent to the incorporation of a permanent wayside top of rail friction modifier (TORFM) system.

To reduce the potential for curve squeal on the alignment, it is essential that the tracks are constructed to a high standard, the rail and light rail vehicle wheels are well maintained and tight radius curve sections are well lubricated.



Based on the design development documentation for Stage 1, measurements on the Canberra Light Rail, Inner West Light Rail and Sydney CBD and South East Light rail indicate that these measures would reduce curve squeal such that the predicted noise levels overestimate the measured noise levels. However, if these measures are not consistently implemented, measurements in Sydney have demonstrated that the potential for noise levels on curves could be significantly higher than considered in this assessment.

#### **4.6.1.2 Consideration of highly resilient or very-highly resilient trackforms**

Highly resilient or very highly resilient trackform may need to be installed in various sections of the alignment to reduce ground-borne vibration to sensitive receivers adjacent to the track. A sensitivity test has been undertaken based on the results of the noise modelling with a +2 dB correction applied to both the  $L_{Aeq}$  and  $L_{Amax}$  results to identify whether any additional receivers would qualify for mitigation. Based on the results of the sensitivity test, the additional receivers that would qualify for mitigation are listed below:

- residential dwelling at 174 South Street, Ermington (H470)
- residential dwelling at 17 Tristram Street, Ermington (H492)
- residential dwelling at 3 Tristram Street, Ermington (H500)
- residential dwelling at 31A Broadoaks Street, Ermington (I176)
- residential dwelling at 73 Hughes Street, Ermington (J093)
- residential development at 5 Uhrig Road, Lidcombe (R039).

During the design development process, various trackform types would be investigated to address potential ground-borne noise and vibration impacts. The airborne noise studies during the design development process would consider the various trackform types.

#### **4.6.1.3 Confirmation of key assumptions used in the noise modelling**

A review of the operational noise and vibration compliance reports for the City and South East Light Rail has been undertaken where discrepancies have been found between the predicted and measured noise levels at curves, crossovers and rolling noise from light rail vehicles. The most significant discrepancies were at compliance locations adjacent to curves where the difference between measured and predicted  $L_{Aeq(9hour)}$  noise levels ranged from -7 dB to +3 dB and -17 dB to +9 dB for  $L_{Amax}$  noise levels. The curve gain corrections applied in this assessment are:

- + 3 dB for curves with a radius between 100 metres and 500 metres
- + 8 dB for curves with a radius less than 100 metres.

Once Stage 1 is complete, compliance noise monitoring would be undertaken comparing predicted noise levels with measured noise levels at selected compliance monitoring locations. The outcomes of the compliance reports would be taken into account during the design development process of the project including any adjustments to assumptions detailed in Appendix C-3 and Appendix C-4, where appropriate.

#### **4.6.1.4 Operational road traffic noise**

The results of the noise modelling indicate that 32 receivers are predicted to experience an increase in noise level greater than 2 dB and receive noise levels above the RNP controlling noise criteria. All identified receivers are located north of South Street and Boronia Street where the eastbound lane would move closer to the residences to allow for the centre-running light rail track.

During the design development process, a road traffic noise assessment would be undertaken considering the following:

- simultaneous noise monitoring and traffic count data for South Street, Boronia Street and side streets to validate the noise model in accordance with the *Model Validation Guideline* (Transport for NSW, 2018)
- a review of the forecast traffic volumes for the year opening and year opening + 10 years
- vehicles crossing over the rail track using traffic volumes forecast for the side streets

- three-dimensional road and light rail interface and local topography
- assessment against the requirements of the *Road Noise Policy* (DECCW, 2011) with consideration to the *Noise Criteria Guideline* (Transport for NSW, 2015a) and *Noise Mitigation Guideline* (Transport for NSW, 2015b).

Potential noise control measures are presented in Table 4.26 for consideration during the design development process.

**Table 4.26** Noise control measures for operational road traffic noise impacts at South Street and Boronia Street

Element	Control option	Estimated noise benefit	Reasonableness and feasibility
Noise mounds and/or noise barriers	Block line of sight between the noise source (vehicles travelling on the road) and the most-affected residences using noise barriers or noise mounds.	Generally up to 10 dB of noise reduction depending on the height and location of the barrier, height and location of the source and height and location of the receiver.	Not considered reasonable or feasible as residences north of South Street and Boronia Street require driveway access.
Vehicle speeds (at-source)	Reducing vehicle speeds over the rail track using speed limits.	Assuming a 20*log relationship between speed and noise level and based on a 50 km/hr road speed limit: L <sub>Aeq</sub> 2 dB for 40 km/hr L <sub>Aeq</sub> 4 dB for 30 km/hr L <sub>Aeq</sub> 6 dB for 20 km/hr L <sub>Aeq</sub> >10 dB for 10 km/hr	Depends on the feasibility from a road performance and safety perspective.
Property treatment (at-receiver)	Property treatment (mechanical ventilation to allow windows to be closed – in accordance with the Building Code of Australia requirements).	Compared to open windows, a 10 to 20 dB reduction in noise levels would be expected when assessed internally depending on the glazing system (Rw 20 to 30).	Considered reasonable and feasible once noise control at the source has been investigated.  During the design development process, further noise assessment would be undertaken to confirm mitigation requirements.

## 4.6.2 Ground-borne noise mitigation options

The results of the ground-borne noise and vibration modelling indicate that while all sensitive receivers are predicted to comply with the ground-borne vibration criteria, 129 residential receivers are predicted to exceed the ground-borne noise trigger levels (where the ground-borne noise levels are also higher than the airborne noise levels).

The RING notes that “*when the noise and vibration trigger levels identified in this guideline [the RING] and the associated guideline Assessing vibration: a technical guideline (DEC 2006) are likely to be exceeded, the noise and vibration assessment should identify feasible and reasonable mitigation measures.*” The terms ‘reasonable’ and ‘feasible’ are as defined in section 4.6.1.

Similar to airborne noise, source control measures are the most-effective option as they benefit the greatest number of receivers. Furthermore, for ground-borne noise, they are often the only reasonable mitigation option.

An assessment of potential source control measures for ground-borne noise is provided in Table 4.27.

**Table 4.27** Ground-borne noise source control measures

Element	Control option	Estimated noise benefit	Reasonableness and feasibility	Further investigation during design development?
Trackform alignment	Shift track alignment away from residential receivers in affected areas.	A doubling of distance between the source and receiver would provide a 5 to 20 dB benefit in noise levels due to greater material damping and geometric spreading.	Determined by other project alignment and operational constraints. Not feasible.	No.
Trackform stiffness	Decreasing track stiffness (i.e. increasing track resilience) via the use of special boots, sleeper pads, under-ballast mats or floating track systems to provide high or very high ground-borne noise and vibration attenuation.	Decreasing track stiffness would provide a 5 to 10 dB reduction in ground-borne noise levels. However, decreasing the track stiffness would have the adverse effect of increasing the airborne noise contribution at sensitive receivers. It is understood that 'high' and 'very high' attenuation tracks are installed in some sections of Stage 1 track. Noise and vibration measurements of these trackforms should be undertaken to accurately quantify potential ground-borne noise and vibration benefits and increase in airborne noise levels.	Reasonable and feasible at chainages adjacent to residential areas currently qualifying for mitigation.	Yes. To be considered between John Street stop and Melrose Park stop and future growth areas such as Camellia town centre and Melrose Park.
Light rail vehicle design	Reduction in light rail vehicle speed.	A 20 per cent reduction in speed would reduce ground-borne noise levels by 2 dB.	Note feasible as the light rail vehicle speed (and frequency) are essential to meet the service frequency and capacity demands for the project.	No
Maintenance	Minimise wheel and rail roughness.	Depends on whether rail roughness or wheel roughness dominates the system. The assessment assumes the wheel and rail is adequately maintained and as such, there would be no vibration 'benefit' from proper maintenance.  Excessive vibration from wheel and rail irregularities due to poor maintenance could be significant.	The specification for operations would include requirements for maintaining the rail surface and train wheel condition in accordance with the relevant standards.	Yes

## 4.6.3 Fixed facilities – airborne noise mitigation options

### 4.6.3.1 Light rail stops

Due to the infrequent use of PA systems at light rail stops, noise impacts are not anticipated at residences adjacent to the light rail stops. Nevertheless, PA systems at stops should be designed to comply with the Npfl intrusiveness noise levels and the sleep disturbance screening criterion at all stops.

Table 4.28 presents a summary of the subjective level of noise impact for each light rail stop and mitigation measures to be considered during the design development process.

**Table 4.28** Mitigation considerations for light rail stops

Subjective level of impact	Light rail stop	Description of impact	Recommended mitigation	Further comments
None	<ul style="list-style-type: none"> <li>– Holker Street</li> <li>– Jacaranda Square</li> <li>– Olympic Boulevard.</li> </ul>	The nearest existing residential receivers are sufficiently distant that noise impacts are not anticipated.	PA systems at stops should be designed to comply with the Npfl intrusiveness and sleep	None.
Low	<ul style="list-style-type: none"> <li>– Sandown Boulevard</li> <li>– Melrose Park</li> <li>– Waratah Street.</li> </ul>	The nearest existing residential receivers are sufficiently distant that noise impacts are not anticipated, however future re-zoning is planned in Camellia town centre and Melrose Park where residences may be located adjacent to these light rail stops.	disturbance noise trigger levels at all locations. PA systems would be self-adjusting to the ambient noise level to ensure a balance between speech intelligibility for customers and prevention of annoyance for neighbours.	The design of these light rail stops should consider future residential land uses during the design development process.
Moderate	<ul style="list-style-type: none"> <li>– John Street</li> <li>– Nowill Street</li> <li>– River Road</li> <li>– Murdoch Street</li> <li>– Atkins Road</li> <li>– Footbridge Boulevard</li> <li>– Hill Road</li> <li>– Carter Street.</li> </ul>	<p>The nearest existing residential receivers may experience temporary annoyance during PA announcements.</p> <p>The infrequent nature of the announcements is anticipated to result in minimal subjective noise impacts at stops.</p>		<p>Design considerations could include:</p> <ul style="list-style-type: none"> <li>– Facing PA speakers away from nearest residences and towards the ground</li> <li>– More speakers at lower volume rather than a few speakers at high-volume.</li> </ul>

### 4.6.3.2 Traction power substations

The results of noise modelling indicate that noise emission from traction power substations is predicted to comply with the NPfI intrusiveness trigger levels at all nearby sensitive receivers. Further noise modelling would be undertaken during the design development process to ensure the final design of the substations complies with the relevant environmental noise limits.

### 4.6.3.3 Stabling and maintenance facility

An investigation of possible noise mitigation options to reduce noise levels from the additional light rail vehicle movements associated with the Stage 2 operations at the stabling and maintenance facility is provided in Table 4.29. At-source and at-receiver noise mitigation measures are recommended as in-transmission noise controls (noise barriers) are considered not reasonable or feasible to be effective in reducing noise levels to potential future residential receivers at the Camellia town centre.

**Table 4.29** Mitigation options for stabling and maintenance facility – Stage 2 operations

Noise mitigation type	Mitigation description	Description of impact
At-source	Prevention of curve squeal.	Tracks to be constructed to a high standard, the rail and light rail vehicle wheels well maintained and tight curve sections to be well lubricated. This could include incorporation of a permanent wayside top of rail friction modifier (TORFM) system.
In-transmission	Noise barriers between source and receiver	The Draft Camellia Rosehill Strategy indicates residential towers of up to 24 storeys at this location. A noise barrier would be ineffective in blocking the line-of-sight from the light rail vehicles to these receivers.
At-receiver	Architectural treatment at the receiver	Opportunity for future residential developments to incorporate acoustic treatments as part of their design and approval. Further modelling would be undertaken during the Stage 2 design development process to determine cumulative noise levels of the Stage 1 and Stage 2 operations at these receivers. The required noise mitigation required for these receivers would be refined during this stage. It is likely that these future residential developments would also need to consider architectural treatments to ensure the requirements of the Transport and Infrastructure SEPP can be met due to the proximity of these buildings to the Stage 2 light rail alignment.

## 4.6.4 Future planning control options

The design development of the project would consider future development in the selection of at-source mitigation options, where feasible. In parallel, future development adjacent to the project would also be required to consider noise and vibration intrusion to protect the acoustic amenity of future occupants. Planning controls have been recommended in Table 4.30 for consideration.

**Table 4.30** Recommended planning controls at Camellia town centre and Melrose Park North and South precincts

Future receiver area	Recommended planning control
Camellia town centre	<ul style="list-style-type: none"> <li>– Consideration of applying a setback distance of a minimum 25 metres from the track for residential development in the local development control plan.</li> <li>– Noise-sensitive development (residences, educational facilities, child care centres and places of worship) within 50 metres of the track should consider noise and vibration from the facility in their design and approval to comply with the requirements in Clause 87 of the Transport and Infrastructure SEPP.</li> <li>– Sensitive development within 150 metres of the stabling and maintenance facility (including the turnouts) at Camellia should consider airborne noise emission from the facility in their design and approval.</li> </ul>
Melrose Park North and South precincts	<ul style="list-style-type: none"> <li>– Consideration of applying a setback distance of a minimum 25 metres from the track for residential development in the local development control plan.</li> <li>– Noise-sensitive development (residences, educational facilities, child care centres and places of worship) within 50 metres of the track should consider noise and vibration project from the facility in their design and approval to comply with the requirements in Clause 87 of the Transport and Infrastructure SEPP.</li> </ul>

## 4.6.5 Summary of operational noise and vibration mitigation measures

Project specific mitigation measures have been recommended from the analysis of predicted impacts and would be required to be implemented in order to reduce the number of potentially impacted receivers. Table 4.31 provides details of the project specific mitigation measures.



**Table 4.31** Recommended project specific mitigation and management measures during operation

Project element	Mitigation type	Mitigation measure
Light rail vehicles, light rail track, PA systems at stops, substations and modifications to the stabling and maintenance facility	Operational noise and vibration review (ONVR)	<p>An operational noise and vibration review (ONVR) of the developed design would be undertaken to review the potential for operational impacts and confirm feasible and reasonable mitigation measures to be incorporated into the design. The ONVR would include:</p> <ul style="list-style-type: none"> <li>– reviewing compliance monitoring for Parramatta Light Rail Stage 1 to refine the assumptions used for Parramatta Light Rail Stage 1 and determine effectiveness of the mitigation implemented</li> <li>– surveying relevant buildings to determine appropriate internal noise trigger levels</li> <li>– undertaking a survey of vibration sensitive equipment within 100 metres of the project site</li> <li>– co-ordination of Stage 1 and Stage 2 contractors to ensure any additional receivers qualifying for mitigation consideration due to a doubling of vehicles on the shared track are captured</li> <li>– design thresholds for the light rail track to reduce how proud the track sits above the road surface where vehicles cross the light rail track</li> <li>– Public address systems at stops would be designed to comply with the <i>Noise Policy for Industry</i> (NSW EPA, 2017) intrusiveness and sleep disturbance noise trigger levels at all locations. PA systems would include automatic volume adjustments to account for the ambient noise level</li> <li>– traction power substations would be designed to comply with the NPfI criteria</li> <li>– a detailed road traffic noise assessment would be undertaken for the reconfiguration of South and Boronia streets in accordance with the <i>Noise Criteria Guideline</i> (Roads and Maritime, 2015a) and the <i>Noise Mitigation Guideline</i> (Roads and Maritime, 2015b) to confirm receivers that qualify for consideration of feasible and reasonable mitigation measures</li> <li>– new tracks (including at the stabling and maintenance facility) are to be constructed to a high standard, the rail and light rail vehicle wheels well maintained and tight curve sections to be well lubricated. This could include incorporation of a permanent wayside top of rail friction modifier (TORFM) system</li> <li>– consideration of feedback from, and preferences of, directly affected landowners/landholders.</li> </ul> <p>The operational noise and vibration review would be undertaken in consultation with relevant council(s) and the NSW EPA. The review would be developed in accordance with the RING, the NPfI and the RNP.</p>
Light rail vehicles, light rail track, PA systems at stops, traction power substations and modifications to the stabling and maintenance facility	Review of operational mitigation performance	<p>Monitoring of noise and vibration would be undertaken within 12 months of the commencement of operation to compare actual noise and vibration performance against that predicted by the operational noise and vibration review (ONVR).</p> <p>The results of monitoring would be documented in an operational noise and vibration compliance report. Additional feasible and reasonable mitigation measures would be considered where any additional receivers are identified as qualifying for consideration of noise mitigation in accordance with the relevant guidelines.</p>
Light rail infrastructure and road traffic noise	Early implementation of operational noise mitigation	<p>Consideration would be given to implementing operational noise mitigation early in the construction program to reduce the potential for construction noise impacts, where the mitigation would not be impacted by future works.</p>

## 4.7 Residual noise and vibration levels

As the mitigation options would be explored in detail during the design development process, it is difficult to estimate the residual noise levels at sensitive receivers at this stage with accuracy. A qualitative assessment of residual noise impacts is presented in Table 4.32 for each noise and vibration generating element of the project.

**Table 4.32** Qualitative assessment of potential residual noise impacts

Noise source	Qualitative assessment of potential residual noise impacts
Airborne noise from light rail vehicles	No residential receivers have been identified as qualifying for consideration for mitigation as noise levels are not predicted to exceed the $L_{A\text{Max}}$ trigger level of 80 dBA.
Ground-borne noise from light rail vehicles	<p>The majority of exceedances of the ground-borne noise trigger levels are at residences between the John Street stop and the Melrose Park stop, where unmitigated noise levels are predicted to be between 35 dBA and 49 dBA at the receiver that qualify for consideration for mitigation.</p> <p>The installation of highly resilient or very highly resilient trackform is predicted to reduce ground-borne noise levels by 5 to 10 dBA. As most of qualifying receivers are predicted to receive noise levels within 35 dBA to 40 dBA, residual noise levels would be below the 35 dBA trigger level for these receivers.</p> <p>For receivers predicted to receive noise unmitigated noise levels of 40 dBA or higher, residual noise impacts may be experienced. The most-affected receiver is predicted to receive residual noise levels of 39 dBA assuming a 10 dB reduction in noise levels.</p>
Ground vibration	No exceedances of the ground vibration criteria have been predicted. As such, no residual impacts are anticipated.
Operational road traffic noise – South Street and Boronia Street	It has been recommended that a detailed operational road traffic noise assessment be undertaken for the reconfiguration of South Street and Boronia Street as a result of the project. This assessment would be undertaken against the requirements of the <i>Noise Mitigation Guideline</i> (Transport for NSW, 2015) where at-source mitigation options would be considered and implemented where they are reasonable and feasible. Any residual noise impacts would be addressed with at-property treatments depending on the level of exceedance above the road noise criteria.
Fixed facilities	<ul style="list-style-type: none"> <li>– Noise from PA systems would be designed to comply with NPfl. No residual impacts are anticipated.</li> <li>– Noise from traction power substations is not predicted to result in any exceedances of the NPfl trigger levels. No residual impacts are anticipated.</li> <li>– Residual noise from the stabling and maintenance facility are predicted to exceed NPfl trigger levels at future residential receivers. At-receiver controls are not likely to affect outdoor noise levels (i.e. on balconies), however with 6.38 mm laminated glazing or better installed, noise levels would be negligible when assessed internally.</li> </ul>

## 5. Conclusion

### Construction noise and vibration

#### Construction noise

Consistent with other major transport infrastructure projects in suburban and urban areas, noise impacts would be inevitable during construction as noise intensive equipment would be required in proximity to sensitive receivers.

Table 5.1 provides a qualitative overview of the potential impacts associated with the project.

**Table 5.1** Qualitative overview of construction noise impacts

Qualitative impact	Activity	Comments
High impact (long term)	<ul style="list-style-type: none"> <li>light rail track and public domain works</li> <li>bridge works</li> <li>roadworks and other pavement works.</li> </ul>	<p>Due to the proximity and duration of works to sensitive receivers especially at Rydalmere, Ermington, Melrose Park, Wentworth Point, Lidcombe and the Parramatta CBD (mainly commercial receivers), a significant number of &gt;20 dB NML exceedances are predicted.</p> <p>NML exceedances are predicted to be &lt;10 dB at sensitive receivers for works in Camellia and for most works at Sydney Olympic Park due to the large separation distances between construction works sites and sensitive receivers.</p> <p>OOHW work (including night works) would also be required for various construction activities to minimise disruptions to the transport network.</p>
High impact (short term)	<ul style="list-style-type: none"> <li>demolition works (including clearing)</li> <li>compound site (including clearing)</li> <li>construction of stops</li> <li>construction of substations.</li> </ul>	<p>Due to the proximity of works to sensitive receivers especially at Rydalmere, Ermington, Melrose Park, Wentworth Point and Lidcombe, a significant number of 10-20 dB and &gt;20 dB NML exceedances are predicted although noise intensive activities are expected to be relatively short-term.</p> <p>NML exceedances are predicted to be &lt;10 dB at sensitive receivers for works in Camellia and for most works at Sydney Olympic Park due to the large separation distances between construction works sites and sensitive receivers.</p>
Lower impact	<ul style="list-style-type: none"> <li>spoil and ballast recycling</li> <li>modification works at stabling and maintenance facility at Camellia</li> <li>track and road works in Camellia.</li> </ul>	<p>Due to the large separation distance between these works in the Camellia industrial area and the nearest sensitive receivers, NML exceedances are predicted to be nil or &lt;10 dB at sensitive receivers given there is a minimum separation distance of 800 metres between the work area and the nearest residences in Rosehill and Rydalmere. OOHW (including night work) is not anticipated to result in significant impacts at sensitive receivers.</p>

To shorten the length of construction and minimise associated disruptions to the community, an extension of the ICNG recommended standard hours have been proposed, subject to approval. The proposed primary project working construction hours proposed are 7am to 7pm, Monday to Sunday including public holidays. Engagement was undertaken with a selection of community members to gain an understanding of the community's preference with balancing the primary project working hours, the overall construction program length and their amenity during the construction period. Survey results found that a total of 75 per cent of respondents supported the primary project working hours on weekdays, 67 per cent supported them on Saturdays and 53 per cent supported the primary project working hours on Sundays and/or public holidays.

Where noise levels have been predicted to exceed NMLs, reasonable and feasible work practices have been recommended to reduce potential impacts. The standard measures (management, source mitigation and path mitigation measures) prescribed in the CNVS would apply, where reasonable and feasible. Residual noise impacts would be managed in accordance with the CNVS where additional mitigation measures would apply once all reasonable and feasible mitigation measures have been implemented.

Project specific management and mitigation measures have also been recommended and would be reviewed and refined during the design development process.

Various construction activities would occur outside the primary project working construction hours (including night works) for safety reasons and to minimise disruptions to the transport network.

To assist with managing impacts during OOHW, these activities would require:

- consideration of the hierarchy of time periods for works outside the ICNG recommended standard hours and a strong justification for work outside of these hours
- the development of a OOHW protocol to be included in the NVMP and CEMP
- the development of site or activity specific Construction Noise and Vibration Impact Statements (CNVIS) in accordance with the CNVS.

## **Construction vibration**

The outcomes of the construction vibration impact assessment indicate the following:

- 455 buildings fall within the safe working distance for cosmetic damage (unreinforced buildings) due to vibratory intensive works associated with the project
- 958 buildings have been identified as falling within the safe working distance for human comfort due to vibratory intensive works associated with the project
- various heritage items and sensitive structure items along the project site have also been identified as falling within the screening distance for potential damage.

Condition surveys would be undertaken at various buildings identified as falling within the safe working distances for cosmetic damage. Where appropriate, vibration management levels would be refined and vibration monitoring would be undertaken where vibratory intensive work would be expected to exceed vibration management levels to determine site specific minimum working distances. Vibration impacts to human comfort would be managed through the additional mitigation measures prescribed in the CNVS.

Known Aboriginal sites, potential Aboriginal archaeological deposits and Historic Archaeological Management Units of potential high local and/or State significance have been identified within the project site. Detailed assessments and a test excavation program is proposed, prior to construction works, to confirm the presence of archaeological site and sensitivity to vibratory equipment. As far as reasonably practical, direct or indirect impacts on items and sites of Aboriginal and non-Aboriginal heritage significance would be avoided and would be considered during the design development and construction planning phases of the project.

## **Construction traffic**

Sensitive receivers adjacent to the following roads have been identified as exceeding the RNP noise requirements during the construction period:

- South Street (collector road) – between Silverwater Road and River Road
- John Street (local road) – between South Street and Antoine Street
- Fallon Street (local road) – between Primrose Avenue and John Street
- Primrose Avenue (local road) – between South Street and John Street
- Hilder Road (local road) – between Tristram Street and Coffey Street.

Management and mitigation measures have been recommended to reduce potential construction traffic noise related impacts at sensitive receivers.

## **Noise and Vibration Management Plan**

A Construction Environmental Management Plan (CEMP) would be prepared during the design development process and implemented through all construction activities. A Noise and Vibration Management Plan (NVMP) would be included in the CEMP to provide the framework for the management and mitigation of potential construction noise and vibration impacts.

# Operational noise and vibration

## Airborne noise

Three additional receiver buildings have been identified to qualify for airborne noise mitigation as a result of the doubling of light rail vehicle movements along the section of track shared by Stage 1 and Stage 2 light rail vehicles. These receivers are:

- Pre-Uni New College Parramatta – 3 Barrack Lane, Parramatta (educational institute)
- PM Counselling Services – 153 George Street, Parramatta (medical)
- Arthur Phillip High School – 80 -100 Macquarie Street (educational institute).

For the surface track between the Sandown Boulevard stop and the Carter Street stop, no residential receivers have been identified as qualifying for mitigation consideration in accordance with the RING.

A sensitivity check has also been undertaken applying a +2 dB correction to the predicted levels to account for the potential of highly resilient or very highly resilient trackform to reduce ground-borne noise and vibration from the track. The sensitivity check indicates that six residential buildings could qualify for mitigation consideration.

## Ground-borne noise and vibration

A total of 129 residential receivers are predicted to exceed the night-time ground-borne noise trigger levels prescribed in the RING, where the ground-borne noise level also exceeds the airborne noise level. The qualifying receivers are primarily located adjacent to the alignment between the John Street stop and the Melrose Park stop, with a few isolated receivers in Wentworth Point and Lidcombe.

Generally, at-source control measures are the most-effective option as they benefit the greatest number of receivers. Control measures in transmission, such as noise barriers, are not considered an effective measure to reduce ground-borne noise and vibration.

Potential at-source noise mitigation options have been discussed including control options for the trackform and maintenance of the track to minimise friction between the wheel and the rail.

Decreasing the track stiffness (i.e. increasing track resilience) via the use of special boots, sleeper pads, under ballast mats or floating track systems to provide high or very-high ground-borne noise and vibration attenuation would be investigated during the next stages of design, especially between the John Street and Melrose Park stops where most affected residences are located.

Property treatments at the receiver would be considered once reasonable and feasible at-source mitigation measures have been implemented.

Compliance noise and vibration measurements from Parramatta Light Rail Stage 1 and the Sydney CBD and South East Light Rail would assist with informing the key assumptions adopted during the design development process for Stage 2. Additionally, the effectiveness of various mitigation measures implemented for Stage 1 would inform the mitigation strategy for Stage 2.

## Future development adjacent to the project

Noise and vibration sensitive development within the Camellia town centre and the Melrose Park North and South precincts that are approved prior to the approval of the project would be considered during the design development process. For developments approved subsequent to the approval of the project, developers would be required to ensure the design of the development complies with Clause 87 of the Transport and Infrastructure SEPP. Operational noise contours have been provided to show indicative noise levels across these urban growth areas to assist in the planning of these areas. Planning controls have also been recommended for future development adjacent to the project alignment.

## Airborne noise from fixed facilities

PA systems would be designed to comply with the NPfI intrusiveness and sleep disturbance trigger levels at all sensitive receivers. PA systems would also be self-adjusting to the ambient noise level to reduce noise levels during more sensitive periods of the day.

Traction power substations would also be designed to comply with the lower of the NPfI intrusiveness and amenity noise levels at sensitive receivers. The rectifier and auxiliary transformers would be housed inside buildings to reduce the potential for noise impacts at receivers.

It has been predicted that light rail vehicle noise at the stabling yards and entering and exiting the facility would be the dominant noise source contributing to exceedances of the operational noise trigger levels at potential future receivers at the Camellia town centre. At-source noise mitigation has been recommended to prevent curve squeal noise and it has also been recommended that future developments incorporate acoustic treatments as part of their design and approval, considering noise from the project.

### **Changes to the road traffic noise levels during operation**

The estimated forecast 'no build' and 'build' traffic volumes along the local road network for 2031 have been used to calculate whether any sections of road are predicted to increase by more than 2 dB as a result of the project. The predictions indicate that no section of road is predicted to increase by more than 2 dB based on the forecast traffic volumes.

### **Vehicles crossing over rail tracks**

It has been predicted that the  $L_{Aeq(15\text{hour})}$  and  $L_{Aeq(9\text{hour})}$  noise levels could increase by up to 0.6 dB at the most-affected sensitive receivers to these intersections. Taking into account the forecast traffic volumes and potential increase in  $L_{Aeq}$  noise levels where vehicles would cross the rail track,  $L_{Aeq(15\text{hour})}$  and  $L_{Aeq(9\text{hour})}$  road noise levels are not predicted to increase by more than 2 dB. Note should be made that  $L_{A_{fmax}}$  noise levels could increase by approximately 5 to 7 dB at these intersections depending on the type of vehicle and its speed.

### **Reconfiguration of road at South Street and Boronia Street**

Sections of South Street and Boronia Street would require minor reconfigurations as a result of the project, where the eastbound lanes would move closer to residences to the north of South Street and Boronia Street to allow for a centre-running light rail track. Additionally, there are various intersections along South Street and Boronia Street where vehicles would cross over the rail tracks.

The results of the noise modelling indicate that 32 receivers are predicted to experience an increase in noise level greater than 2 dB and receive noise levels above the RNP controlling noise criteria for residences adjacent to collector roads, being  $L_{Aeq(15\text{hour})}$  60 dBA for the day period and  $L_{Aeq(9\text{hour})}$  55 dBA during the night period.

All identified receivers are located north of South Street and Boronia Street where the eastbound lane would move closer to the residences to allow for the centre-running light rail track. It is recommended that an operational traffic noise assessment be undertaken during the design development process in accordance with RNP and the relevant Transport for NSW road traffic noise guidelines.



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# **Appendix A**

**Acoustical terms and glossary**

## Acoustic concepts and terminology

### Definition of 'noise'

Sound may be defined as any pressure variation that the human ear can detect. The terms “sound” and “noise” are more or less interchangeable however, “noise” is generally often referred to as unwanted sound.

### Factors that contribute the environmental noise

Noise from an activity such as construction noise or noise during the operation of a facility at a given receiver location can be affected by a number of different factors, including:

- How loud the source activity is and the type of source:
  - Point (e.g. a pump or motor)
  - Line (e.g. a road or railway line)
  - Area (e.g. the external façades of an industrial building)
- The distance from the source to receiver
- The type of ground between the sound and receiver locations (e.g. hard surfaces or porous ground)
- The ground topography between the source and the receiver. e.g. is it flat or hilly? Blocking the line of sight will generally reduce the noise level for the receiver
- Obstacles that may block the line of sight between the source and the receiver. e.g. buildings or noise walls
- Atmospheric absorption (dependent on humidity and temperature)
- Meteorological conditions that may increase or reduce environmental sound propagation (e.g. wind direction or temperature inversions)

### Noise measurements

Noise is generally measured using a specially designed ‘sound level meter’ (SLM) and must meet internationally recognized performance standards. To avoid expressing sound or noise in terms of Pa, which could involve some unmanageable numbers, the logarithmic decibel or dB scale is used. The scale uses the hearing threshold of  $20 \mu\text{Pa}$  or  $20 \times 10^{-6} \text{ Pa}$  as the reference level and is defined as 0 dB.

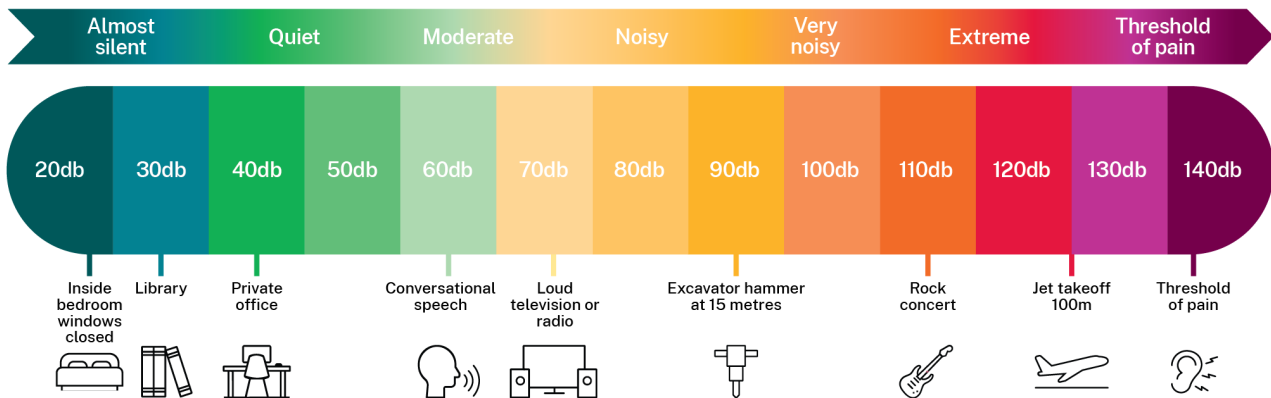
### Typical noise levels

The figure below presents typical noise sources for each various sound pressure levels and a corresponding subjective noise level description.

## Noise level comparisons

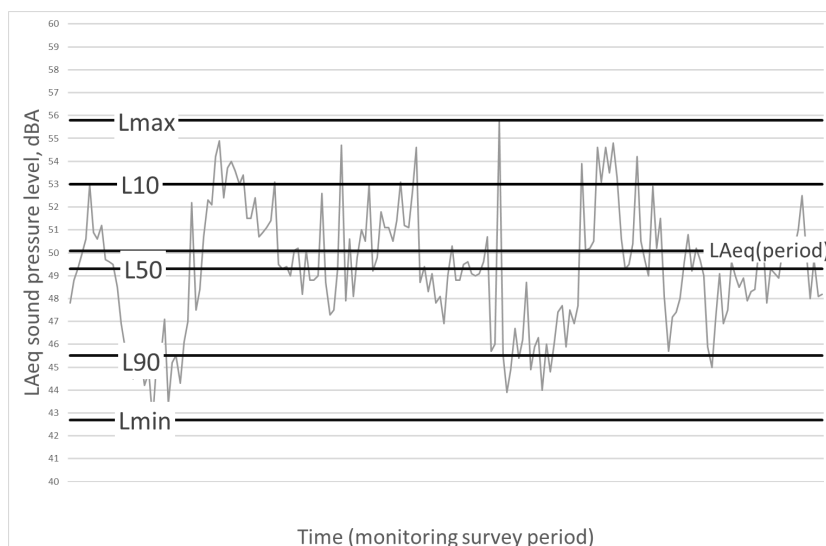
People's perception of noise is strongly influenced by their environment.

A noise level that is perceived as loud in one situation may appear quiet in another.



## Typical noise descriptors

Noise is represented by the descriptor  $L_{AN}$ , representing a statistical sound measurement recorded on the 'A' weighted scale. A typical noise monitoring chart is shown in the graph below along with the noise descriptors.



Where:

- $L_{Amax}$ : The maximum sound level recorded during the measurement period.
- $L_{Amin}$ : The minimum sound level recorded during the measurement period.
- $L_{A10(period)}$ : The A-weighted sound pressure level that is exceeded for 10% of the measurement period.
- $L_{Aeq(period)}$ : Equivalent sound pressure level, the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring.
- $L_{A90(period)}$ : The A-weighted sound pressure level that is exceeded for 90% of the time over which a given sound is measured. This is considered to represent the background noise e.g.  $L_{A90(15min)}$ .

## Changes in noise levels

The table below presents a qualitative description of average human responses to changes in noise levels.

Difference	Human response
Difference of 2 dBA	Generally imperceptible by the human ear
Difference of 5 dBA	Considered significant
Difference of 10 dBA	Perceived as a doubling (or halving) of the noise source
Addition of two identical noise levels	Increase levels by 3 dBA
Addition of second noise level of similar character	If the secondary noise level is a minimum 8 dBA below the primary noise level, the noise level will not significantly increase
Doubling of distance between source and receiver	Results in a 3 dBA decrease for a line source and 6 dBA for a point source
A doubling of traffic volume	Results in a 3 dBA increase in noise

## Audibility of noise

The table below presents quantitative guidance and qualitative descriptions regarding the audibility of noise.

Audibility	Description
Inaudible	Noise source cannot be heard. The noise level is generally less than the background noise level, potentially by more than 10 dBA or greater
Barely audible	Characteristics of the noise is difficult to define or masked by extraneous noise. The noise level is generally 5-7 dBA below the background noise or ambient noise level, depending on the nature of the noise e.g. constant or intermittent
Just audible	Characteristics of the noise can be defined but extraneous noise sources are also contributing to the received noise. The noise level is typically below the background and ambient noise level.
Audible	Characteristics of the noise can be easily defined. The noise level may be at the level of the background noise and above.
Dominant	The noise source is significantly 'louder' than all other noise sources. The noise level will likely be significantly greater than the background noise level.

## Types of noise sources

The table below offers a qualitative description of various noise types and provides the noise descriptor that is typically used to measure the type of noise.

Duration of the noise	Description
Continuous noise	Continuous noise is produced by equipment or activities that operates without interruption in the same mode, for e.g. blowers, pumps and processing equipment. Measuring for just a few minutes with hand-held equipment is sufficient to determine the noise level. If tones or low frequencies are heard, the frequency spectrum can be measured for documentation and further analysis. Continuous noise sources are generally captured by the $L_{90}$ noise descriptor.
Intermittent noise	Intermittent noise is a noise level that increases and decreases rapidly. This might be caused by a train passing by, factory equipment that operates in cycles, or aircraft flying above. Intermittent noise is measured in a similar way to continuous noise, with a sound level meter. The duration of each occurrence and the time between each event is important to note. To gain a more reliable estimate of the noise level, multiple occurrences of the noise source is measured to gain a reliable estimate. Intermittent noise sources are generally captured by the $L_{eq}$ noise descriptor.
Impulsive noise	The noise from impacts or explosions, for e.g. from a pile driver, punch press or gunshot, is called impulsive noise. It is brief and abrupt, and its startling effect causes greater annoyance than would be expected from a simple measurement of sound pressure level. To quantify the impulsiveness of noise, the difference between a quickly responding and a slowly responding parameter can be used. Impulsive noise sources are generally captured by the $L_{max}$ or $L_{peak}$ noise descriptor.
Frequency content	Description
Low frequency	Noise containing major components in the low-frequency range (10 hertz [Hz] to 160 Hz) of the frequency spectrum
Tonal noise	Tonal noise contains one or more prominent tones (i.e. distinct frequency components), and is normally regarded as more offensive than 'broad band' noise
Defining characteristic	Description
Extraneous noise	Noise resulting from activities that are not typical of the area. Atypical activities may include construction, and traffic generated by holiday periods and by special events such as concerts or sporting events. Normal daily traffic is not considered to be extraneous.
Subject noise	The noise in question removed from any extraneous noise in the area
Offensive noise	The definition of offensive noise in the POEO Act is noise: (a) that, by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances: (i) is harmful to (or is likely to be harmful to) a person who is outside the premises from which it is emitted, or (ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or (b) that is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances, prescribed by the regulations.

## Frequency analysis

Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal. This analysis was traditionally carried out using analogue electronic filters, but is now normally carried out using Fast Fourier Transform (FFT) analysers. The units for frequency are Hertz (Hz), which represent the number of cycles per second. Frequency analysis can be in:

- Octave bands (where the centre frequency and width of each band is double the previous band)
- 1/3 octave bands (3 bands in each octave band)
- Narrow band (where the spectrum is divided into 400 or more bands of equal width)



# Vibration

## Definition of 'vibration'

Vibration may be defined as cyclic or transient motion. This motion can be measured in terms of its displacement, velocity or acceleration. Most assessments of human response to vibration or the risk of damage to buildings use measurements of vibration velocity.

## Vibration descriptors

These may be expressed in terms of 'peak' velocity or 'rms' velocity. The former is the maximum instantaneous velocity, without any averaging, and is sometimes referred to as 'peak particle velocity', or PPV. The latter incorporates 'root mean squared' averaging over some defined time period. Vibration measurements may be carried out in a single axis or alternatively as triaxial measurements. Where triaxial measurements are used, the axes are commonly designated vertical, longitudinal (aligned toward the source) and transverse. The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level  $V$ , expressed in mm/s can be converted to decibels by the formula  $20 \log (V/V_0)$ , where  $V_0$  is the reference level ( $10^{-9}$  m/s). Care is required in this regard, as other reference levels may be used by some organisations.

## Types of vibration

Vibration in buildings can be caused by many different external sources, including industrial, construction and transportation activities. The vibration may be continuous (with magnitudes varying or remaining constant with time), impulsive (such as in shocks) or intermittent (with the magnitude of each event being either constant or varying with time). A description of each vibration type including examples are presented in the table below.

Vibration type	Description	Examples
Continuous vibration	Vibration continues uninterrupted for a defined period (usually throughout daytime and/or night-time). This type of vibration is assessed on the basis of weighted rms acceleration values	Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery)
Impulsive vibration	A vibration source (continuous or intermittent) which has a rapid build up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping). This type of vibration is assessed on the basis of weighted rms acceleration values	Infrequent: Activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading.
Intermittent vibration	Interrupted periods of continuous (for e.g. a drill) or repeated periods of impulsive vibration (for e.g. a pile driver), or continuous vibration that varies significantly in magnitude. This type of vibration is assessed on the basis of vibration dose values	Trains, nearby intermittent construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer this would be assessed against impulsive vibration criteria

## How humans perceive vibration

People are able to 'feel' vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as 'normal' in a car, bus or train is considerably higher than what is perceived as 'normal' in a shop, office or dwelling.

## Typical vibration levels

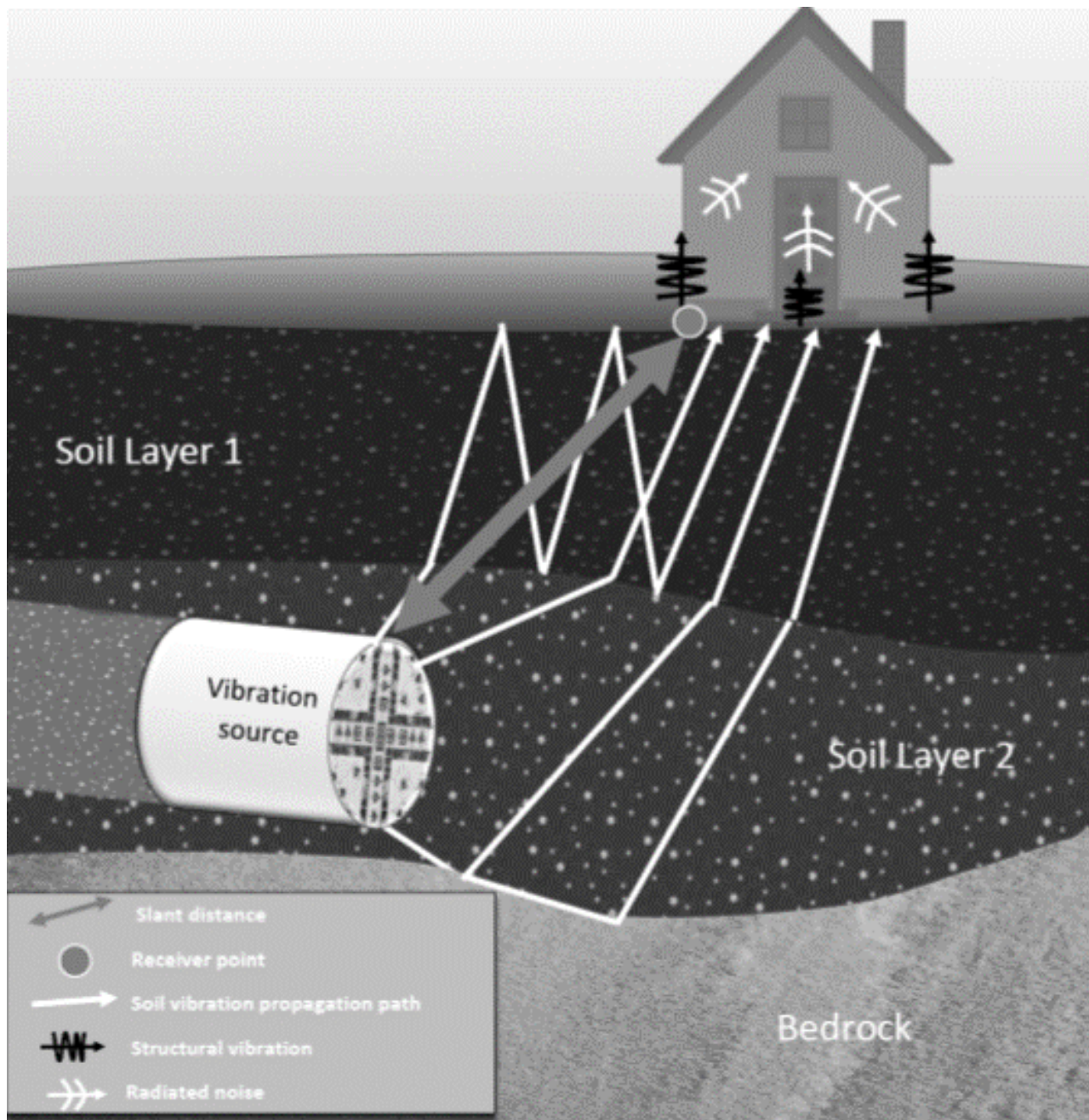
Typical ground vibration from civil construction activities occurs in the frequency range of approximately 8 Hz to 100 Hz. Within this frequency range, building contents such as blinds and pictures would commence visible movement at 0.5 mm/s. At vibration levels higher than 0.9 mm/s, rattling of windows, crockery or loose objects would be audible and annoying.

Velocity level (mm/s)	Typical source	Response
0.01	Typical background vibration level	Scanning electron microscopes to 50000 x amplification
0.03		500x amplification bench microscopes
0.1	Average passenger train vibration	Approximate threshold for human perception of vibration
0.3	Average freight train vibration Max passenger train vibration	Approx. residential annoyance for train passbys
1	Large rock breaker	Vibration level that will generally result in complaints
3	Blasting/ Impact pile driving	Threshold for minor cosmetic damage

## Ground-borne noise and vibration

Noise that propagates through a structure as vibration and is radiated by vibrating wall, ceiling and floor surfaces is termed “ground-borne noise”, “regenerated noise”, or sometimes “structure borne noise”. Ground-borne noise originates as vibration and propagates between the source and receiver through the ground and/or building structural elements, rather than through the air. Typical sources of ground-borne noise include tunnelling construction works or underground railway operations.

The figure below presents the various paths by which vibration and ground-borne noise may be transmitted between a source and receiver for construction activities that occur below the ground level (for e.g. a tunnel boring machine).



## Acronyms and abbreviations

Term	Definition
AWS	Automatic Weather Station
BOM	Bureau of Meteorology
dB	Decibel is the unit used for expressing the sound pressure level (SPL) or power level (SWL) in acoustics.
dBA	Decibel expressed with the frequency weighting filter used to measure 'A-weighted' sound pressure levels, which conforms approximately to the human ear response, as our hearing is less sensitive at low and high frequencies.
dBZ or dBL	The unit used to measure 'Z-weighted' sound pressure levels with no weighting applied, linear.
CEMP	Construction Environmental Management Plan
DECC	Department of Environment and Climate Change
DECCW	Department of Environment, Climate Change and Water
EPA	Environmental Protection Authority
ICNG	<i>Interim Construction Noise Guideline</i> (DECC, 2009).
NPfI	<i>Noise Policy for Industry</i> (EPA, 2017).
$L_{Aeq(period)}$	Equivalent sound pressure level: the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring.
$L_{A10(period)}$	The noise level exceeded for 10 per cent of the time and is approximately the average of the maximum noise levels.
$L_{A90(period)}$	The sound pressure level that is exceeded for 90% of the measurement period.
$L_{Amax}$	The absolute maximum noise level in a noise sample
NSW	New South Wales
OOHW	Out-of-hours Works
PPV	Peak particle velocity is the maximum vector sum of three orthogonal time-synchronized velocity components regardless of whether these component maxima occurred simultaneously.
RBL	Rating Background Level . The overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period.
rms	Root Mean Square Amplitude (rms) is the square root of the average of the squared values of the waveform. In the case of the sine wave, the RMS value is 0.707 times the peak value, but this is only true in the case of the sine wave.
RNP	<i>Road Noise Policy</i> (DECCW, 2011).
SEARs	Secretary's Environmental Assessment Requirements
SPL	Sound Pressure Level
SWL	Sound Power Level
Rw	Weighted Sound Reduction Index which provides a single-number quantity which characterises the airborne sound insulation of a material or building element over a range of frequencies
TBM	Tunnel Boring Machine
VDV	Vibration dose value - As defined in BS6472 – 2008, VDV is given by the fourth root of the integral of the fourth power of the frequency weighted acceleration.

## Common Terms

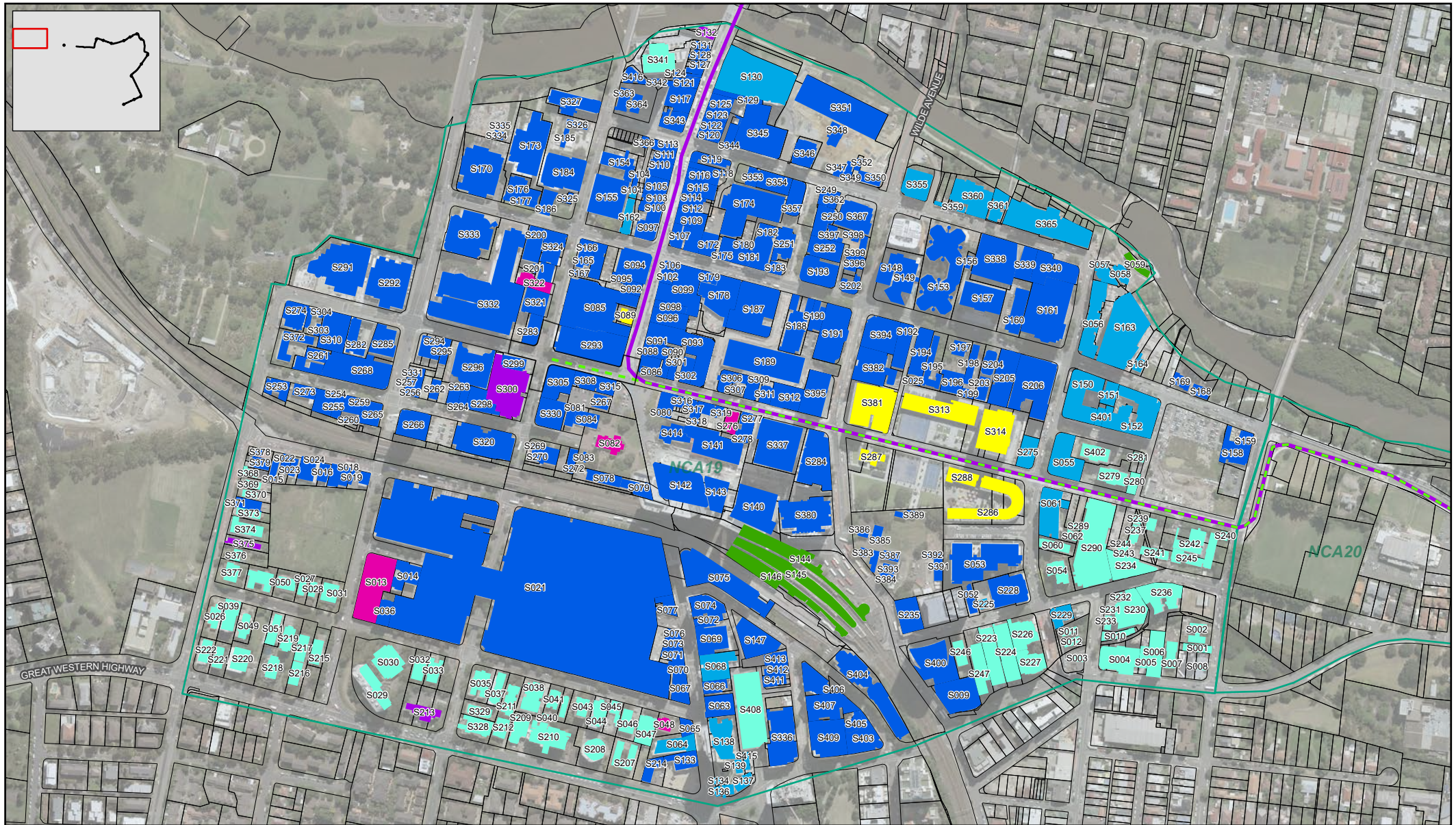
Term	Definition
A weighting	The human ear responds more to frequencies between 500 Hz and 8 kHz and is less sensitive to very low-pitch or high-pitch noises. The frequency weightings used in sound level measurements are often related to the response of the human ear to ensure that the meter better responds to what you actually hear
Adverse weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient noise	The all-encompassing noise associated within a given environment. It is the composite of sounds from many sources, both near and far. This is described using the Leq descriptor
Background noise	The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed. This is described using the L90 descriptor
Compliance	The process of checking that source noise levels meet with the noise limits in a statutory context.
Determining authority	Defined by Section 110 of the <i>Environmental Planning and Assessment Act 1979</i> as 'a Minister or public authority and, in relation to any activity, means the Minister or public authority by or on whose behalf the activity is or is to be carried out or any Minister or public authority whose approval is required in order to enable the activity to be carried out.'
Extraneous noise	Noise resulting from activities that are not typical of the area. Atypical activities may include construction, and traffic generated by holiday periods and by special events such as concerts or sporting events. Normal daily traffic is not considered to be extraneous
EIS	Environmental Impact Assessment
Feasible and reasonable measures	Feasibility relates to engineering considerations and what is practical to build. reasonableness relates to the application of judgement in arriving at a decision, taking into account the following factors: - Noise mitigation benefits (amount of noise reduction provided, number of people protected); Cost of mitigation (cost of mitigation versus benefit provided); Community views (aesthetic impacts and community wishes); Noise levels for affected land uses (existing and future levels, and changes in noise levels)
Ground-borne noise	Noise heard within a building that is generated by vibration transmitted through the ground into the structure from construction works, sometimes referred to as 'regenerated noise' or 'structure-borne noise'. Ground-borne noise can be more noticeable than airborne noise for underground works such as tunnelling. The ground-borne noise levels are only applicable when ground-borne noise levels are higher than airborne noise levels.
Ground-borne vibration	Vibration transmitted from a source to a receptor via the ground
Hertz	The measure of frequency of sound wave oscillations per second. 1 oscillation per second equals 1 hertz.
Masking	The phenomenon of one sound interfering with the perception of another sound. For example, the interference of traffic noise with use of a public telephone on a busy street.
Maximum noise event	The loudest event or events within a given period of time. This is generally described using the $L_{max}$ descriptor
Meteorological conditions	Wind and temperature inversion conditions
Most-affected location	Location(s) that experience (or will likely experience) the greatest noise impact from the construction works under consideration. In determining these locations, existing background noise levels, noise source location(s), distance and any shielding between the construction works (or proposed works) and the residences and other sensitive land uses need to be considered.

Term	Definition
Noise management level	The Noise Management Level (NML) as defined as the EPA's ICNG. To be measured and assessed at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the residential property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most affected point within 30 m of the residence.
Noise sensitive receiver	An area or place potentially affected by noise which includes: a residential dwelling an educational institution, library, childcare centre or kindergarten a hospital, surgery or other medical institution an active (e.g. sports field, golf course) or passive (e.g. national park) recreational area commercial or industrial premises a place of worship.
Non-compliance	Development is deemed to be in non-compliance with its noise consent/ licence conditions if the monitored noise levels exceed its statutory noise limit (exceptions may be given if the noise level exceeds by less than 2 dB)
Octave	A division of the frequency range into bands, the upper frequency limit
Project noise trigger level	Target noise levels for a particular noise generating facility. They are based on the most stringent of the intrusive criteria or amenity criteria. Which of the two criteria is the most stringent is determined by measuring the level and nature of existing noise in the area surrounding the actual or propose noise generating facility.
Proposal	The construction and operation of the SWRO site, the modifications to the Illawarra WFP site and associated infrastructure including the power route, the delivery pipeline, the se and the intake and outlet tunnels.
proposal site	The immediate location of the proposal, which is the area that has the potential to be directly disturbed by construction and operation.
Resonance	Resonance describes the phenomenon of increased amplitude that occurs when the frequency of a periodically applied force is equal or close to a natural frequency of the system on which it acts.
Study area	Land in the vicinity of, and including, the proposal site. The 'study area' is the wider area surrounding the proposal site.
Temperature inversion	An atmospheric condition in which temperature increases with height above the ground.
Third-octave	Single octave bands divided into three parts.



# **Appendix B**

**Sensitive receivers**



#### Legend

- Stage 1 Alignment
- - - Shared running with PLR Stage 1
- Project site
- NCAs
- Cadastre

- Sensitive Receiver**
- Commercial
  - Educational institute
  - Hotel
  - Mixed use

- Non-sensitive
- Place of worship
- Residential

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Meters

Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 56



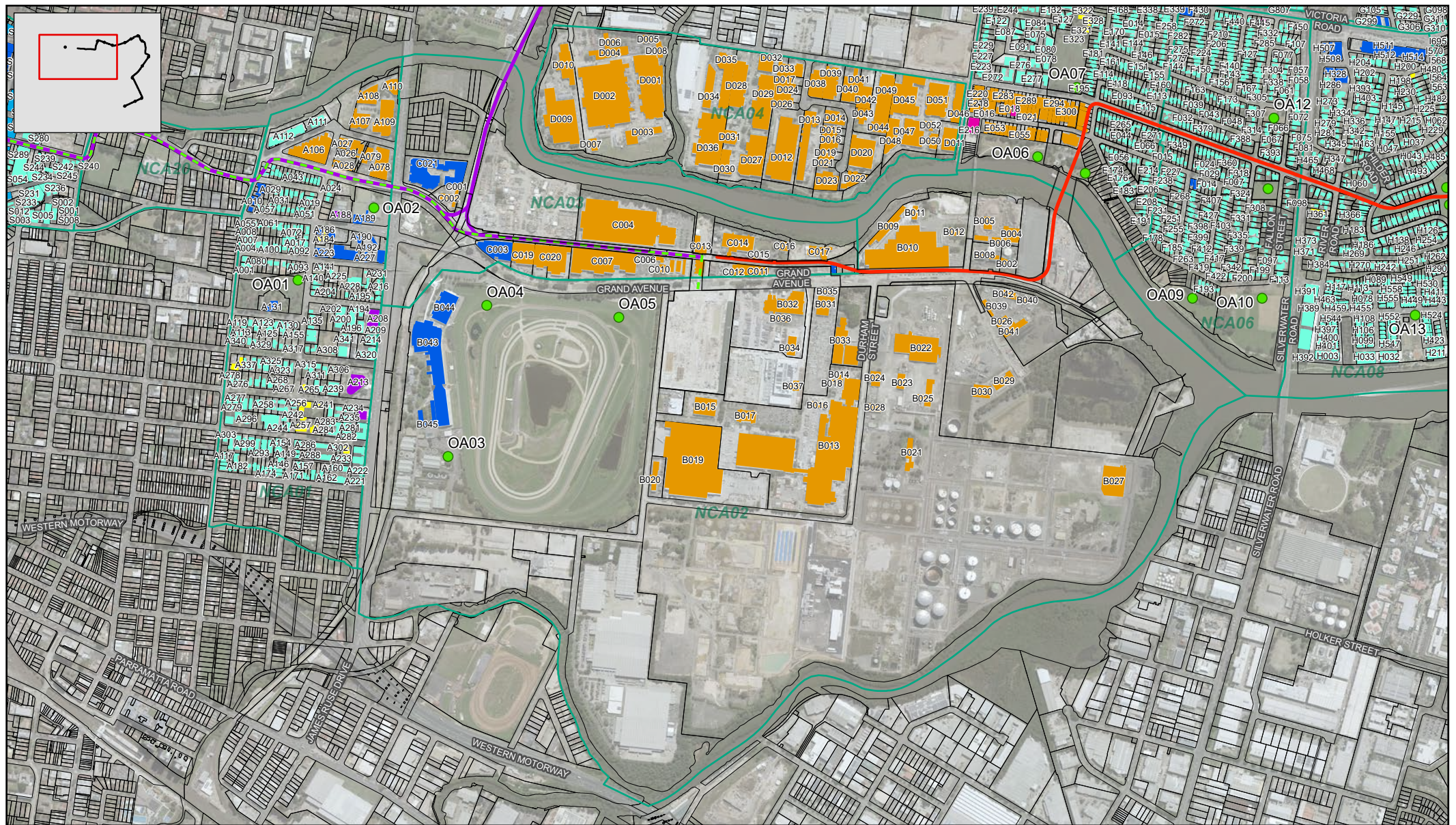
**Transport for NSW**  
**Parramatta Light Rail Stage 2 EIS**  
**Noise and vibration impact assessment**

Project No. **12557728**  
Revision No. **-**  
Date **28/06/2022**

**Sensitive receivers**

**FIGURE B-1.1**



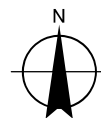


#### Legend

<span style="color: purple;">—</span> Stage 1 Alignment	<span style="color: green;">●</span> Open area receiver	<span style="background-color: lightblue;">■</span> Mixed use
<span style="color: green;">- - -</span> Shared running with PLR Stage 1	<span style="background-color: yellow;">■</span> Sensitive Receiver	<span style="background-color: lightgreen;">■</span> Non-sensitive
<span style="color: red;">—</span> Stage 2 Alignment	<span style="background-color: blue;">■</span> Commercial	<span style="background-color: pink;">■</span> Place of worship
<span style="border: 1px solid black;">□</span> Project site	<span style="background-color: yellow;">■</span> Educational institute	<span style="background-color: lightcyan;">■</span> Residential
<span style="border: 1px solid green;">□</span> NCAs	<span style="background-color: purple;">■</span> Hotel	
<span style="background-color: lightgrey;">□</span> Cadastre	<span style="background-color: orange;">■</span> Industrial	

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Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 56



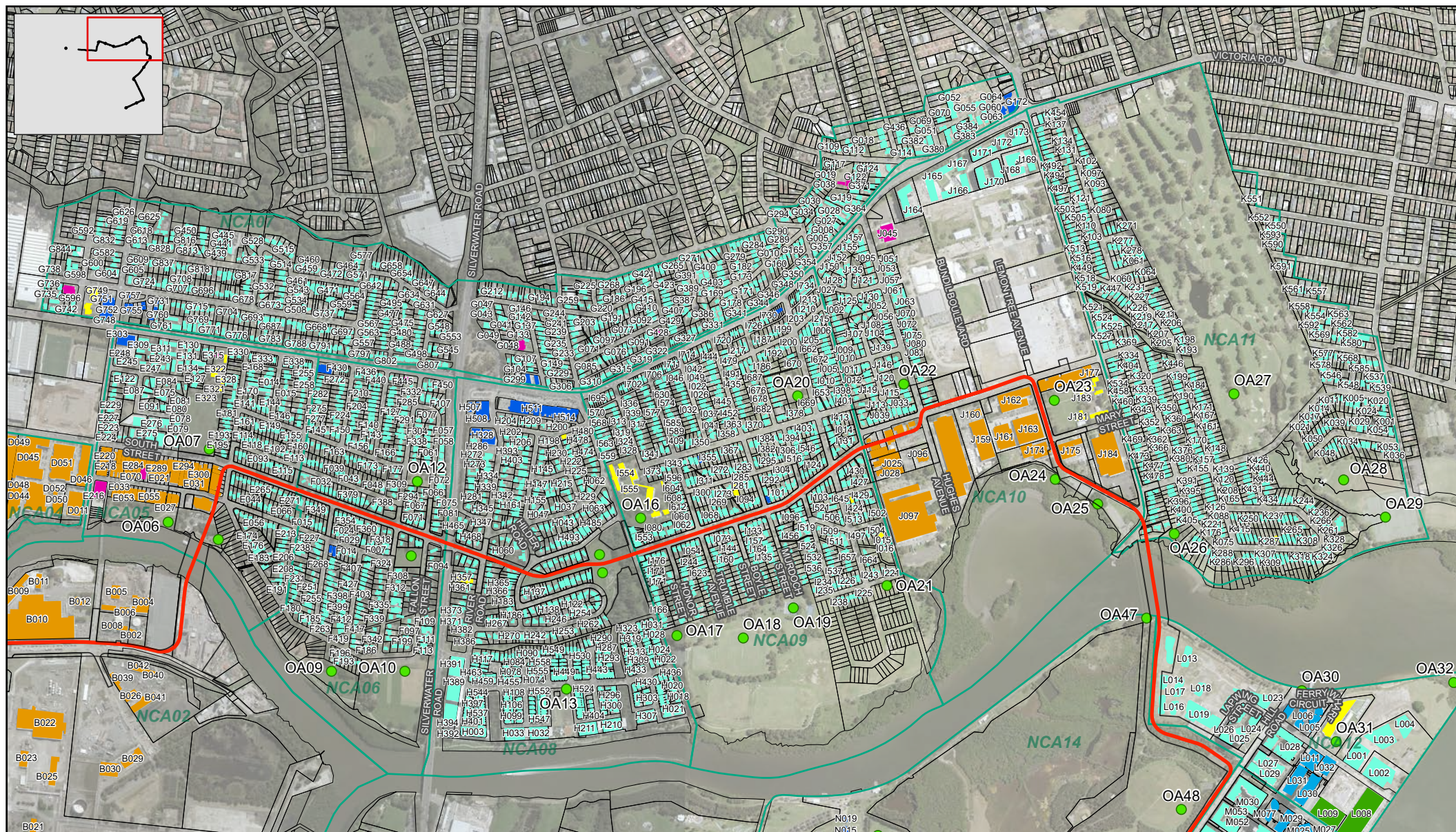
Transport for NSW  
Parramatta Light Rail Stage 2 EIS  
Noise and vibration impact assessment

Project No. 12557728  
Revision No. -  
Date 28/06/2022

Sensitive receivers

FIGURE B-1.2



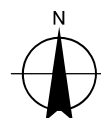


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<span style="border: 1px solid black;"> </span> Project site	<span style="color: blue;">■</span> Commercial	<span style="color: pink;">■</span> Place of worship
<span style="border: 1px solid cyan;"> </span> NCAs	<span style="color: yellow;">■</span> Educational institute	<span style="color: cyan;">■</span> Residential
<span style="border: 1px solid grey;"> </span> Cadastre	<span style="color: orange;">■</span> Industrial	
<span style="color: green;">●</span> Open area receiver	<span style="color: lightblue;">■</span> Mixed use	

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Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 56



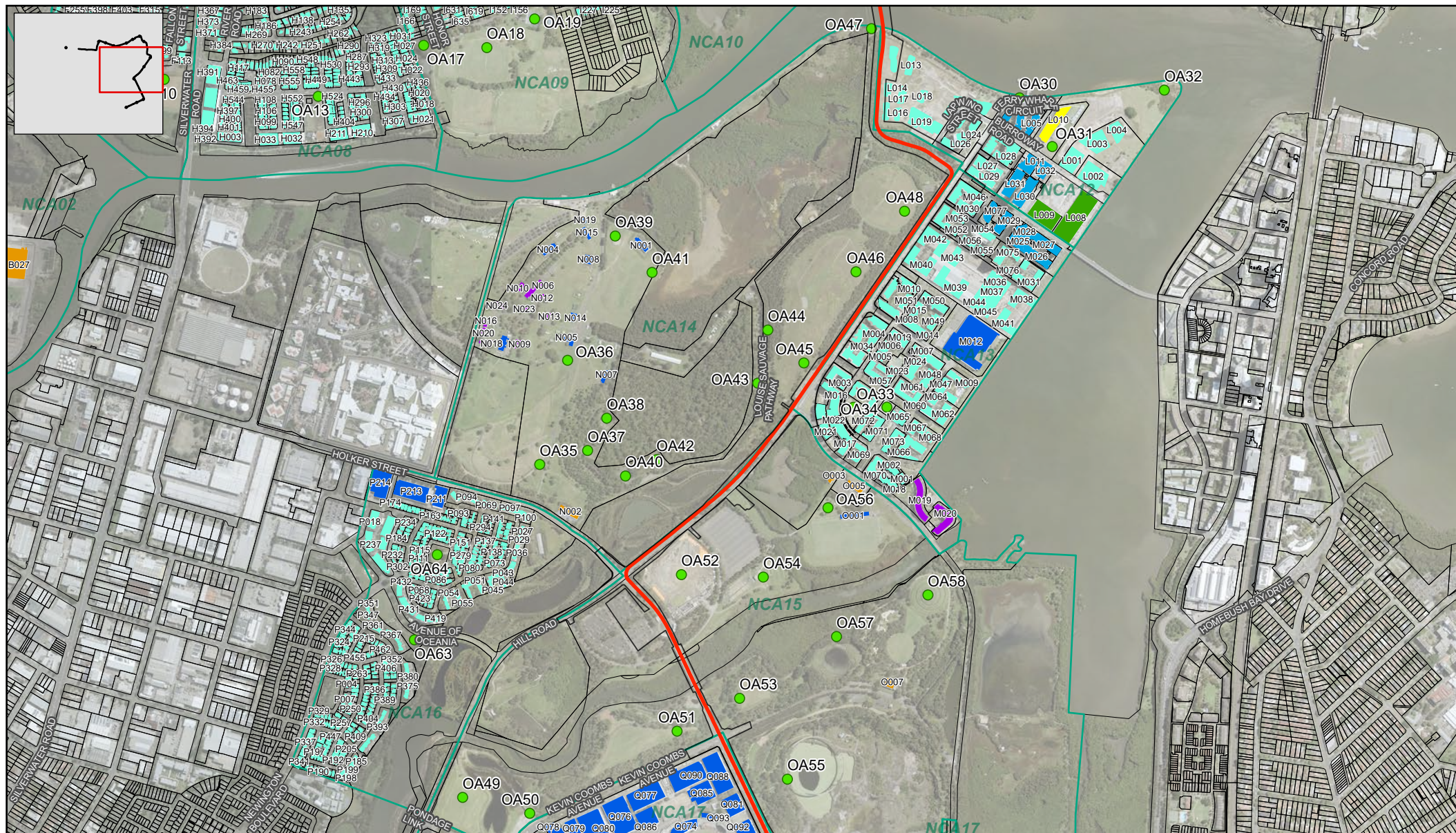
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Noise and vibration impact assessment

Project No. 12557728  
Revision No. -  
Date 28/06/2022

Sensitive receivers

FIGURE B-1.3



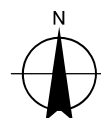


# Legend

- Stage 2 Alignment
- Project site
- NCAs
- Cadastral
- Open area receiver
- Sensitive Receiver
- Commercial
- Educational institute
- Hotel
- Industrial
- Mixed use
- Non-sensitive
- Residential

Paper Size ISO A4  
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Meters

Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 56



Transport for NSW  
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Noise and vibration impact assessment

Project No. 12557728  
Revision No. -  
Date 28/06/2022

Sensitive receivers

FIGURE B-1.4





#### Legend

- |  |   |   |
|--|---|---|
| <span style="color: red;">—</span> Stage 2 Alignment         | <span style="color: green;">●</span> Open area receiver           | <span style="background-color: orange;">■</span> Industrial     |
| <span style="border: 1px solid black;"> </span> Project site | <span style="background-color: blue;">■</span> Sensitive Receiver | <span style="background-color: cyan;">■</span> Mixed use        |
| <span style="border: 1px solid green;"> </span> NCAs         | <span style="background-color: purple;">■</span> Commercial       | <span style="background-color: green;">■</span> Non-sensitive   |
| <span style="border: 1px solid grey;"> </span> Cadastre      | <span style="background-color: magenta;">■</span> Hotel           | <span style="background-color: lightblue;">■</span> Residential |

Paper Size ISO A4  
0 210 420  
Meters

Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 56



Transport for NSW  
Parramatta Light Rail Stage 2 EIS  
Noise and vibration impact assessment

Project No. 12557728  
Revision No. -  
Date 28/06/2022

Sensitive receivers

**FIGURE B-1.5**



# **Appendix C**

**Detailed methodologies**

## C-1 Noise monitoring methodology




Background noise monitoring (long term method in accordance with the Noise Policy for Industry (NPfI) (EPA, 2017) was undertaken at 11 residential locations within the study area to quantify the existing background and ambient noise levels in the surrounding environment. The measured  $L_{A90}$  background noise levels have been used to establish the rating background noise levels (RBLs) for each the relevant periods of the day, in accordance with Fact Sheet A and Fact Sheet B of the NPfI. The RBLs have been used to establish the construction noise management levels (NMLs) in accordance with the ICNG and the intrusiveness noise levels in accordance with the NPfI.

Attended noise monitoring was also undertaken at each residential logger location to characterize the existing noise environment and describe typical noise sources in the area.  $L_{Amax}$ ,  $L_{Aeq}$ ,  $L_{A10}$  and  $L_{A90}$  noise levels were measured during the 15-minute monitoring period.




The methodology for the noise monitoring program included the following:

- Noise monitoring was undertaken using nine Svan 977 and two Rion NL-52 Type 1 environmental noise loggers. All noise loggers were programmed to accumulate  $L_{A90}$ ,  $L_{A10}$  and  $L_{Aeq}$  noise descriptors continuously over the entire monitoring period. Details and results of the noise monitoring equipment are provided in tables below.
- A calibration check was performed on the noise monitoring equipment using a sound level calibrator. At completion of the measurements, the meter's calibration was re-checked to ensure the sensitivity of the noise monitoring equipment had not varied. The noise loggers were found to be within the acceptable tolerance of  $\pm 0.5$  dB.
- All monitoring activities were undertaken with consideration of the specifications outlined in Australian Standard AS1055 (1997) *Description and Measurement of Environmental Noise*.
- Noise monitoring was undertaken from Thursday 9 December 2021 to Wednesday 22 December 2021, at the 11 residential locations along the light rail alignment to determine rating background levels (RBLs), and was used to establish the construction NMLs and operational noise trigger levels. The noise loggers also measured existing ambient and road traffic noise levels for reference. Note should be made that:
  - Noise logger H failed after four days and the data is considered insufficient to establish RBLs. Noise data from Noise logger F has been used to establish RBLs for NCA-H
  - Noise logger I failed after seven days and the data is considered sufficient to establish RBLs.
- Meteorological data (wind speed, wind direction, rainfall, temperature and humidity) was sourced from the Bureau of Meteorology's Sydney Olympic Park AWS (station number 066212).
- The data collected by the noise loggers was downloaded and analysed to determine invalid data due to adverse weather conditions. Invalid data generally refers to periods of time where average wind speeds were greater than 5 m/s, or when rainfall occurred.
- Determination of the RBLs were undertaken in accordance with NPfI.
- Attended noise measurements were undertaken using a Svan 977 Type 1 environmental sound level meter (SLM) (Serial no. 36872). A calibration check was performed on the SLM using a sound level calibrator. At completion of the measurements, the meter's calibration was re-checked to ensure the sensitivity of the noise monitoring equipment had not varied. The noise logger was found to be within the acceptable tolerance of  $\pm 0.5$  dB ( $-0.1$  dB drift).




**Table C.1**      *Logger A – 5 Hope Street, Rosehill*

Date	ABL L <sub>90</sub> , dBA			Ambient L <sub>Aeq</sub> noise level, dBA			Road traffic L <sub>Aeq</sub> (period)		Road traffic – L <sub>Aeq</sub> (1hr)		Equipment details	Equipment settings
	Day	Eve	Night	Day	Eve	Night	D	N	D	N		
Thursday-9-Dec-21	53	49	42	62	60	59	61	59	62	62	RION NL-52 Type 1 SN: 131631  1.5 m above ground level Free-field conditions IEC 61672-3:2013 Compliant Manufactured prior 2019	A-weighted Fast time response 15 minute intervals  Pre and post calibration variation: -0.3 dBA Svantek SV30A Class 1 Sound level calibrator SN: 29030 AS 60942:2003 Compliant Manufactured prior 2017
Friday-10-Dec-21	52	49	40	62	60	57	61	57	62	59		
Saturday-11-Dec-21	50	49	40	60	59	55	60	55	61	57		
Sunday-12-Dec-21	48	48	37	59	59	57	59	57	60	60		
Monday-13-Dec-21	51	48	40	61	59	58	61	58	62	61		
Tuesday-14-Dec-21	52	48	41	62	61	57	62	57	62	60		
Wednesday-15-Dec-21	51	50	39	61	59	57	61	57	62	59		
Thursday-16-Dec-21	52	49	39	62	60	57	61	57	62	60	Equipment photo	Logger location
Friday-17-Dec-21	51	51	43	61	60	57	61	57	62	59		
Saturday-18-Dec-21	50	50	40	59	59	55	59	55	60	57		
Sunday-19-Dec-21	48	49	40	57	58	57	58	57	59	60		
Monday-20-Dec-21	51	48	40	61	65	57	63	57	63	59		
Tuesday-21-Dec-21	49	48	40	61	59	58	60	58	62	62		
Wednesday-22-Dec-21	52	-	-	63	-	-	63	-	65	-		
RBL	51	49	40	-	-	-	-	-	-	-		
Overall Leq	-	-	-	61	60	57	61	57	62	60		
Attended noise monitoring results												
Date and time	L <sub>max</sub>			L <sub>Aeq</sub>		L <sub>A10</sub>		L <sub>90</sub>			Equipment photo	Notes
9 December 2021 13:15 to 13:30	77			62		65		53				<ul style="list-style-type: none"><li>James Ruse Drive traffic noise is dominant</li><li>Trucks ~71 dBA Lmax</li><li>Cars ~50 to 60 dBA LAeq</li><li>Buses ~ 65 dBA LAeq</li><li>Local traffic on Hope Street and some birds</li></ul>

**Table C.2**      *Logger E – 100 South Street, Rydalmere*

Date	ABL L <sub>90</sub> , dBA			Ambient L <sub>Aeq</sub> noise level, dBA			Road traffic L <sub>Aeq</sub> (period)		Road traffic – L <sub>Aeq</sub> (1hr)		Equipment details	Equipment settings
	Day	Eve	Night	Day	Eve	Night	D	N	D	N		
Thursday-9-Dec-21	48	38	37	58	52	52	56	52	58	56	Svan 977 Type 1 SN: 36872  1.5 m above ground level Free-field conditions IEC 61672-3:2013 Compliant Manufactured prior 2019	A-weighted Fast time response 15 minute intervals  Pre and post calibration variation: -0.1 dBA Svantek SV30A Class 1 Sound level calibrator SN: 29030 AS 60942:2003 Compliant Manufactured prior 2017
Friday-10-Dec-21	45	41	36	57	52	49	56	49	58	52		
Saturday-11-Dec-21	43	39	36	56	54	48	56	48	56	49		
Sunday-12-Dec-21	37	39	33	54	53	49	53	49	54	53		
Monday-13-Dec-21	42	38	35	57	54	50	56	50	58	52		
Tuesday-14-Dec-21	42	35	34	57	56	49	57	49	59	52		
Wednesday-15-Dec-21	41	40	32	57	58	51	57	51	58	55		
Thursday-16-Dec-21	45	40	32	57	54	49	56	49	59	53	Equipment photo	Logger location
Friday-17-Dec-21	43	42	32	58	55	49	58	49	60	51		
Saturday-18-Dec-21	39	40	33	54	52	48	53	48	55	52		
Sunday-19-Dec-21	40	38	32	53	57	50	55	50	55	53		
Monday-20-Dec-21	43	35	33	57	52	49	56	49	58	52		
Tuesday-21-Dec-21	42	35	30	57	52	50	56	50	58	54		
Wednesday-22-Dec-21	42			57			57	-	59	-		
RBL	42	39	33	-	-	-	-	-	-	-		
Overall Leq	-	-	-	57	55	50	56	50	58	52	Attended noise monitoring results	
Date and time	L <sub>max</sub>			L <sub>Aeq</sub>			L <sub>A10</sub>		L <sub>90</sub>		Equipment photo	Notes
9 December 2021 14:02 to 14:17	75			57			60		46			<ul style="list-style-type: none"><li>– Road traffic noise along South Street is dominant</li><li>– Cars ~52 to 72 dBA L<sub>Aeq</sub></li><li>– Bird noise and nearby dogs barking</li><li>– Truck pass-by 72 dBA L<sub>max</sub>.</li></ul>

**Table C.3**      *Logger F – 168 South Street, Rydalmere*




Date	ABL L <sub>90</sub> , dBA			Ambient L <sub>Aeq</sub> noise level, dBA			Road traffic L <sub>Aeq</sub> (period)		Road traffic – L <sub>Aeq</sub> (1hr)		Equipment details	Equipment settings
	Day	Eve	Night	Day	Eve	Night	D	N	D	N		
Thursday-9-Dec-21	53	45	42	63	57	56	59	56	62	60	Svan 977 Type 1 SN: 97591  1.5 m above ground level Free-field conditions IEC 61672-3:2013 Compliant Manufactured prior 2019	A-weighted Fast time response 15-minute intervals  Pre and post calibration variation: -0.3 dBA Svantek SV30A Class 1 Sound level calibrator SN: 29030 AS 60942:2003 Compliant Manufactured prior 2017
Friday-10-Dec-21	50	47	40	61	56	52	60	52	64	55		
Saturday-11-Dec-21	49	47	40	59	57	53	58	52	60	54		
Sunday-12-Dec-21	46	47	36	58	56	54	57	54	58	58		
Monday-13-Dec-21	47	44	39	61	57	54	60	54	61	57		
Tuesday-14-Dec-21	47	43	36	61	57	54	60	54	62	58		
Wednesday-15-Dec-21	47	45	35	61	59	69	60	69	61	71		
Thursday-16-Dec-21	47	45	34	59	55	52	58	52	61	55	Equipment photo	Logger location
Friday-17-Dec-21	46	44	34	59	55	49	58	49	59	53		
Saturday-18-Dec-21	44	45	34	56	54	51	56	51	57	54		
Sunday-19-Dec-21	45	42	36	61	56	51	59	51	63	54		
Monday-20-Dec-21	47	41	35	59	54	50	58	50	60	54		
Tuesday-21-Dec-21	46	42	32	58	54	51	57	51	58	54		
Wednesday-22-Dec-21	46	-	-	57	-	-	57	-	58	-		
RBL	47	45	36	-	-	-	-	-	-	-		
Overall Leq	-	-	-	60	56	59	59	59	60	55	Attended noise monitoring results	
Date and time	L <sub>max</sub>			L <sub>Aeq</sub>			L <sub>A10</sub>		L <sub>90</sub>		Equipment photo	Notes
9 December 2021 14:31 to 14:46	78			65			67		55			<ul style="list-style-type: none"><li>– Road traffic noise along Silverwater Road (continuous) and South Street (intermittent) is dominant</li><li>– Cars ~60 to 65 dBA L<sub>Aeq</sub></li><li>– Bird noise</li><li>– Truck pass-by 74 dBA L<sub>max</sub>.</li></ul>






**Table C.4**      *Logger H – 33 River Road, Ermington*

Date	ABL L <sub>90</sub> , dBA			Ambient L <sub>Aeq</sub> noise level, dBA			Road traffic L <sub>Aeq</sub> (period)		Road traffic – L <sub>Aeq</sub> (1hr)		Equipment details	Equipment settings	
	Day	Eve	Night	Day	Eve	Night	D	N	D	N			
Thursday-9-Dec-21	52	47	45	62	59	57	60	57	61	61	Rion NL-52 Type 1 SN: 131632  1.5 m above ground level Free-field conditions IEC 61672-3:2013 Compliant Manufactured prior 2019	A-weighted Fast time response 15 minute intervals  Pre and post calibration variation: 0.6 dBA Svantek SV30A Class 1 Sound level calibrator SN: 29030 AS 60942:2003 Compliant Manufactured prior 2017	
Friday-10-Dec-21	53	50	42	62	60	54	61	54	63	57			
Saturday-11-Dec-21	52	49	43	60	58	54	59	53	61	57			
Sunday-12-Dec-21	47	47	37	58	66	51	63	51	61	53			
Monday-13-Dec-21	-	-	-	-	-	-	-	-	-	-			
Tuesday-14-Dec-21	-	-	-	-	-	-	-	-	-	-			
Wednesday-15-Dec-21	-	-	-	-	-	-	-	-	-	-			
Thursday-16-Dec-21	-	-	-	-	-	-	-	-	-	-			
Friday-17-Dec-21	-	-	-	-	-	-	-	-	-	-			
Saturday-18-Dec-21	-	-	-	-	-	-	-	-	-	-			
Sunday-19-Dec-21	-	-	-	-	-	-	-	-	-	-			
Monday-20-Dec-21	-	-	-	-	-	-	-	-	-	-			
Tuesday-21-Dec-21	-	-	-	-	-	-	-	-	-	-			
Wednesday-22-Dec-21	-	-	-	-	-	-	-	-	-	-			
RBL	52	48	42	-	-	-	-	-	-	-			
Overall Leq	-	-	-	60	62	55	61	55	61	57			
Attended noise monitoring results													
Date and time	L <sub>max</sub>			L <sub>Aeq</sub>			L <sub>A10</sub>			L <sub>90</sub>		Equipment photo	Notes
9 December 2021 15:04 to 15:19	74			59			62			50			<ul style="list-style-type: none"><li>– Road traffic noise along Silverwater Road (continuous) and River Road (intermittent) is dominant</li><li>– Cars ~50 to 60 dBA L<sub>Aeq</sub></li><li>– Bird noise</li><li>– Truck pass-by 74 dBA L<sub>max</sub></li><li>– Similar acoustic environment to Location F</li></ul>




**Table C.5**      *Logger I – 55 Boronia Street, Ermington*

Date	ABL L <sub>90</sub> , dBA			Ambient L <sub>Aeq</sub> noise level, dBA			Road traffic L <sub>Aeq</sub> (period)		Road traffic – L <sub>Aeq</sub> (1hr)		Equipment details	Equipment settings
	Day	Eve	Night	Day	Eve	Night	D	N	D	N		
Thursday-9-Dec-21	44	36	38	57	53	54	54	54	57	57	Svan 977 Type 1 SN: 36825  1.5 m above ground level 1m from the facade IEC 61672-3:2013 Compliant Manufactured prior 2019	A-weighted Fast time response 15 minute intervals  Pre and post calibration variation: -0.4 dBA  Svantek SV30A Class 1 Sound level calibrator SN: 29030 AS 60942:2003 Compliant Manufactured prior 2017
Friday-10-Dec-21	40	42	35	59	54	48	58	48	59	50		
Saturday-11-Dec-21	42	40	36	57	54	47	57	47	58	50		
Sunday-12-Dec-21	36	39	32	54	53	49	53	49	55	53		
Monday-13-Dec-21	40	39	38	57	54	50	56	50	57	51		
Tuesday-14-Dec-21	41	40	35	56	54	48	56	48	58	50		
Wednesday-15-Dec-21	38	-	-	55	-	-	55	-	56	-		
Thursday-16-Dec-21	-	-	-	-	-	-	-	-	-	-	Equipment photo	Logger location
Friday-17-Dec-21	-	-	-	-	-	-	-	-	-	-		
Saturday-18-Dec-21	-	-	-	-	-	-	-	-	-	-		
Sunday-19-Dec-21	-	-	-	-	-	-	-	-	-	-		
Monday-20-Dec-21	-	-	-	-	-	-	-	-	-	-		
Tuesday-21-Dec-21	-	-	-	-	-	-	-	-	-	-		
Wednesday-22-Dec-21	-	-	-	-	-	-	-	-	-	-		
RBL	40	39	35	-	-	-	-	-	-	-		
Overall Leq	-	-	-	57	54	50	56	50	57	51	Attended noise monitoring results	
Date and time	L <sub>max</sub>			L <sub>Aeq</sub>			L <sub>A10</sub>		L <sub>90</sub>		Equipment photo	Notes
10 December 2021 15:52 to 16:07	79			56			59		45			<ul style="list-style-type: none"><li>– Road traffic noise along Boronia Street (intermittent) is dominant</li><li>– Quiet suburban street</li><li>– Cars ~55 to 65 dBA L<sub>Aeq</sub></li><li>– Bird noise ~53 dBA L<sub>Aeq</sub></li><li>– No trucks during measurements</li></ul>

**Table C.6**      *Logger J – 9 Hope Street, Ermington*




Date	ABL L <sub>90</sub> , dBA			Ambient L <sub>Aeq</sub> noise level, dBA			Road traffic L <sub>Aeq</sub> (period)		Road traffic – L <sub>Aeq</sub> (1hr)		Equipment details	Equipment settings
	Day	Eve	Night	Day	Eve	Night	D	N	D	N		
Friday-10-Dec-21	46	41	37	60	57	51	59	51	61	54	Svan 977 Type 1 SN: 36972  1.5 m above ground level 1m from the facade IEC 61672-3:2013 Compliant Manufactured prior 2019	A-weighted Fast time response 15 minute intervals  Pre and post calibration variation: -0.4 dBA Svantek SV30A Class 1 Sound level calibrator SN: 29030 AS 60942:2003 Compliant Manufactured prior 2017
Saturday-11-Dec-21	42	40	36	57	54	49	57	49	58	51		
Sunday-12-Dec-21	38	39	35	57	58	52	57	52	59	55		
Monday-13-Dec-21	44	41	37	58	57	52	57	52	59	55		
Tuesday-14-Dec-21	44	40	38	59	56	52	58	52	60	55		
Wednesday-15-Dec-21	43	43	36	58	58	51	58	51	59	55		
Thursday-16-Dec-21	45	40	35	58	56	51	58	51	59	53		
Friday-17-Dec-21	45	42	37	58	58	51	58	51	59	55	Equipment photo	Logger location
Saturday-18-Dec-21	39	39	36	64	58	49	63	49	66	53		
Sunday-19-Dec-21	38	37	36	55	54	52	54	52	57	56		
Monday-20-Dec-21	44	39	36	58	55	51	57	51	59	54		
Tuesday-21-Dec-21	42	39	36	59	55	50	58	50	59	54		
Wednesday-22-Dec-21	43	-	-	58	-	-	58	-	59	-		
RBL	43	40	36	-	-	-	-	-	-	-		
Overall Leq	-	-	-	59	56	51	58	51	59	55	Attended noise monitoring results	
Date and time	L <sub>max</sub>			L <sub>Aeq</sub>		L <sub>A10</sub>		L <sub>90</sub>		Equipment photo		Notes
10 December 2021 10:28 to 11:43	82			58		59		52				<ul style="list-style-type: none"><li>– Road traffic noise along Hope Street (intermittent) is dominant</li><li>– Distant traffic and construction noise</li><li>– Cars ~55 to 65 dBA L<sub>Aeq</sub></li><li>– Barking dogs and birds</li></ul>

**Table C.7**      *Logger K – 78 Lancaster Avenue, Melrose Park*

Date	ABL L <sub>90</sub> , dBA			Ambient L <sub>Aeq</sub> noise level, dBA			Road traffic L <sub>Aeq</sub> (period)		Road traffic – L <sub>Aeq</sub> (1hr)		Equipment details	Equipment settings	
	Day	Eve	Night	Day	Eve	Night	D	N	D	N			
Friday-10-Dec-21	41	38	35	50	47	44	49	44	51	48	Svan 977 Type 1 SN: 45743  1.5 m above ground level Free-field conditions IEC 61672-3:2013 Compliant Manufactured prior 2019	A-weighted Fast time response 15 minute intervals  Pre and post calibration variation: -0.1 dBA Svantek SV30A Class 1 Sound level calibrator SN: 29030 AS 60942:2003 Compliant Manufactured prior 2017	
Saturday-11-Dec-21	40	38	32	56	49	46	55	44	61	46			
Sunday-12-Dec-21	37	36	32	52	49	45	51	45	52	47			
Monday-13-Dec-21	36	36	33	53	47	43	52	43	56	47			
Tuesday-14-Dec-21	37	35	31	60	50	44	59	44	54	48			
Wednesday-15-Dec-21	37	37	30	57	51	43	56	43	56	47			
Thursday-16-Dec-21	38	36	30	52	47	42	50	42	52	46			
Friday-17-Dec-21	37	39	30	51	51	46	51	46	53	49	Equipment photo	Logger location	
Saturday-18-Dec-21	37	38	31	59	52	46	58	46	54	50			
Sunday-19-Dec-21	37	38	33	51	51	48	51	48	53	51			
Monday-20-Dec-21	37	36	32	53	52	46	53	46	57	49			
Tuesday-21-Dec-21	36	35	30	51	49	42	51	42	54	46			
Wednesday-22-Dec-21	36	-	-	50	-	-	50	-	52	-			
RBL	37	37	32	-	-	-	-	-	-	-			
Overall Leq	-	-	-	55	50	45	54	45	54	48			
Attended noise monitoring results													
Date and time	L <sub>max</sub>			L <sub>Aeq</sub>			L <sub>A10</sub>			L <sub>90</sub>		Equipment photo	Notes
10 December 2021 10:28 to 11:43 (At nearby park)	76			56			55			47			<ul style="list-style-type: none"><li>– Distant road traffic noise is dominant along with natural sounds such as birds</li><li>– Distant construction, aircraft, marine vessel noise</li><li>– Rock-hammering ~45 LAeq</li><li>– Truck passing ~65 dBA LAeq</li><li>– Intermittent car movements ~60 dBA LAeq.</li></ul>



**Table C.8**      *Logger L – 105/15 Hill Road, Wentworth Point*

Date	ABL L <sub>90</sub> , dBA			Ambient L <sub>Aeq</sub> noise level, dBA			Road traffic L <sub>Aeq</sub> (period)		Road traffic – L <sub>Aeq</sub> (1hr)		Equipment details	Equipment settings	
	Day	Eve	Night	Day	Eve	Night	D	N	D	N			
Friday-10-Dec-21	49	50	39	59	58	51	58	51	60	54	Svan 977 Type 1 SN: 97579  2.0 m above ground level Free-field conditions IEC 61672-3:2013 Compliant Manufactured prior 2019	A-weighted Fast time response 15 minute intervals  Pre and post calibration variation: 0.2 dBA Svantek SV30A Class 1 Sound level calibrator SN: 29030 AS 60942:2003 Compliant Manufactured prior 2017	
Saturday-11-Dec-21	48	47	39	64	57	52	63	53	60	57			
Sunday-12-Dec-21	45	47	38	57	57	50	57	50	58	55			
Monday-13-Dec-21	47	47	38	57	58	54	58	54	59	56			
Tuesday-14-Dec-21	48	47	38	58	57	51	58	51	60	54			
Wednesday-15-Dec-21	48	50	38	60	57	51	59	51	59	54			
Thursday-16-Dec-21	48	46	38	57	57	51	57	51	58	54			
Friday-17-Dec-21	48	49	39	58	57	51	58	51	59	54	Equipment photo	Logger location	
Saturday-18-Dec-21	46	48	38	57	57	50	57	49	58	53			
Sunday-19-Dec-21	46	45	39	56	56	50	56	50	57	54			
Monday-20-Dec-21	48	47	38	57	57	52	57	52	58	55			
Tuesday-21-Dec-21	48	47	38	57	57	50	57	50	58	54			
Wednesday-22-Dec-21	46			56			56	-	57	-			
RBL	48	47	38										
Overall Leq				59	57	51	58	51	58	54			
Attended noise monitoring results													
Date and time	L <sub>max</sub>			L <sub>Aeq</sub>			L <sub>A10</sub>			L <sub>90</sub>		Equipment photo	Notes
10 December 2021 09:40 to 09:55	75			58			60			50			<ul style="list-style-type: none"><li>– Road traffic noise along Hill Road is dominant</li><li>– Banging noise from wharf area ~62 dBA</li><li>– Pedestrian, cyclists and dogs on Hill Road</li><li>– Construction works nearby</li><li>– Garbage truck ~65 dBA L<sub>Aeq</sub></li><li>– Bus pass-by ~62-65 dBA L<sub>Aeq</sub></li><li>– Boat horns audible.</li></ul>



**Table C.9**      *Logger M – 286/33 Hill Road, Wentworth Point*




Date	ABL L <sub>90</sub> , dBA			Ambient L <sub>Aeq</sub> noise level, dBA			Road traffic L <sub>Aeq</sub> (period)		Road traffic – L <sub>Aeq</sub> (1hr)		Equipment details	Equipment settings	
	Day	Eve	Night	Day	Eve	Night	D	N	D	N			
Friday-10-Dec-21	56	53	35	64	63	57	64	57	65	59	Svan 977 Type 1 SN: 45746  1.5 m above ground on the 1st floor  Free-field conditions IEC 61672-3:2013 Compliant Manufactured prior 2019	A-weighted Fast time response 15 minute intervals  Pre and post calibration variation: 0.3 dBA Svantek SV30A Class 1 Sound level calibrator SN: 29030 AS 60942:2003 Compliant Manufactured prior 2017	
Saturday-11-Dec-21	48	50	36	63	62	57	62	57	63	60			
Sunday-12-Dec-21	48	51	35	62	62	57	62	57	63	60			
Monday-13-Dec-21	53	51	38	62	62	57	62	57	63	60			
Tuesday-14-Dec-21	54	52	39	63	62	58	63	58	64	60			
Wednesday-15-Dec-21	53	53	36	63	64	57	63	57	65	61			
Thursday-16-Dec-21	54	51	35	63	62	57	63	57	64	60			
Friday-17-Dec-21	53	54	39	63	63	58	63	58	64	61	Equipment photo	Logger location	
Saturday-18-Dec-21	52	54	37	63	62	57	63	56	64	59			
Sunday-19-Dec-21	50	50	39	62	62	58	62	58	63	60			
Monday-20-Dec-21	54	51	37	63	62	58	63	58	64	61			
Tuesday-21-Dec-21	53	50	36	63	63	57	63	57	64	60			
Wednesday-22-Dec-21	52	-	-	62	-	-	62	-	64	-			
RBL	53	51	36	-	-	-	-	-	-	-			
Overall Leq	-	-	-	63	63	57	63	57	64	60	Attended noise monitoring results		
Date and time	L <sub>max</sub>			L <sub>Aeq</sub>			L <sub>A10</sub>			L <sub>90</sub>		Equipment photo	Notes
10 December 2021 09:40 to 09:55	76			67			70			58			<ul style="list-style-type: none"><li>– Road traffic noise along Hill Road is dominant</li><li>– Medium truck ~70 dBA</li><li>– Bus stopping ~70 dB</li><li>– Bus accelerating 74 dB</li><li>– Urban noise environment</li><li>– Electric bus ~65 dBA.</li></ul>

Table C.10 Logger Q – 101/9 Australia Avenue, Sydney Olympic Park




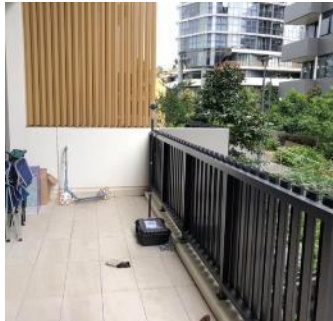

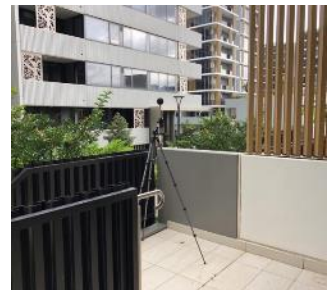
Date	ABL L <sub>90</sub> , dBA			Ambient L <sub>Aeq</sub> noise level, dBA			Road traffic L <sub>Aeq</sub> (period)		Road traffic – L <sub>Aeq</sub> (1hr)		Equipment details	Equipment settings	
	Day	Eve	Night	Day	Eve	Night	D	N	D	N			
Friday-10-Dec-21	52	49	42	60	59	55	60	55	62	58	Svan 977 Type 1 SN: 45746  2.0 m above ground on the 1st floor  Free-field conditions IEC 61672-3:2013 Compliant Manufactured prior 2019	A-weighted Fast time response 15 minute intervals  Pre and post calibration variation: 0.05 dBA Svantek SV30A Class 1 Sound level calibrator SN: 29030 AS 60942:2003 Compliant Manufactured prior 2017	
Saturday-11-Dec-21	48	48	43	59	60	56	59	56	60	58			
Sunday-12-Dec-21	46	47	41	58	58	55	58	55	59	59			
Monday-13-Dec-21	50	46	41	59	57	54	58	54	59	57			
Tuesday-14-Dec-21	50	47	40	58	58	53	58	53	59	56			
Wednesday-15-Dec-21	50	50	41	62	58	54	61	54	65	56			
Thursday-16-Dec-21	51	49	41	61	58	55	60	55	61	57			
Friday-17-Dec-21	50	49	40	59	59	54	59	54	60	56	Equipment photo	Logger location	
Saturday-18-Dec-21	48	49	42	59	60	54	59	54	61	57			
Sunday-19-Dec-21	47	47	41	58	59	54	58	54	59	58			
Monday-20-Dec-21	52	48	42	59	58	52	59	52	59	56			
Tuesday-21-Dec-21	51	48	40	59	58	57	59	57	60	57			
Wednesday-22-Dec-21	49	-	-	60	-	-	60	-	61	-			
RBL	50	48	41	-	-	-	-	-	-	-			
Overall Leq	-	-	-	59	59	55	59	55	60	57			
Attended noise monitoring results													
Date and time	L <sub>max</sub>			L <sub>Aeq</sub>			L <sub>A10</sub>			L <sub>90</sub>		Equipment photo	Notes
10 December 2021 10:42 to 10:57	82			58			59			52			<ul style="list-style-type: none"><li>– Road traffic noise along Australia Avenue is dominant</li><li>– Train pass-by ~70 dBA L<sub>Aeq</sub></li><li>– Truck unloading ~55 dBA L<sub>Aeq</sub></li><li>– Truck pass-by ~65 dBA L<sub>Aeq</sub></li><li>– Rail horn 82 dBA L<sub>Amax</sub>.</li></ul>

Table C.11 Logger R – 459/ 9 Grazier Street, Lidcombe

Date	ABL L <sub>90</sub> , dBA			Ambient L <sub>Aeq</sub> noise level, dBA			Road traffic L <sub>Aeq</sub> (period)		Road traffic – L <sub>Aeq</sub> (1hr)		Equipment details	Equipment settings	
	Day	Eve	Night	Day	Eve	Night	D	N	D	N			
Friday-10-Dec-21	54	50	44	58	54	49	56	49	59	51	Svan 977 Type 1 SN: 497530  1.5 m above ground Free-field conditions IEC 61672-3:2013 Compliant Manufactured prior 2019	A-weighted Fast time response 15 minute intervals  Pre and post calibration variation: -0.6 dBA Svantek SV30A Class 1 Sound level calibrator SN: 29030 AS 60942:2003 Compliant Manufactured prior 2017	
Saturday-11-Dec-21	50	48	45	60	53	49	59	49	61	51			
Sunday-12-Dec-21	46	47	43	52	52	48	51	48	53	50			
Monday-13-Dec-21	49	46	44	62	50	48	61	48	65	50			
Tuesday-14-Dec-21	52	46	44	61	52	48	60	48	64	50			
Wednesday-15-Dec-21	50	46	45	65	53	49	64	49	67	51			
Thursday-16-Dec-21	52	47	44	66	51	48	63	48	67	50			
Friday-17-Dec-21	53	49	46	63	53	49	61	49	65	50	Equipment photo	Logger location	
Saturday-18-Dec-21	48	48	45	60	51	48	59	48	63	51			
Sunday-19-Dec-21	47	48	46	59	53	50	57	50	59	52			
Monday-20-Dec-21	50	48	46	62	51	50	61	50	64	53			
Tuesday-21-Dec-21	50	47	46	60	52	49	59	49	62	50			
Wednesday-22-Dec-21	52	-	-	56	-	-	56	-	56	-			
RBL	50	48	45	-	-	-	-	-	-	-			
Overall Leq	-	-	-	61	52	49	60	49	63	51			
Attended noise monitoring results													
Date and time	L <sub>max</sub>			L <sub>Aeq</sub>			L <sub>A10</sub>			L <sub>90</sub>		Equipment photo	Notes
10 December 2021 11:18 to 11:33	82			66			68			61			<ul style="list-style-type: none"><li>Construction noise dominant ~65 to 70 dB LAeq</li><li>Very reverberant area due to reflection of buildings</li><li>Rock-breaking ~65 dBA</li><li>Dropping materials ~70 dBA.</li></ul>

## C-2 Construction noise modelling methodology

### C-2-1 Construction noise prediction method

Acoustic modelling was undertaken using SoundPLAN 8.2 noise modelling software to predict the effects of construction noise generated by the project. General parameters used in the model are listed in Table C.12.

Table C.12 Noise modelling parameters

Variable	Parameter used
Calculation method	ISO 9613- 2: Acoustics — Attenuation of sound during propagation outdoors — Part 2: General method of calculation (ISO, 1996)
Meteorology	Well-developed moderate ground based temperature inversion, such as commonly occurs on clear, calm nights or 'downwind' conditions which are favourable to sound propagation.
Topography	Sourced from ELVIS GIS Australia - 5 m elevation intervals
Receiver heights	1.5 m above the ground floor and +3.0 metres for every storey above
Ground absorption	0.00 for all waterbodies within the study area 0.00 at all areas in the Parramatta CBD (NCA-S) 0.50 for all other areas (0 is non-porous ground and 1 is porous ground such as that found in a rural setting comprising of mainly grass and vegetation)
Building footprints and heights	Sourced from Geoscape PSMA
Temperature	20 deg Celsius
Humidity	80%

### C-2-2 Noise generating equipment

The exact details of the construction methodology, plant or equipment for the project, such as the intensity of works, sound power levels or operating duration are not yet known therefore this assessment is based on a variety of conservative assumptions. This information would be refined during the next stages of design and construction planning. The magnitude of the noise levels associated with construction activities would be dependent upon several factors:

- the intensity and location of construction activities
- the type of equipment used
- existing local noise sources
- intervening terrain
- the prevailing weather conditions.

The indicative list of equipment assumed for each construction scenario is listed in Table C.13 and would be refined during the design development process.

Noise levels for equipment has been sourced from the CNVS, *AS 2436 Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites* (Australian Standards, 2010) and the GHD internal database where sound power level data was not available. The activity sound power level assumes the two loudest items of equipment for the sub-scenario are operating simultaneously and is representative of the worst-case construction activities occurring.

For each sub-scenario, noise intensive equipment has also been identified and include equipment that are considered to generate high noise emissions or equipment that contain special audible characteristics such as tonal or annoying qualities.

The  $L_{AFmax}$  level, equivalent to the  $L_{AF1(1 \text{ minute})}$ , used to assess potential sleep disturbance assessment is based on the loudest item of equipment for each sub-scenario that has been identified as requiring night work.

Where  $L_{AFmax}$  noise levels were not available, the following assumptions have been made to estimate the  $L_{AFmax}$  noise level:

- for continuous heavy machinery noise sources (e.g. compressors and generators), the  $L_{AFmax}$  noise level has been assumed to be 3 dB greater than the  $L_{Aeq(15min)}$  noise level
- for all other equipment,  $L_{AFmax}$  noise level has been assumed to be 8 dB greater than the  $L_{Aeq(15min)}$  noise level.



Table C.13 Detailed construction equipment and activity sound power levels

Plant Item					Asphalt Milling Machine	Ballast Regulator	Ballast Tamper	Track Laying Machine	Bobcat	Compressor	Concrete Pump	Concrete Saw	Rail Saw	Concrete Truck /	Elevated Working	Excavator (10 tonne)	Excavator (40 tonne)	Excavator (Breaker)	Franna Crane	Front End Loader	Generator	Hand Tools	Line Marking Plant	Mobile Crane (50 tonne)	Piling Rig (Impact) (3)	Roller (non-vibratory)	Semi Trailer	Slip Form Machine	Suction Truck	Truck (10 tonne)	Truck (25t)	Flatbed Truck	Dump Truck	Vibratory Roller (10 - 12t)	Welding Equipment	
Sound Power Level (LAeq)					117	118	118	114	104	109	109	118	121	106	97	100	115	121	98	112	103	98	108	113	125	107	108	102	109	103	103	108	110	109	110	
Minutes Used in Worst case 15 Minute Period (1)					15	15	15	15	15	15	7.5	5	5	7.5	15	15	15	7.5	15	15	15	15	15	15	7.5	15	5	15	15	15	15	15	15	15	15	15
Correction added for annoying characteristics (2)												5	5					5							5									5		
Modified Sound Power Level (LAeq)					117	118	118	114	104	109	106	118	121	103	97	100	115	123	98	112	103	98	108	113	127	107	103	102	109	103	103	108	110	114	110	
Sound Power Level (LAmax)					125	126			112	112		126	129			123	129							116	116	136									117	
Scenario	Activity description	Scenario ID	Activity SWL, Laeq(15 min)	Activity SWL, LAmax																																
Demolition	Removal works	S01.0 1	110						X												X	X								X						
	Demolition and clearing	S01.02	123						X									X			X	X								X	X					
	Removal works at the Sandown Line	S01.3	121	129 (Rail Saw)					X			X									X	X								X						
Compounds	Site Establishment	S02.01	117							X			X						X					X		X				X			X	X		
	Services & Utilities	S02.02	120					X			X						X											X	X							
	Site Deliveries	S02.03	115																X					X								X				
Spoil & Ballast	Screening & Crushing	S03.01	117	123 (Excavator)													X			X												X				
Substations	Site Establishment	S04.01	113																X					X						X						
	Construction & Installation	S04.02	114							X			X		X				X					X			X		X	X	X	X				
Mainline - Track works SaMF to Carter St	Earthworks	S05.01	116														X				X							X	X		X					
	Earthworks (with Breaker/saw)	S05.02	123								X						X	X			X									X		X				
	Concrete Works	S05.03	114	116 (Mobile Crane)						X			X						X					X						X		X				
	Trackworks	S05.04	122	129 (Rail Saw)				X					X							X			X		X					X		X			X	
	Trackworks - Tamping	S05.05	121			X	X																													
	Steel Erection & Wiring	S05.06	114													X				X			X		X		X			X		X				
SaMF - carpark and ballast track	Earthworks (carpark and track)	S06.01	118	123 (Excavator)													X														X	X		X		
	Concrete Works (carpark and track)	S06.02	114	116 (Mobile Crane)						X			X						X					X				X	X		X					
	Trackworks (track only)	S06.03	123	129 (Rail Saw)		X	X	X					X				X			X			X								X	X			X	
	Steel Erection & Wiring (carpark and track)	S06.05	114													X				X			X			X				X		X				
Stops	Concrete Works	S07.01	114							X			X						X			X		X						X						
	Finishing Works	S07.02	115													X		X		X			X				X			X						
Bridges	Site Establishment	S08.01	114																	X					X					X						
	Pilling - including temporary jetties	S08.02	127	116 (Mobile Crane)																					X	X					X					
	Construction & Installation	S08.03	113	116 (Mobile Crane)																X					X			X			X					
	Concrete Works	S08.04	114								X			X						X			X		X						X					
Off corridor roadworks	Excavation	S09.01	115														X														X	X				
	Excavation (with Breaker)	S09.02	124														X	X													X					
	Pavement Works	S09.03	118	125 (Asphalt Milling Machine)	X			X		X			X								X					X		X		X	X					
	Signage and Line Marking	S09.04	109	116 (Line Marking Plant)																X			X	X						X						

Notes  
(1) This refers to the amount of time in minutes that individual items of equipment would be in use for during the worst-case 15 minute assessment period, based on site observations. Some items of plant, such as rockbreakers and semi-trailers, are not typically used in a continuous manner.  
(2) The ICNG requires that activities identified as particularly annoying (such as jackhammering, rockbreaking and power saw operation) have a 5 dB 'penalty' added to predicted noise levels when using the quantitative method.  
(3) Based on Lmax level 136 dBA

## C-3 Operational airborne noise modelling methodology for light rail vehicles

### C-3-1 Light rail vehicle source noise levels

Source noise levels for the Urbos light rail vehicles have been sourced from the Parramatta Light Rail Operational Noise and Vibration Review and were determined using the method outlined in Chapter 5 of *Railway Traffic Noise – The Nordic Prediction Method*. Attended measurements results from light rail vehicle pass-by measurements on the Canberra Light Rail and Dulwich Hill Light Rail lines were used to validate the source noise levels as part of the design development process for Parramatta Light Rail Stage 1.

A normalised Sound Exposure Level (SEL) in each octave-band was calculated for various light rail vehicle pass-bys to determine 'a' and 'b' values to be used in the noise modelling. These values are presented in Table C.14. The measurements suggest that low-frequency noise generated by light rail vehicle pass-bys in the 16 to 125 Hz octave-bands are considered insignificant and have not been included in the noise modelling.

Table C.14 Light rail vehicle ballast track noise source emission data

Frequency, Hz	a	b
250	10.6	24.4
500	12.5	29.7
1000	17.6	28.8
2000	10.4	20.9
4000	18.4	15.7
8000	16.8	7.2

Based on these 'a' and 'b' values, the predicted SEL and  $L_{AFmax}$  levels from a 45 metres long light rail vehicle at 7.5 metres are listed in Table C.15. A + 3 dB correction has been applied to account for the higher airborne noise levels generated from embedded concrete, paved or turf tracks.

Table C.15 Light rail vehicle ballast track noise source emission data

Track type	light rail vehicle length	Speed	Distance	light rail vehicle pass-by noise level, dBA	
				SEL	L <sub>Amax</sub>
Embedded track (concrete, paved or turf)	45 m	60 km/hr	7.5 m	85	83
Ballast	45 m	60 km/hr	7.5 m	82	80

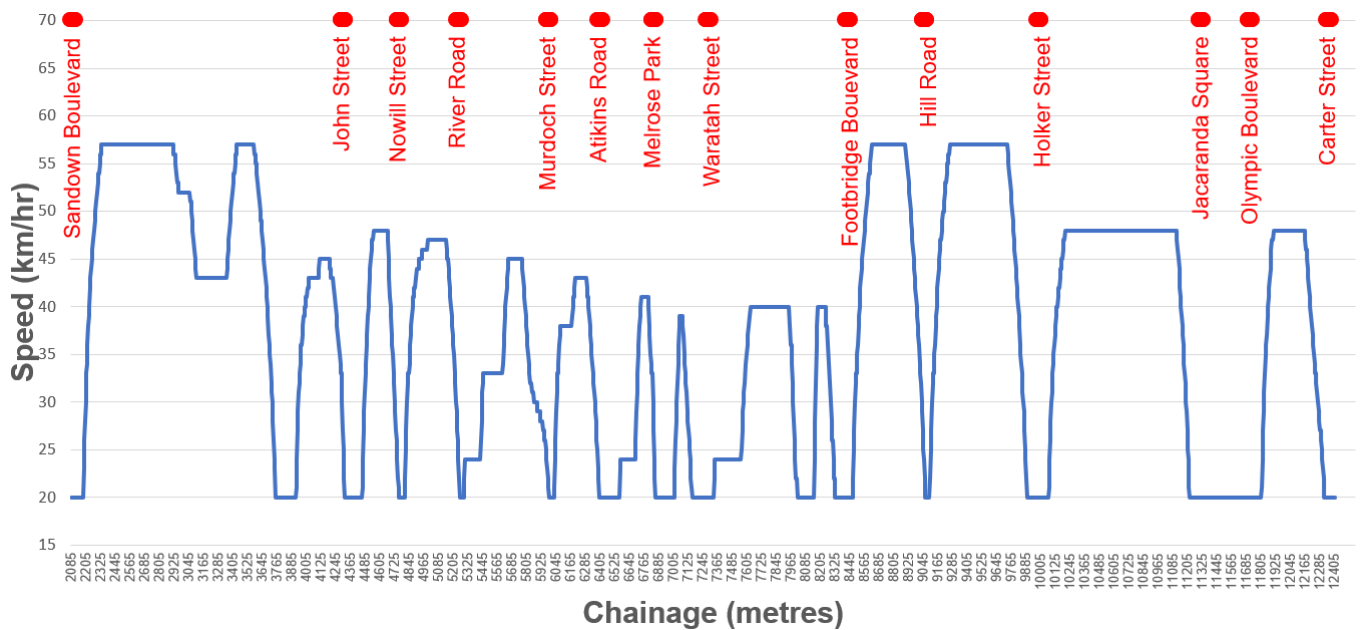
### C-3-2 Noise modelling assumptions and corrections applied

#### Light rail vehicle speeds

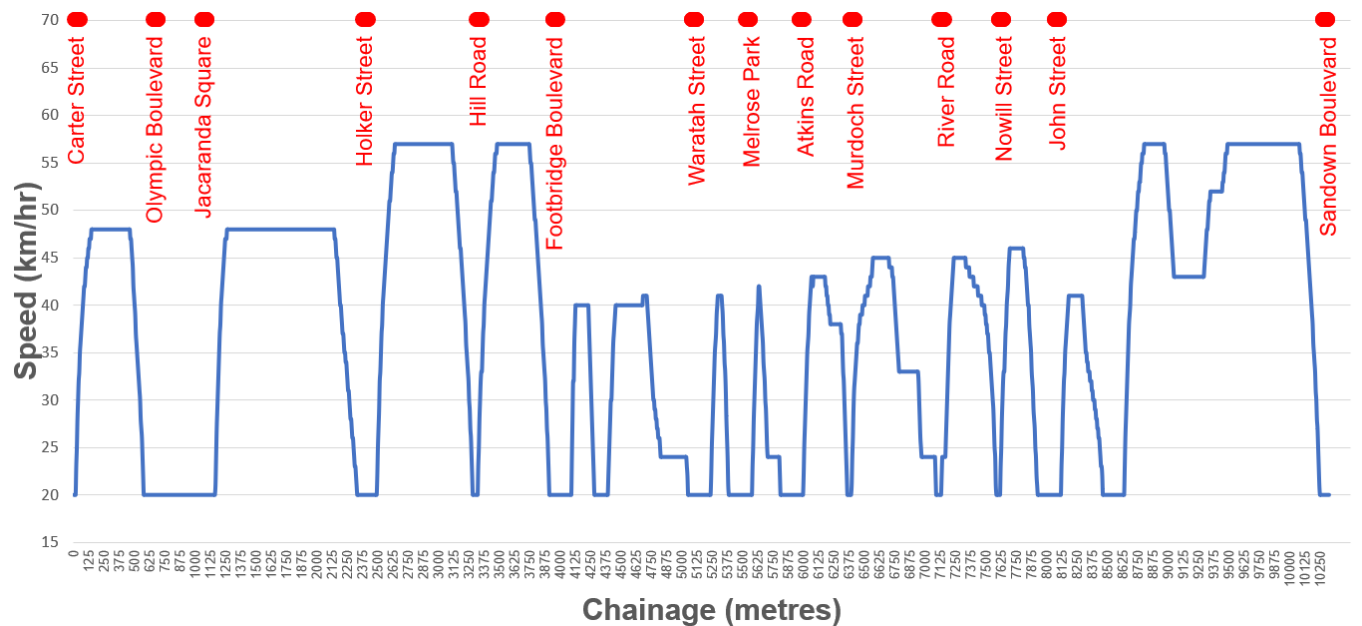
The light rail vehicle speeds along the up and down line used for modelling purposes are shown in the figures below. It is noted that the speed profiles used in the assessment assume that light rail vehicles are not interrupted at any signalised intersections on the alignment. This approach is conservative, as in reality light rail vehicles would be likely to stop at intersections at times with a resultant reduction in speed (and noise emissions) on both approach and departure from the intersection.

A minimum speed of 20 km/hr has been used in the modelling and corrections have been applied in the noise model to account for the minimum speed applied by the NMT algorithm in SoundPLAN. As vehicle speed decreases below 20 km/h, noise from auxiliary systems becomes more dominant than rolling noise. These sources produce a relatively steady overall noise level that is independent of speed. While stationary the steady noise level from auxiliary systems is estimated to be 60 dBA at 7.5 metres from the track centreline and 1.2 metres above ground.

The modelled speeds for the down and up track are shown in the Figure C.1 and Figure C.2.



**Figure C.1** Light rail vehicle speed profile – Down line (Sandown Boulevard to Carter Street)



**Figure C.2** Light rail vehicle speed profile – Up line (Carter Street to Sandown Boulevard)

### Light rail vehicle volumes

The light rail vehicle volumes are consistent with the service requirements for Stage 1. Note should be made that light rail vehicle volumes along the section of track shared by Stage 1 and Stage 2 light rail vehicles would double as a result of the project, as shown in Table C.16.

**Table C.16**      *Light rail vehicle volumes used in the noise modelling*

Scenario	Day (7:00 am to 10:00 pm)		Night (10:00 pm to 7:00 am)		Hourly maximum (day)		Hourly maximum (night)	
	Up	Down	Up	Down	Up	Down	Up	Down
<b>Parramatta turnback facility to stabling and maintenance facility (Stage 1 and Stage 2 light rail vehicles)</b>								
Opening typical operations (2024)	228	228	52	52	16	16	12	12
Future typical operations (2034)	248	248	52	52	20	20	12	12
Special events (2024)	296	296	84	84	40	40	40	40
Special events (2034)	316	316	84	84	40	40	40	40
<b>Stabling and maintenance facility to Carter Street (Stage 2 light rail vehicles only)</b>								
Opening typical operations (2024)	114	114	26	26	8	8	6	6
Future typical operations (2034)	124	124	26	26	10	10	6	6
Special events (2024)	148	148	42	42	20	20	20	20
Special events (2034)	158	158	42	42	20	20	20	20

### Low speed noise emission

A minimum speed of 20 km/h has been applied in the noise model as the Nordic Prediction Method used for calculations does not produce accurate predictions at low speeds where pass-by noise is dominated by light rail vehicle equipment noise sources.

### Rail surface and wheel tread condition

It is assumed that light rail vehicle wheel and rail roughness condition would be maintained to conform with international best practices.

### Buildings footprints and heights

Building footprint and height data has been sourced from Geoscape PSMA. Receivers have been modelled at 1.5 metres above ground level and for multi-storey buildings, each storey has been modelled at three metres high (receivers modelled at 1.5 metres above the floor level of each storey).

### Future rail alignment

The 3-dimensional track centre alignments for each track have been provided by the project team. The track centrelines have been entered into the noise model in five metres segments and the kerb heights have been estimated based on the centre track height. The kerb and adjacent road interface is yet to be designed in 3-dimensional and as such, have not yet been included in the noise modelling. Once these components have been designed, they would be incorporated in the updated 3-dimensional noise model during the development design process to ensure an accurate representation of the terrain between the track and the nearest receivers.

### Digital ground terrain model

For the area within 150 metres from the rail alignment 1 metre LiDAR elevation data was sourced from NSW Government – Spatial Services and the remaining study area are utilising 5 metre elevation data (derived from LiDAR) sourced from Geoscience Australia.

### Ground absorption

A ground absorption co-efficient of 0.5 has been used (hard ground/reflecting surface = 0 and large areas of grass vegetation = 1) for the study area. A ground absorption co-efficient of 0 has been used for the areas within five metres of the rail alignment.

## Atmospheric conditions

Atmospheric conditions of 20 degrees Celsius and 70 percent humidity were used in the noise modelling with neutral weather conditions.

## Corrections applied to the track

The corrections applied to the track to account for noise associated with structure-radiated noise from bridges, additional noise from an embedded track, crossovers/turnouts and curves/flanging noise are shown in Table C.17 and are consistent with the corrections applied in the design development for Parramatta Light Rail Stage 1.

Subsequent to compliance noise monitoring undertaken for Stage 1, these corrections would be refined to take into account any discrepancies found between the measured noise levels and the predicted noise levels, where appropriate.

**Table C.17** Noise corrections applied to the track

Type	Approx. chainage (down), m		Approx. chainage (up), m		Correction applied, dB (L <sub>Aeq</sub> and L <sub>Amax</sub> )	Notes/Assumptions
	Start	End	Start	End		
Bridges						
Bridge between Camellia and Rydalmere (new)	3990	4235	8165	8405	+ 3	Embedded slab track on concrete bridge
Bridge over Silverwter Road (new)	4985	5115	7290	7420	+ 3	Embedded slab track on concrete bridge
Bridge in Ken Newman Park (new)	5560	5615	6790	6845	+ 3	Embedded slab track on concrete bridge
Bridge between Melrose Park and Wentworth Point (new)	7425	7830	4580	4985	+ 3	Embedded slab track on concrete bridge
Hill Road Bridge	9405	9520	2895	3010	+ 3	Embedded slab track on concrete bridge
Holker Busway bridge (existing)	10130	10375	2035	2280	+ 3	Embedded slab track on concrete bridge
Trackform						
Entire Parramatta Light Rail Stage 2 track	2085	12415	0	10320	+3	Assumed as embedded trackform (worst-case)
Crossovers and turn-outs						
Camellia	2210	2215	10215	10220	+6	Applied over 10 m section
Camellia	2715	2720	9690	9695	+6	Applied over 10 m section
Camellia	2825	2830	9585	9590	+6	Applied over 10 m section
Ermington	6505	6510	5890	5920	+6	Applied over 10 m section
Wentworth Point	9125	9130	3305	3310	+6	Applied over 10 m section
Sydney Olympic Park	11370	11400	1015	1045	+6	Applied over 10 m section



Type	Approx. chainage (down), m		Approx. chainage (up), m		Correction applied, dB ( $L_{Aeq}$ and $L_{Amax}$ )	Notes/Assumptions
	Start	End	Start	End		
Carter St	12300	12330	85	115	+6	Applied over 10 m section
Curves/flanging noise						
Curve 1	2950	3050	9455	9355	+3	350 m radius
Curve 2	3100	3320	9305	9085	+3	200 m radius
Curve 3	3750	3880	8655	8525	+8	50 m radius
Curve 4	3990	4070	8415	8335	+3	200 m radius
Curve 5	4210	4270	8195	8135	+3	200 m radius
Curve 6	4340	4420	8065	7985	+8	25 m radius
Curve 7	5300	5400	7105	7005	+8	85 m radius
Curve 8	5450	5570	6955	6835	+3	115 m radius
Curve 9	6060	6125	6345	6280	+3	150 m radius
Curve 10	6320	6400	6085	6005	+3	200 m radius
Curve 11	6500	6650	5905	5755	+8	50 m radius
Curve 12	6870	6965	5535	5440	+8	35 m radius
Curve 13	7155	7270	5250	5135	+8	50 m radius
Curve 14	7380	7540	5025	4865	+8	100 m radius
Curve 15	7740	7820	4665	4585	+3	150 m radius
Curve 16	8000	8200	4405	4205	+8	50 m radius
Curve 17	8205	8300	4200	4105	+3	150 m radius
Curve 18	8305	8405	4100	4000	+8	25 m radius
Curve 19	9885	10000	2520	2405	+3	25 m radius
Curve 20	11210	11330	1195	1075	+8	25 m radius

## C-4 Operational ground-borne noise and vibration modelling methodology

### C-4-1 Light rail vehicle source vibration levels

Source vibration data for the Urbos light rail vehicles has been referenced from the Parramatta Light Rail Stage 1 *Ground-borne Noise and Vibration Report* (Parramatta Light Rail report, WSPAJV, 2021). Source vibration levels in the PC Parramatta Light Rail report were calculated by adjusting measurements from the nominated light rail vehicles in Zaragoza, Spain to take into account the track characteristics for Parramatta Light Rail. The PC Parramatta Light Rail report also provides source vibration spectra for 'high' and 'very high' attenuation embedded slab tracks, corresponding to embedded slab tracks with higher resilience utilising special boots. The data should be confirmed via measurements on Stage 1 track as part of the design development process.

The source vibration spectrum for normal embedded slab track from the PC Parramatta Light Rail report is provided in Table C.18, at eight metres from track centreline, and a reference speed of 30 km/h. The vibration spectra is for rms vibration levels and suitable for the calculation of cumulative vibration exposure (i.e. eVDV values). For ground-borne noise calculations, an additional 3 dB has been added to the provided values to account for the ground-borne noise criteria as a maximum noise level.

**Table C.18** *Light rail vehicle embedded track vibration emission data (Source: PC Parramatta Light Rail report, 2021), at 30 km/h and 8 m from track centreline*

Frequency, Hz	Normal embedded slab track, dBV
1	55
1.25	55
1.6	54
2	48
2.5	48
3.15	48
4	46
5	48
6.3	47
8	51
10	55
12.5	57
16	57
20	57
25	66
31.5	72
40	77
50	82
63	83
80	82
100	92
125	86
160	80
200	77

Frequency, Hz	Normal embedded slab track, dBV
250	74
Overall	94

## C-4-2 Ground-borne noise and vibration modelling assumptions

Ground-borne noise and vibration modelling was undertaken using the method described in the US Federal Transit Administration's (FTA) *Transit Noise and Vibration Impact Assessment Manual* (FTA, 2018) and guidance provided in *ISO 14837-1 Mechanical vibration – Ground-borne noise and vibration arising from rail systems*.

This approach applies several adjustments to the source vibration levels to account for operational speeds, damping associated with ground attenuation, coupling losses through the building, floor amplifications and conversion to ground-borne noise. These adjustments are further discussed below.

### Speed correction

A 20 log (speed/reference speed) has been applied to the light rail vehicle source vibration levels to account for the variance in speed along the alignment.

It is noted that the speed profiles used in the assessment assume that light rail vehicles are not interrupted at any signalised intersections on the alignment. This approach is conservative, as in reality light rail vehicles would be likely to stop at intersections at times with a resultant reduction in speed on both approach and departure from the intersection.

### Ground attenuation

Ground attenuation due to geometrical spreading and material damping has been calculated separately using the following methods:

- For attenuation due to geometrical spreading of surface waves, a  $10 \cdot \log(\text{distance}/\text{reference distance})$  correction has been applied.
- For material damping through the soil, the approach outlined in the PC Parramatta Light Rail report has been adopted which is based on *A Frequency Dependent Soil Propagation Model* (Amick, 1999). The attenuation for each frequency is calculated using the following formula:  $8.68\rho\pi fD$ , where  $f$  is the frequency,  $D$  is the distance from the reference source measurement location to the receiver and  $\rho$  is a material dependent constant (i.e. a property of the ground). A value of 0.00013 has been chosen for  $\rho$ , consistent with the PC Parramatta Light Rail assessment.

### Soil to building foundation coupling losses

The additional attenuation in vibration arising from the transmission of vibration from the ground to the building foundation has been based on the US FTA manual (2018). The manual provides coupling losses for five categories of structures:

- single family residential
- 1 to 2 storey residential
- 2 to 4 storey masonry building on spread
- large masonry building on piles
- large masonry building on spread footings.

As the structural weight increases, the coupling loss also increases. As a detailed classification of all sensitive receivers into these categories has not been undertaken at this stage of the assessment process, the following conservative assumptions were applied:

- the '1 to 2 storey residential' coupling loss was applied to all residential sensitive receivers
- the 'large masonry building on piles' coupling loss was applied to all other receivers.

## Building floor resonance

The additional amplification within the building due to resonances of floors, walls and ceilings has been based on the US FTA manual (2018). The manual recommends a 6 dB adjustment to the calculated levels.

## Floor to floor attenuation

Results have only been predicted at the ground floor. This is considered to be conservative as the additional dispersion and attenuation of vibration energy on higher floors is typically taken into account via a 1 to 2 dB reduction per floor.

## Corrections applied to the track

The corrections applied to the track to account for noise associated with crossovers/turnouts have been conservatively retained for ground-borne noise and vibration calculations.

## eVDV calculation

The estimated Vibration Dose Value (eVDV) approach has been adopted for the purposes of estimate cumulative vibration exposure over the day and night time periods. The eVDV from a single pass-by is calculated as follows:

$$\text{eVDV} = 0.07 * V_{\text{rms}} * t^{0.25} \text{ m/s}^{1.75}$$

Where  $V_{\text{rms}}$  is the root mean square vibration in mm/s from the pass-by and  $t$  is the pass-by duration.

The eVDV approach is valid for vibration sources with crest factors below 6. The US FTA manual notes that *“for ground-borne vibration from trains, the crest factor is usually 4 to 5”*.

## Ground-borne noise corrections

The final calculated ground-borne vibration levels (in each one-third spectral band) were further adjusted:

- by +3 dB to convert the rms vibration source values to LAmax values suitable for comparison with the ground-borne noise criteria
- by -27 dB to convert ground-borne vibration levels to ground-borne noise levels using the widely used and accepted Kurzweil equation
- the final ground-borne noise values were A-weighted and log-summed.

For comparison against the airborne noise predictions, a 25 dB external-to-internal loss was applied to the predicted LAmax airborne noise levels, excluding any airborne noise façade corrections. Furthermore, a -2 dB correction was applied to convert the ‘fast’ weighted airborne noise levels to enable comparison with the ‘slow’ weighted ground-borne noise levels. The comparison was undertaken at each façade of the sensitive receiver.

## C-5 Operational airborne noise modelling methodology for substations

### C-5-1 Substation noise sources

It has been assumed that items of plant equipment for each traction power substation (TPS) would be consistent with Stage 1 as shown in Table C.19.

**Table C.19** Sound level data – traction power substations

Item	Location	Number	Sound pressure level, dBA	Sound power level, dBA
Rectifier transformer	Internal	1 per TPS	< 63 dBA @ 1m	< 82
Auxiliary transformer	Internal	1 per TPS	< 63 dBA @ 1m	< 80
Indoor A/C unit	Internal	10 per TPS	53 dBA @ 1m	66
Outdoor A/C unit	External	10 per TPS	56 dBA @ 1m	70

As the transformers are housed inside buildings and are not classed as a significant noise source, noise from transformers are anticipated to be negligible at nearby receivers. As such, the dominant noise source from each substation has been determined to be the outdoor A/C units.

To model noise emission from these A/C units, 10 A/C units at a sound power level of 70 dBA each has been assumed at each substation (an area source with a sound power level of 80 dBA).

### C-5-2 Noise modelling methodology

Acoustic modelling was undertaken using SoundPLAN 8.2 noise modelling software to predict indicative environmental noise levels at the nearest sensitive receivers to the substations during operation. The general parameters used in the noise model are presented in Table C.20.

**Table C.20** Noise modelling parameters

Variable	Parameter used
Software	SoundPLAN 8.2
Calculation method	ISO 9613-2: Acoustics — Attenuation of sound during propagation outdoors – Part 2: General method of calculation
Topography	1 m LiDAR elevation data was sourced from NSW Government – Spatial Services
Receiver heights	1.5 m above the ground floor and +3.0 m for every storey above
Ground absorption	0.0 for areas within 5 m of the edge of the rail track and 0.5 for all other areas (0 is non-porous ground such as concrete and 1 is porous ground such as grass)
Building footprints and heights	Sourced from Geoscape PSMA
Temperature	20 deg Celsius
Humidity	80%
Number of reflections	1 reflection from surrounding structures
Noise source type	Each traction power substation has been modelled as an area source with a sound power level of 80 dBA at 3 m above the ground level at each site.



## C-6 Construction road traffic assessment methodology

The potential noise impacts from construction related traffic associated with the project have been assessed through comparison of the estimated pre-construction traffic volumes (2025) and the peak construction traffic volumes (2025) along the surrounding road network. It has been assumed that the increase in noise level at sensitive receivers along major roads such as James Ruse Drive, Victoria Road and Silverwater Road would be negligible during the construction period due to the existing high traffic volumes along these roads.

The pre-construction and duration construction traffic volumes on sub-arterial, collector and local road haulage routes have been used to determine where potentially noticeable increases in road traffic noise (i.e. a greater than 2.0 dB increase) may be apparent due to construction related traffic movements and redistribution of traffic due to temporary road closures.

Due to limited information being made available, the following assumptions have been made to estimate the pre-construction and during-construction traffic volumes:

- 2019 Base Case volumes have been expanded from 2-hour Strategic Model volumes using Daily Expansion Factors.
- Sub-arterial road and collector volumes are total 7am to 10pm (15 hour) and 10pm to 7am (9 hour) volumes. Local road volumes are based on one hour peak volumes.
- Construction volumes are for the construction peak in 2025. The following assumptions have been made:
  - 15 hour Day period = 62.5% of Daily trips
  - 9 hour Night period = 37.5% of Daily trips.
- Side streets traffic volumes in Rydalmere have been extrapolated from 2026 volumes (side-street traffic counts) and assumes:
  - Heavy vehicles are 3.5% of total traffic
  - Light vehicle growth is 25% from 2017-2026
  - Heavy vehicles growth is 65% from 2017-2026.

The traffic volumes are presented in Table C.21 (sub-arterial and collector roads) and Table C.22 (local roads) below.

Calculations have been made using the CoRTN prediction method to estimate the increase in noise level at the nearest sensitive receivers to the impacted roads during the construction period. Where the increase is predicted to be greater than 2 dB, calculations have been undertaken to determine the noise level at the most-affected sensitive receivers and compared against the RNP controlling noise criteria for sub-arterial/collector roads and for local roads.

Where a greater than 2 dB increase is predicted and the RNP controlling noise criteria is exceeded, mitigation strategies have been recommended to reduce potential noise impacts.

Further investigation of construction traffic should be undertaken during the design development process.

**Table C.21**      *Estimated traffic volumes (pre-construction and during-construction) – sub-arterial/collector roads*

Road	Road Section Start	Road Section End	Road type	Existing traffic – Day (15 hour)		Existing – Night (9 hour)		Existing speed, km/hr		Additional construction traffic – day (15 hour)		Additional construction traffic – night (9 hour)	
				LV	HV	LV	HV	Day	Night	LV	HV	LV	HV
South Street	Park Road, Rydalmere	John Street	DGA	7256	189	1454	44	50	50	10	18	6	11
South Street	John Street	Patricia Street	DGA	6257	183	1253	43	50	50	11	55	7	33
South Street	Patricia Street	Nowill Street	DGA	5949	174	1191	41	50	50	11	55	7	33
South Street	Nowill Street	Primrose Street	DGA	5920	173	1185	40	50	50	11	55	7	33
South Street	Primrose Street	Fallon Street	DGA	5913	180	1184	42	50	50	11	55	7	33
South Street	Fallon Street	Silverwater Road	DGA	6060	184	1213	43	50	50	11	55	7	33
South Street	Silverwater Road	River Road, Ermington	DGA	1057	32	212	7	50	50	11	55	7	33
Boronia Street	Spurway Street/Broad Oaks Street	Honor Street	DGA	5877	876	1150	204	50	50	31	25	19	15
Boronia Street	Honor Street	Trumble Avenue	DGA	5988	893	1171	208	50	50	31	25	19	15
Boronia Street	Trumble Avenue	Boyle Street	DGA	5662	844	1107	196	50	50	31	25	19	15
Boronia Street	Boyle Street	Murdoch Street	DGA	5642	841	1104	196	50	50	31	25	19	15
Boronia Street	Murdoch Street	Spofforth Street	DGA	5703	807	1117	188	50	50	31	25	19	15
Boronia Street	Spofforth Street	Trumper Street	DGA	5728	810	1122	189	50	50	31	25	19	15
Boronia Street	Trumper Street	Atkins Road, Ermington	DGA	5482	776	1074	180	50	50	31	25	19	15
Atkins Road	Boronia Street	Hope Street	DGA	6002	750	1180	174	50	50	31	25	19	15
Hope Street	Atkins Road, Ermington	Hughes Avenue	DGA	8780	1181	1724	275	50	50	31	25	19	15
Hope Street	Hughes Avenue	Waratah Street	DGA	10792	383	2157	89	50	50	31	25	19	15
Hope Street	Waratah Street	Wharf Road/Lancaster Avenue, Melrose Park	DGA	9064	321	1812	75	50	50	31	25	19	15
Wharf Road	Hope Road/Lancaster Avenue	Mary Street	DGA	8451	210	1693	49	50	50	93	70	56	42
Wharf Road	Mary Street	Andrew Street	DGA	9339	232	1871	54	50	50	93	70	56	42
Hill Road	Burroway Road/Footbridge Boulevard, Wentworth Point	Nuvolari Place	DGA	12335	131	2477	30	60	60	14	52	8	31
Hill Road	Nuvolari Place	Baywater Drive	DGA	15587	165	3130	38	60	60	14	52	8	31
Hill Road	Baywater Drive	Stromboli Strait	DGA	17802	189	3575	44	60	60	14	52	8	31
Hill Road	Stromboli Strait	Bennelong Parkway	DGA	18785	199	3772	46	60	60	14	52	8	31
Hill Road	Bennelong Parkway	Holker Street, Sydney Olympic Park	DGA	20929	208	4203	48	60	60	14	52	8	31
Spurway Street	Boronia Street	Tristram Street	DGA	4863	611	956	142	50	50	80	60	48	36
Spurway Street	Tristram Street	Victoria Road	DGA	5033	539	993	125	50	50	80	60	48	36
Atkins Road	Hope Street	Victoria Road	DGA	3349	428	660	100	50	50	35	6	21	3
Hughes Avenue	Hope Street	Victoria Road	DGA	1435	206	282	48	50	50	1	0	1	0
Wharf Road	Hope Street	Victoria Road	DGA	6244	340	1243	79	50	50	93	70	56	42
Kevin Coombs Avenue	Australia Avenue	Old Hill Link	DGA	8091	497	1613	116	60	60	0	1	0	0
Old Hill Link	Edwin Flack Avenue	Hill Road	DGA	671	60	602	60	60	60	0	1	0	0

**Table C.22**      *Estimated traffic volumes (pre-construction and during-construction) – local roads*

Road	Road Section Start	Road Section End	Road type	Existing traffic – Day (1 hour)		Existing traffic – Night (1 hour)		Existing speed, km/hr		Additional construction traffic – Day (1 hour)		Additional construction traffic – Night (1 hour)	
				LV	HV	LV	HV	Day	Night	LV	HV	LV	HV
Grand Avenue	James Ruse Drive/Hassall Street	ALDI Access/Rosehill Gardens Gate 1 Access	DGA	845	62	748	71	60	60	165	9	165	9
Grand Avenue	ALDI Access/Rosehill Gardens Gate 1 Access	Durham Street	DGA	489	36	433	41	60	60	165	9	165	9
Grand Avenue	Durham Street	Thackeray Street/Unnamed Road	DGA	159	12	141	13	60	60	165	9	165	9
Holker Busway	Holker Street	Kevin Coombs Avenue/Marjorie Jackson Parkway	DGA	1	0	1	0	60	60	5	20	3	12
Australia Avenue	Kevin Coombs Avenue/Marjorie Jackson Parkway	Grand Parade	DGA	822	38	733	44	60	60	5	18	3	11
Australia Avenue	Grand Parade	Murray Rose Avenue	DGA	849	43	755	49	60	60	5	18	3	11
Australia Avenue	Murray Rose Avenue	Dawn Fraser Avenue	DGA	977	49	870	56	60	60	5	18	3	11
Australia Avenue	Dawn Fraser Avenue	Parkview Drive/Herb Elliott Avenue	DGA	1021	68	906	79	60	60	5	18	3	11
Dawn Fraser Avenue	Australia Avenue	Park Street	DGA	125	14	110	16	60	60	5	18	3	11
Dawn Fraser Avenue	Park Street	Showground Road	DGA	225	25	197	29	60	60	5	18	3	11
Dawn Fraser Avenue	Showground Road	Olympic Boulevard	DGA	270	42	234	48	60	60	5	18	3	11
Dawn Fraser Avenue	Olympic Boulevard	Edwin Flack Avenue, Sydney Olympic Park.	DGA	598	79	537	79	60	60	2	2	2	2
Uhrig Road	Edwin Flack Avenue, Sydney Olympic Park.	Carter Street	DGA	306	93	274	93	50	50	9	9	9	9
Access	Uhrig Road/Carter Street	M4 Motorway	DGA	918	109	824	108	50	50	9	9	9	9
John Street	South Street	Antoine Street	DGA	46	2	41	2	50	50	4	8	4	8
John Street	Victoria Road	Gladys Street	DGA	87	3	78	3	50	50	1	0	1	0
Fallon Street	South Street	John Street	DGA	21	1	19	1	50	50	16	2	16	2
Fallon Street	Primrose Avenue	South Street	DGA	20	1	18	1	50	50	16	2	16	2
Primrose Avenue	South Street	John Street	DGA	53	2	47	2	50	50	34	2	34	2
Primrose Avenue	Victoria Road	South Street	DGA	92	4	82	4	50	50	34	2	34	2
River Road	Lindsay Avenue	South Street	DGA	223	9	200	9	50	50	26	1	26	1
River Road	South Street	Victoria Road	DGA	299	12	268	12	50	50	26	1	26	1
Hilder Road	Lindsay Avenue	Tristram Street	DGA	59	2	53	2	50	50	19	1	19	1
Hilder Road	Tristram Street	Coffey Street	DGA	87	3	78	3	50	50	35	4	35	4

## C-7 Operational road traffic assessment methodology

The potential noise impacts associated with changes in noise levels along public roads as a result of the project have been assessed through comparison of the no-build traffic volumes and the 'build' traffic volumes along the surrounding road network. Traffic volumes are based on available traffic modelling data being for 2031 and assumes the Sydney Metro West project is operational.

It has been assumed that the increase in noise level at sensitive receivers along major roads such as James Ruse Drive, Victoria Road and Silverwater Road would be negligible during the construction period due to the existing high traffic volumes along these roads.

The 'no build' and 'build' construction traffic volumes on sub-arterial, collector and local road haulage routes have been used to determine where potentially noticeable increases in road traffic noise (i.e. a greater than 2.0 dB increase) may be apparent as a result of the changes in road traffic conditions associated with the project.

Due to limited information available, various side streets (e.g. side streets in Rydalmere) have not been included in the assessment as no information has been made available for these local roads.

The traffic volumes are presented in Table C.23 (sub-arterial and collector roads) and Table C.24 (local roads) below.

Calculations have been made using the CoRTN prediction method to estimate the increase in noise level at the nearest sensitive receivers to the impacted roads during the construction period. Where the increase is predicted to be greater than 2 dB, calculations have been undertaken to determine the noise level at the most affected sensitive receivers and compared against the RNP controlling noise criteria for sub-arterial/collector roads and for local roads.

Where a greater than 2 dB increase is predicted and the RNP controlling noise criteria is exceeded, mitigation strategies have been recommended to reduce potential noise impacts.

Further investigation of construction traffic should be undertaken during the design development process.

**Table C.23** *Estimated traffic volumes (pre-construction and during-construction) – sub-arterial/collector roads*

Road	Road Section Start	Road Section End	Road type	Existing traffic – Day (15 hour)		Existing – Night (9 hour)		Existing speed, km/hr		Additional construction traffic – day (15 hour)		Additional construction traffic – night (9 hour)	
				LV	HV	LV	HV	Day	Night	LV	HV	LV	HV
South Street	Park Road, Rydalmere	John Street	DGA	7862	216	1575	50	50	50	8058	217	1614	51
South Street	John Street	Patricia Street	DGA	6763	212	1354	49	50	50	6931	214	1388	50
South Street	Patricia Street	Nowill Street	DGA	6430	202	1287	47	50	50	6590	204	1320	47
South Street	Nowill Street	Primrose Street	DGA	6398	201	1281	47	50	50	6558	203	1313	47
South Street	Primrose Street	Fallon Street	DGA	6297	209	1261	49	50	50	6508	212	1303	49
South Street	Fallon Street	Silverwater Road	DGA	6454	214	1292	50	50	50	6670	217	1335	51
South Street	Silverwater Road	River Road, Ermington	DGA	1126	37	225	9	50	50	1163	38	233	9
Boronia Street	Spurway Street/Broad Oaks Street	Honor Street	DGA	7103	1041	1389	242	50	50	7251	1012	1418	235
Boronia Street	Honor Street	Trumble Avenue	DGA	7236	1061	1415	247	50	50	7387	1031	1445	240
Boronia Street	Trumble Avenue	Boyle Street	DGA	6842	1003	1338	233	50	50	6985	975	1366	227
Boronia Street	Boyle Street	Murdoch Street	DGA	6818	1000	1334	233	50	50	6960	972	1361	226
Boronia Street	Murdoch Street	Spofforth Street	DGA	6863	961	1345	224	50	50	6918	935	1355	218
Boronia Street	Spofforth Street	Trumper Street	DGA	6893	966	1350	225	50	50	6948	939	1361	219
Boronia Street	Trumper Street	Atkins Road, Ermington	DGA	6597	924	1292	215	50	50	6650	899	1303	209
Atkins Road	Boronia Street	Hope Street	DGA	7126	893	1401	208	50	50	7552	869	1484	202
Hope Street	Atkins Road, Ermington	Hughes Avenue	DGA	10091	1336	1982	311	50	50	10243	1273	2011	296
Hope Street	Hughes Avenue	Waratah Street	DGA	12401	422	2479	98	50	50	12146	398	2428	93
Hope Street	Waratah Street	Wharf Road/Lancaster Avenue, Melrose Park	DGA	10415	354	2082	82	50	50	10202	334	2039	78
Wharf Road	Hope Road/Lancaster Avenue	Mary Street	DGA	8847	234	1772	54	50	50	8784	228	1760	53
Wharf Road	Mary Street	Andrew Street	DGA	9777	258	1959	60	50	50	9708	252	1945	59
Hill Road	Burroway Road/Footbridge Boulevard, Wentworth Point	Nuvolari Place	DGA	13464	132	2704	31	60	60	13216	132	2654	31
Hill Road	Nuvolari Place	Baywater Drive	DGA	17014	166	3417	39	60	60	16701	166	3354	39
Hill Road	Baywater Drive	Stromboli Strait	DGA	19432	190	3902	44	60	60	19074	190	3830	44
Hill Road	Stromboli Strait	Bennelong Parkway	DGA	20504	201	4117	47	60	60	20127	201	4042	47
Hill Road	Bennelong Parkway	Holker Street, Sydney Olympic Park	DGA	22500	196	4518	46	60	60	21636	200	4344	46
Spurway Street	Boronia Street	Tristram Street	DGA	5840	735	1148	171	50	50	6021	717	1184	167
Spurway Street	Tristram Street	Victoria Road	DGA	6092	577	1202	134	50	50	6174	562	1218	131
Atkins Road	Hope Street	Victoria Road	DGA	3411	433	672	101	50	50	4469	393	881	92
Hughes Avenue	Hope Street	Victoria Road	DGA	1719	215	338	50	50	50	1729	213	340	50
Wharf Road	Hope Street	Victoria Road	DGA	6507	395	1296	92	50	50	6772	386	1349	90
Kevin Coombs Avenue	Australia Avenue	Old Hill Link	DGA	8475	522	1690	122	60	60	8512	513	1697	119
Old Hill Link	Edwin Flack Avenue	Hill Road	DGA	781	72	700	71	60	60	761	71	683	70



**Table C.24**      *Estimated traffic volumes (pre-construction and during-construction) – local roads*

Road	Road Section Start	Road Section End	Road type	Existing traffic - Day (1 hour)		Existing traffic - Night (1 hour)		Existing speed, km/hr		Additional construction traffic – Day (1 hour)		Additional construction traffic – Night (1 hour)	
				LV	HV	LV	HV	Day	Night	LV	HV	LV	HV
Grand Avenue	James Ruse Drive/Hassall Street	ALDI Access/Rosehill Gardens Gate 1 Access	DGA	1087	67	962	77	60	60	1158	66	1025	77
Grand Avenue	ALDI Access/Rosehill Gardens Gate 1 Access	Durham Street	DGA	629	38	556	44	60	60	670	38	593	44
Grand Avenue	Durham Street	Thackeray Street/Unnamed Road	DGA	205	13	181	14	60	60	218	13	193	14
Australia Avenue	Kevin Coombs Avenue/Marjorie Jackson Parkway	Grand Parade	DGA	850	39	757	45	60	60	844	39	752	44
Australia Avenue	Grand Parade	Murray Rose Avenue	DGA	894	45	796	51	60	60	898	45	800	51
Australia Avenue	Murray Rose Avenue	Dawn Fraser Avenue	DGA	1029	51	916	59	60	60	1034	51	920	59
Australia Avenue	Dawn Fraser Avenue	Parkview Drive/Herb Elliott Avenue	DGA	796	52	706	60	60	60	1028	70	912	80
Dawn Fraser Avenue	Australia Avenue	Park Street	DGA	130	14	114	17	60	60	122	14	107	16
Dawn Fraser Avenue	Park Street	Showground Road	DGA	233	26	205	30	60	60	219	25	192	29
Dawn Fraser Avenue	Showground Road	Olympic Boulevard	DGA	285	45	247	51	60	60	292	45	254	52
Dawn Fraser Avenue	Olympic Boulevard	Edwin Flack Avenue, Sydney Olympic Park.	DGA	732	82	657	81	60	60	750	82	672	81
Uhrig Road	Edwin Flack Avenue, Sydney Olympic Park.	Carter Street	DGA	385	52	346	51	50	50	413	51	371	51
Access	Uhrig Road/Carter Street	M4 Motorway	DGA	998	108	895	108	50	50	1001	106	898	106
John Street	South Street	Antoine Street	DGA	44	2	39	2	50	50	58	2	52	2

## C-8 Maximum noise event source noise levels

### C-8-1 Cars crossing over rail tracks

Noise measurements were undertaken to quantify the  $L_{AFmax}$  noise level of vehicles crossing the light rail track compared against the same vehicles crossing an intersection without crossing the light rail track. Noise monitoring was undertaken at the following intersection on 28 January, 2022:

- High Street and Botany Street, Randwick (Sydney Light Rail along High Street)
- Botany Street and Blenheim Street (no light rail track within the intersection).

Noise measurements were undertaken using two Svan 977 noise loggers at 1.5 metres above ground level using an A-weighting filter and 'fast' integration. A calibration check was undertaken before and after the measurement and the pre to post calibration variation was within +/- 0.5 dB.

Distance loss calculations were undertaken to estimate the sound power level of the vehicles crossing the intersection with and without the light rail track and are plotted in Figure C.3.

Based on the noise measurements, the sound power level of vehicles crossing light rail tracks are estimated to be between  $L_{AFmax}$  100 and 110 dB, depending on the vehicle type and speed. Additionally, the noise measurements indicated that the  $L_{Aeq}$  noise level increased by an average of 4 dB compared to a pass-by without the rail track for the duration of the crossing over the rail (typically between 0.7 seconds and 1.0 second depending on the speed of the vehicle).

For the vehicles crossing over the rail tracks, the noise measurement data suggests an approximate  $20 \cdot \log$  relationship between speed and sound power level.

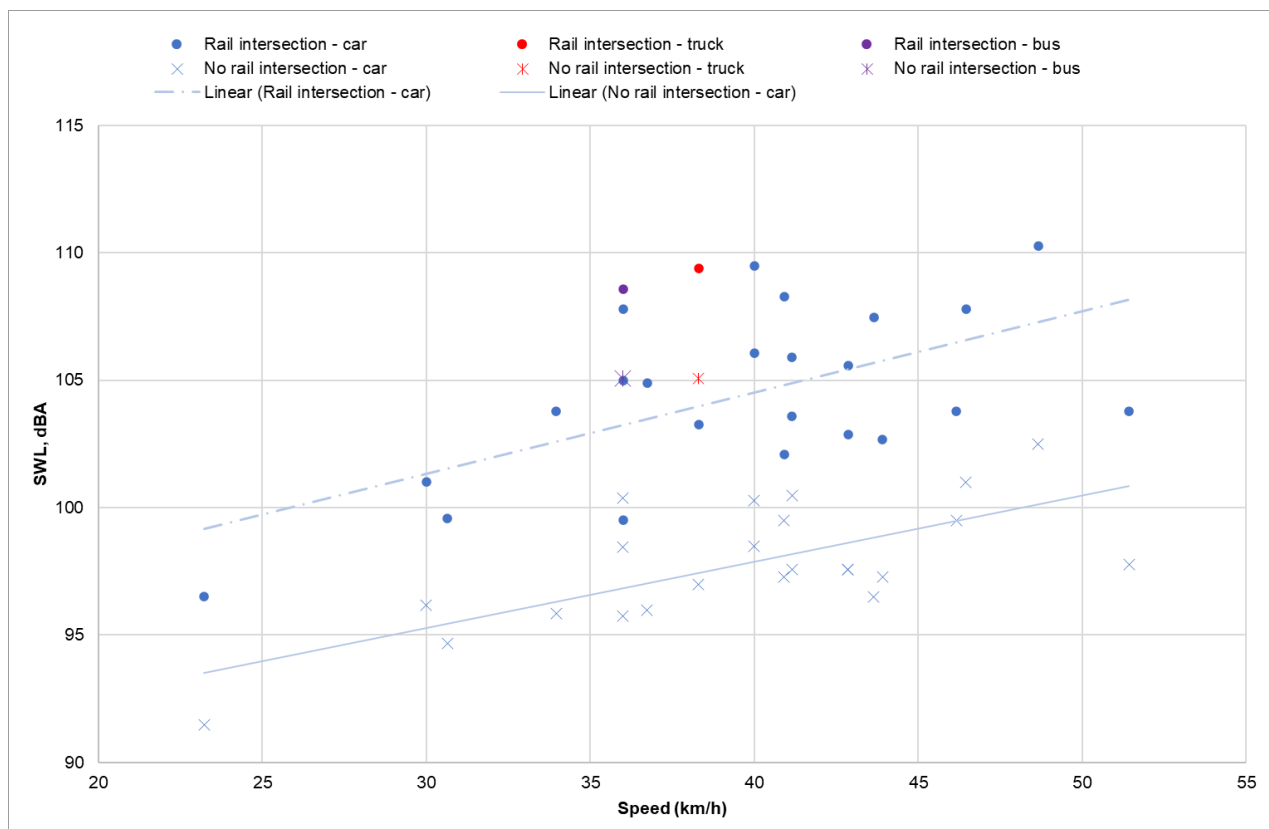


Figure C.3 Estimated sound power level – vehicles travelling across intersection with and without a light rail track

For the purposes of this assessment, a  $L_{AFmax}$  sound power level of 110 dBA has been assigned to the area where vehicles would cross the track at speed and is considered conservative.

To determine the effect of vehicles crossing over rail tracks on the  $L_{Aeq}$  noise level experienced at a receiver, the sound exposure level (SEL) of the following events were analysed:

- Vehicle pass-by events at seven metres from the closet lane at the intersection with no vehicles crossing the rail track.
- Vehicle pass-by events at seven metres from the closest lane at the intersection with vehicles crossing the rail track. The measured SELs are presented in Table C.25. Based on the measurements, an increase of up to  $L_{Aeq}$  0.6 dB, during both the day and night periods, would be expected at receivers fronting intersections where vehicles would cross the light rail track. This is considered conservative as the number of vehicles that would cross the light rail track (perpendicular to the track) would generally be significantly less than the number of vehicles that would travel parallel to the light rail track (and not cross it). The majority of vehicles that cross the intersection would travel parallel to the track and the  $L_{Aeq}$  noise level would not increase as a result of the light rail track as the vehicle would not cross the track.

**Table C.25** Measured noise level of vehicle pass-bys at rail and non-rail intersections (SEL comparison)

Event	Vehicle pass-by – no rail intersection			Vehicle pass-by – rail intersection			Assumed SEL (pass-by and rail crossing)	Difference in noise level (SEL), dB
	Seconds	$L_{Aeq}$	SEL	Seconds	$L_{Aeq}$	SEL		
Average of measured events	11	70.6	81.0	1	73.7	73.0	81.6	0.6

## C-8-2 Heavy vehicle movements

Maximum noise events due to heavy vehicle pass-bys have been analysed at 55 Boronia Street, Rydalmere and at 5 Hope Street, Melrose Park to determine an indicative sound power level of these events.  $L_{AFmax}$  noise levels above 65 dBA were analysed at both locations and calculations were undertaken to determine the sound power level at the source. The measurements and calculations indicate that a  $L_{AFmax}$  sound power level of 105 dBA would be appropriate to adopt for the purposes of predicting the differences in  $L_{AFmax}$  noise levels as a result road design changes associated with the project.

## C-9 South Street/Boronia Street realignment

### C-9-1 Modelling methodology

Sections of South Street and Boronia Street would be realigned as a result of the project, where the eastbound lanes would move closer to residences to the north of South Street and Boronia Street. Additionally, there are various intersections along South Street and Boronia Street where vehicles would cross over the rail tracks.

Acoustic modelling was undertaken using SoundPLAN 8.2 noise modelling software to predict indicative road traffic noise levels at the nearest first row of residences fronting South Street and Boronia Street. The general parameters used in the noise model are presented in the Table C.26.

**Table C.26** Noise modelling parameters – vehicles crossing light rail tracks

Variable	Parameter used
Software	SoundPLAN 8.2
Calculation method	CoRTN prediction method (NSW) +0 dB for cars -0.6 dB for truck engines at 1.5 metres -8.6 dB for truck exhausts at 3.6 metres Conversion factor or – 3 dB applied to convert $L_{A10}$ to $L_{Aeq}$

Variable	Parameter used
Topography	The road interface with the light rail track has not yet been designed in 3 dimensions. As the road gradient has an effect on the sound power level assigned to the road, no topography has been used in the noise modelling.
Receiver locations	1.5 metres above the ground floor and 1 metre in front of the nearest facade
Ground absorption	0.5 for all areas (0 is non-porous ground such as concrete and 1 is porous ground such as grass)
Building footprints and heights	Sourced from Geoscape PSMA
Number of reflections	1 reflection from surrounding structures
Traffic volumes	See Table C.27 and Table C.28 below
Traffic speeds	50 km/hr for South Street and Boronia Street
Façade reflection	+2.5 dB to account for noise reflected from the façade
Corrections	+4.0 dB over a 10 metres section where vehicles would cross over the light rail track
Maximum noise event assessment	<ul style="list-style-type: none"> <li>Line source at 1.5 metres above the ground for heavy vehicle pass-bys at a sound power level of <math>L_{AFmax}</math> 105 dBA</li> <li>Area source at 0.2 metres above the ground for vehicles crossing over the rail tracks at a sound power level of <math>L_{AFMax}</math> 110 dBA.</li> </ul>

**Table C.27** No Build traffic volumes (2031)

Road	Section Start	Section End	No Build – Day (15 hour)		No Build – Night (9 hour)	
			LV	HV	LV	HV
South Street EB	John Street	Silverwater Road	3234	104	648	24
South Street WB	John Street	Silverwater Road	3234	104	648	24
Boronia Street EB	Spurway Street	Atkins Road	3454	497	676	116
Boronia Street WB	Spurway Street	Atkins Road	3454	497	676	116

**Table C.28** Build traffic volumes (2031)

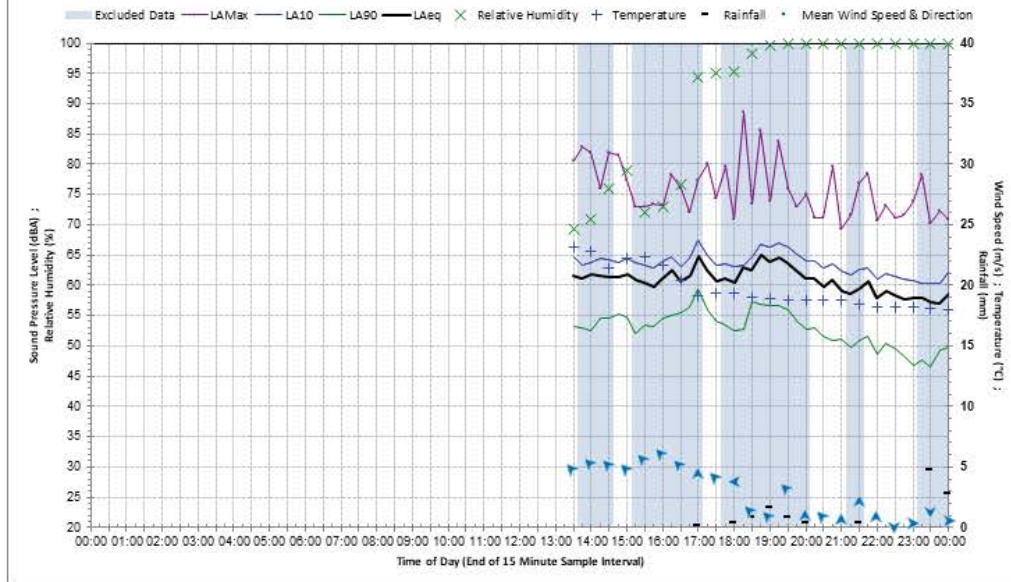
Road	Section Start	Section End	No Build - Day (15 hour)		No Build – Night (9 hour)	
			LV	HV	LV	HV
South Street EB	John Street	Silverwater Road	3326	105	666	24
South Street WB	John Street	Silverwater Road	3326	105	666	24
Boronia Street EB	Spurway Street	Atkins Road	3507	483	686	112
Boronia Street WB	Spurway Street	Atkins Road	3507	483	686	112

# **Appendix D**

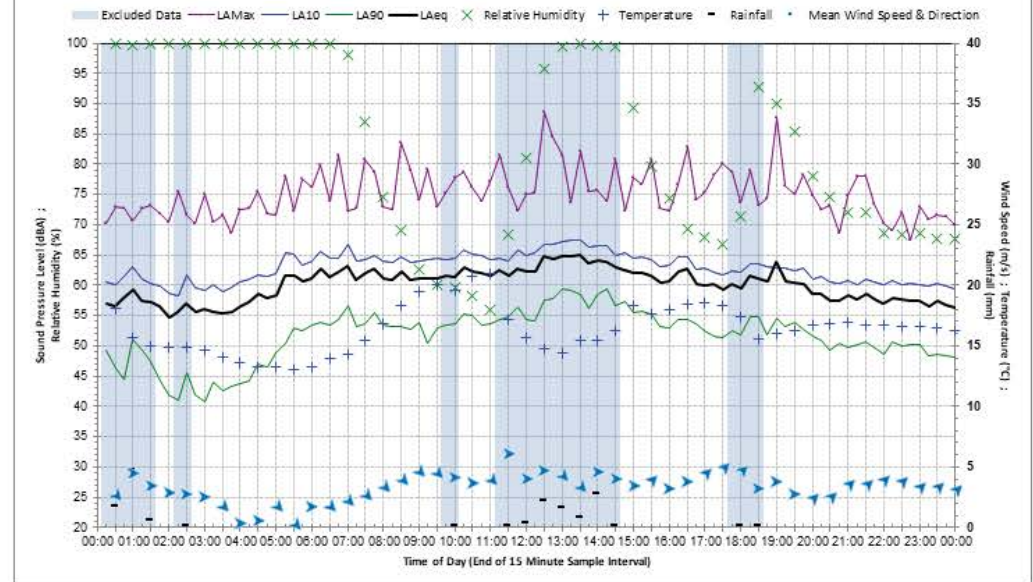
**Unattended noise monitoring charts**



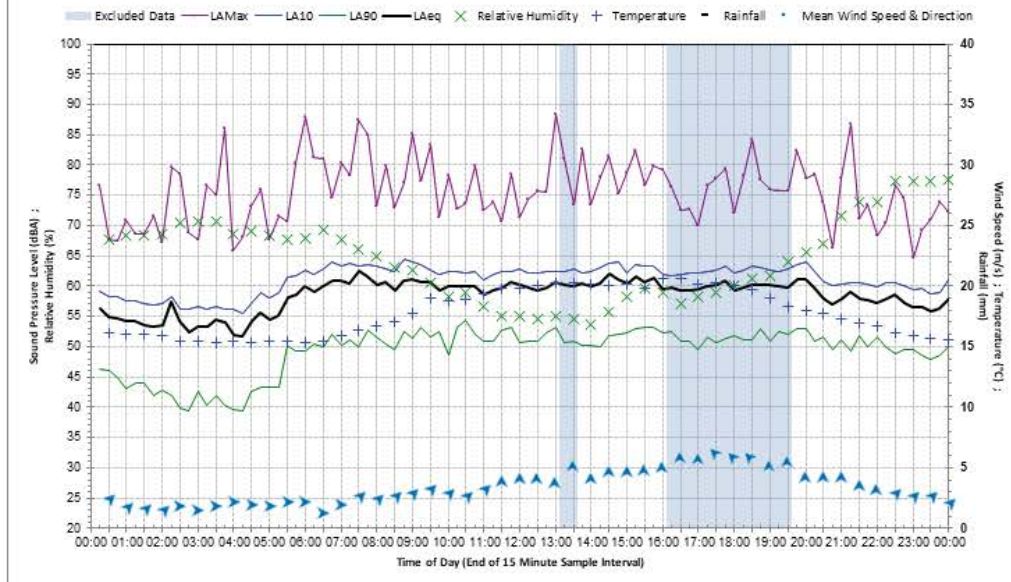
**Statistical Ambient Noise Levels - 5 Hope Street, Rosehill**  
**Thursday 9 December 2021**



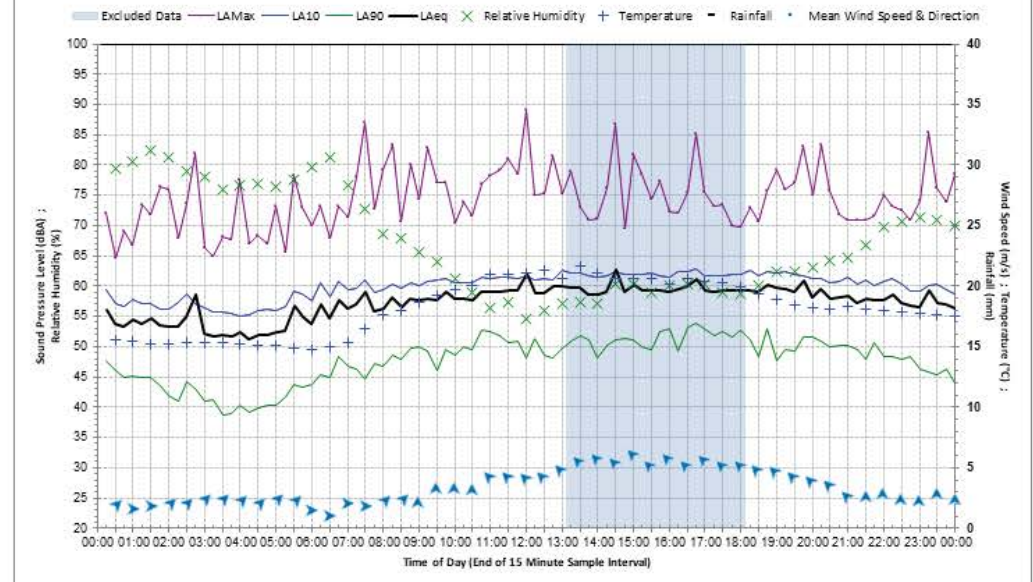
**Statistical Ambient Noise Levels - 5 Hope Street, Rosehill**  
**Friday 10 December 2021**



**Statistical Ambient Noise Levels - 5 Hope Street, Rosehill**  
**Saturday 11 December 2021**

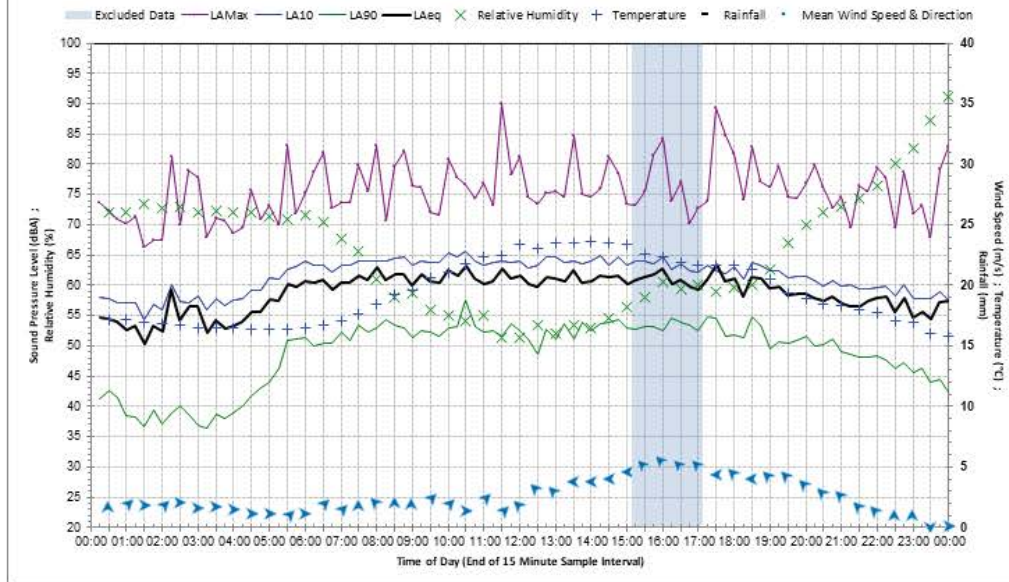


**Statistical Ambient Noise Levels - 5 Hope Street, Rosehill**  
**Sunday 12 December 2021**

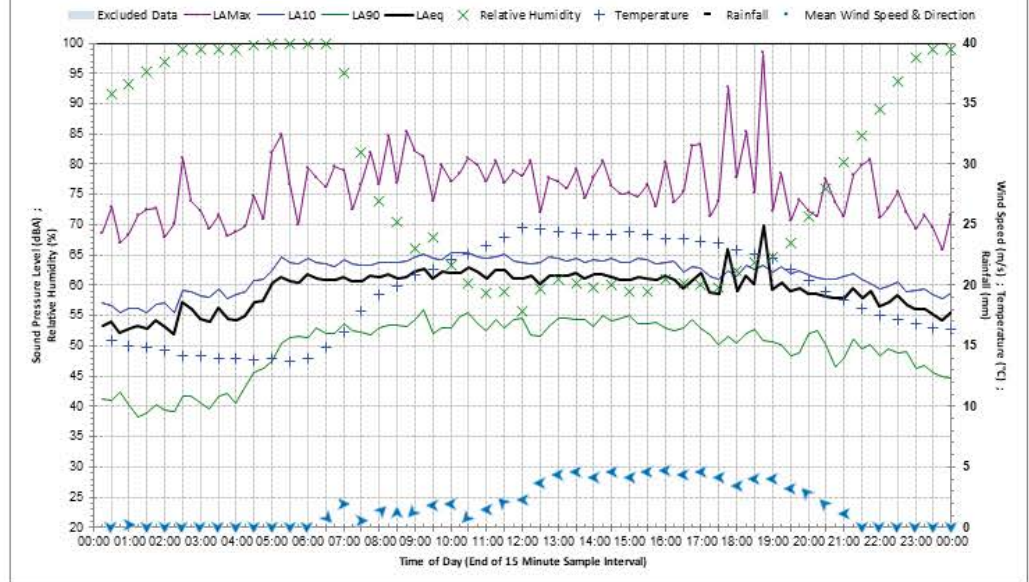




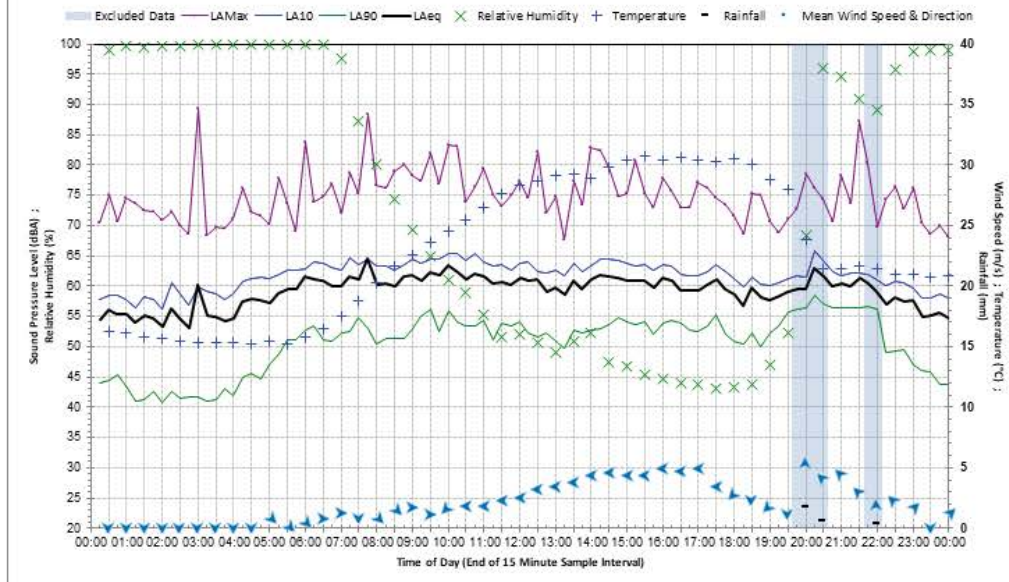
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**Monday 13 December 2021**



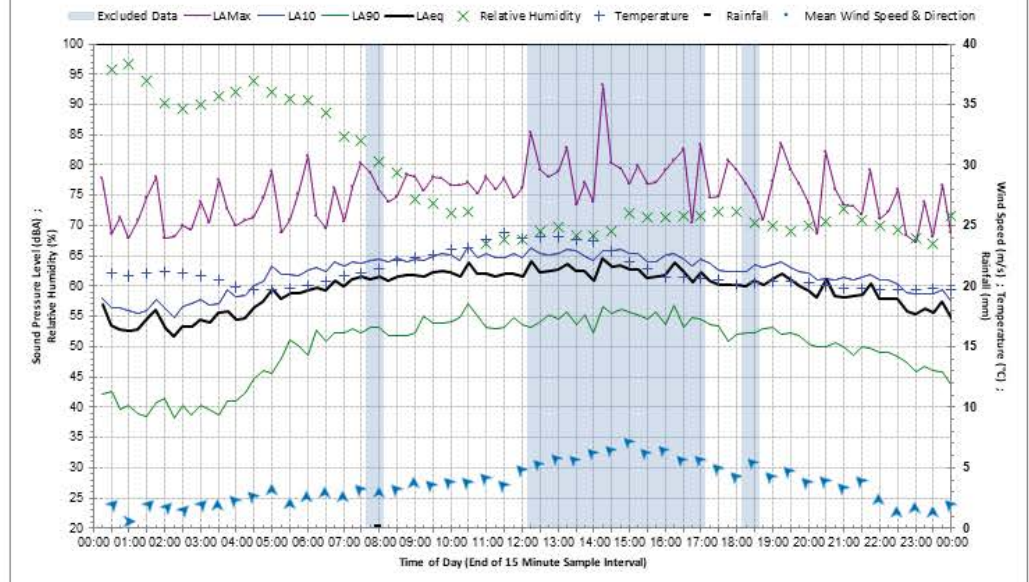
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**Tuesday 14 December 2021**



**Statistical Ambient Noise Levels - 5 Hope Street, Rosehill**  
**Wednesday 15 December 2021**

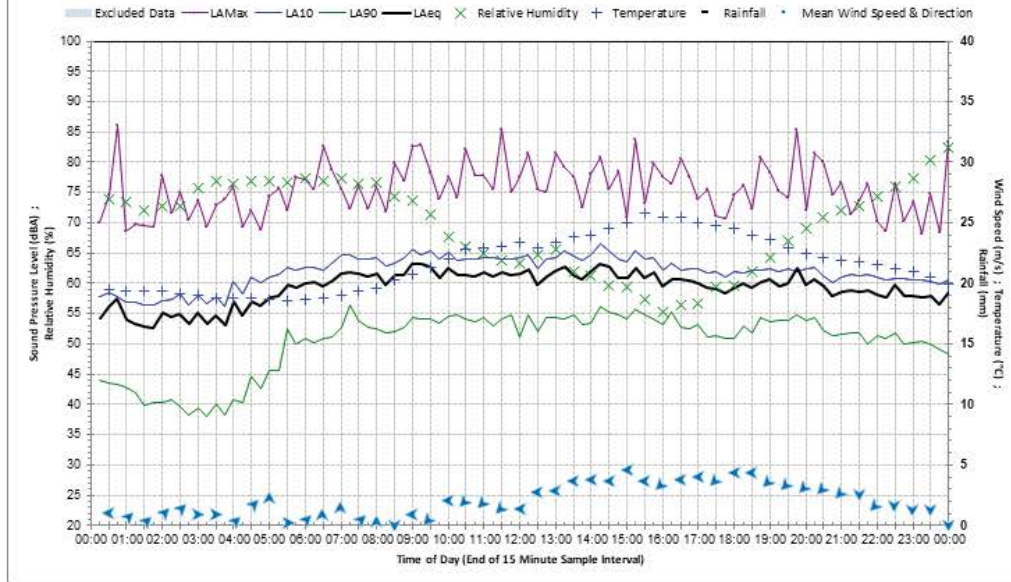


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**Thursday 16 December 2021**

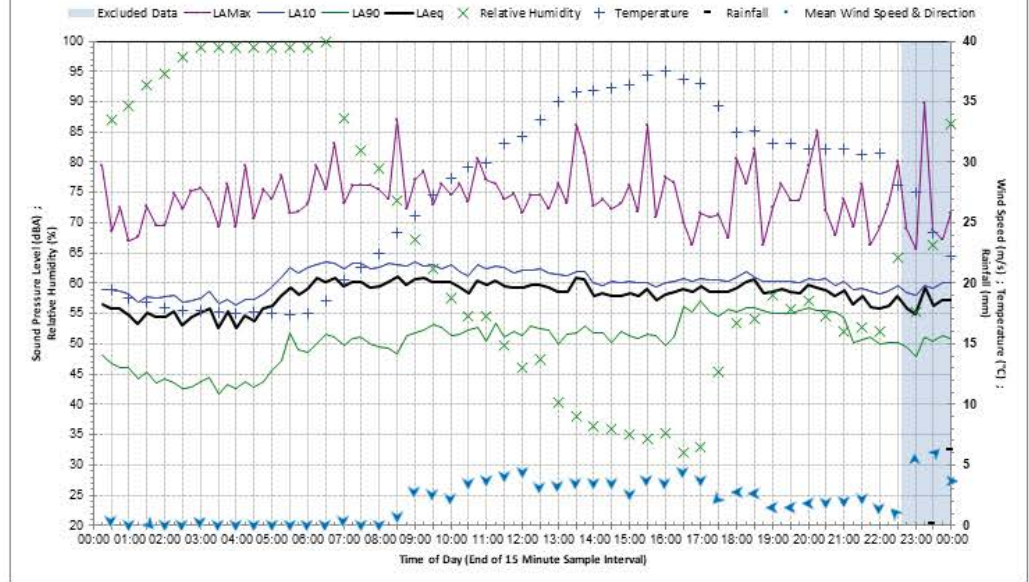




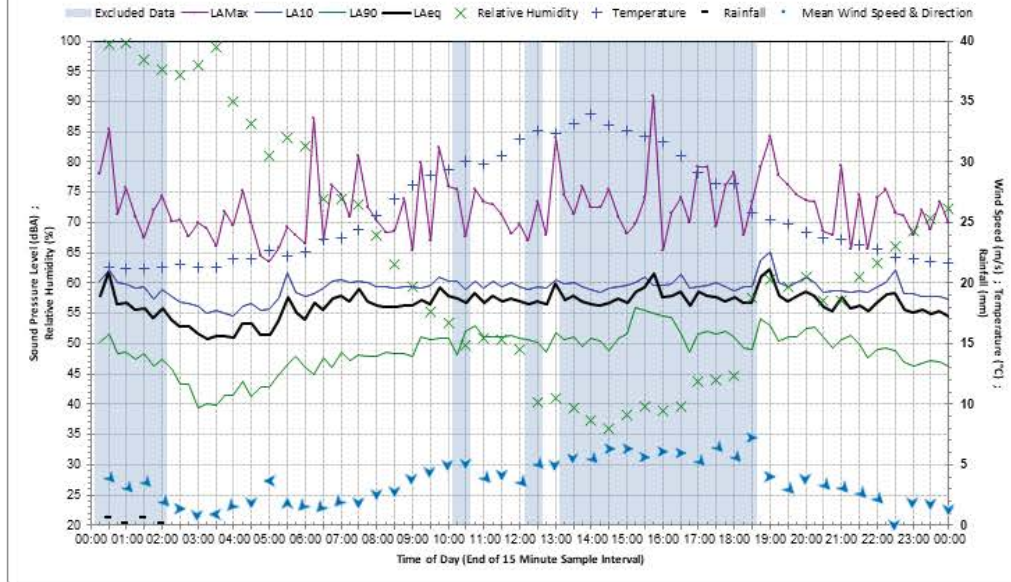
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**Friday 17 December 2021**



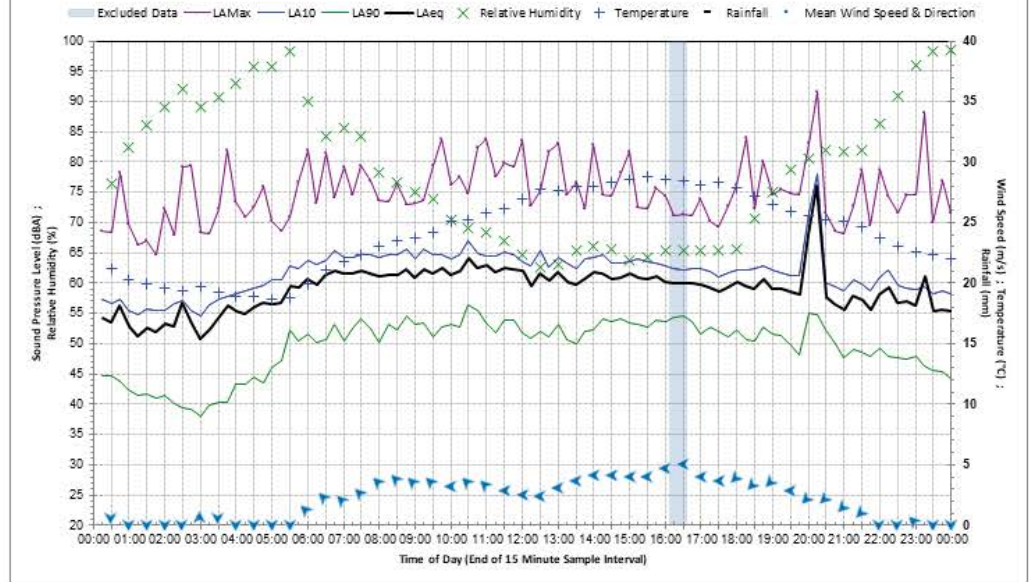
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**Saturday 18 December 2021**



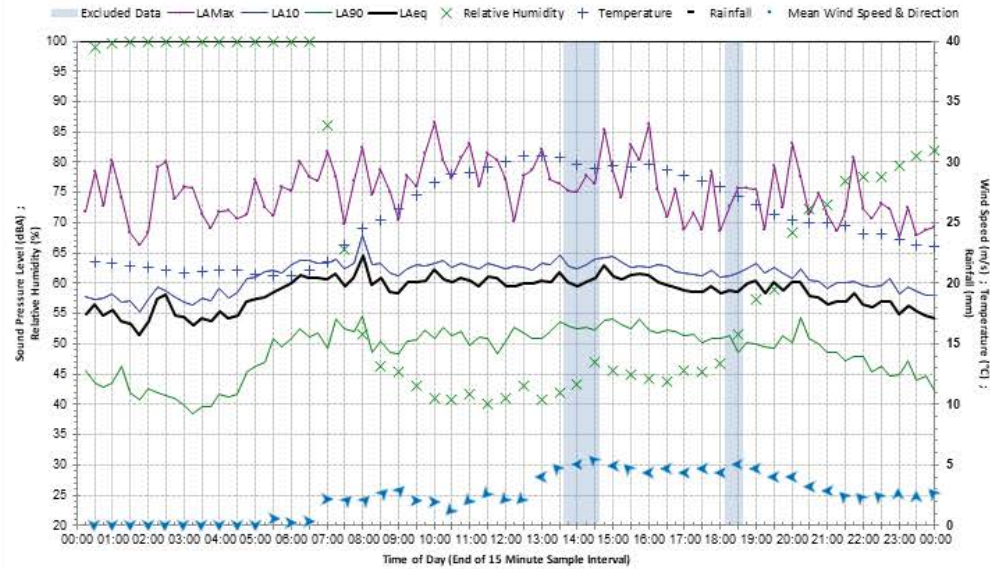
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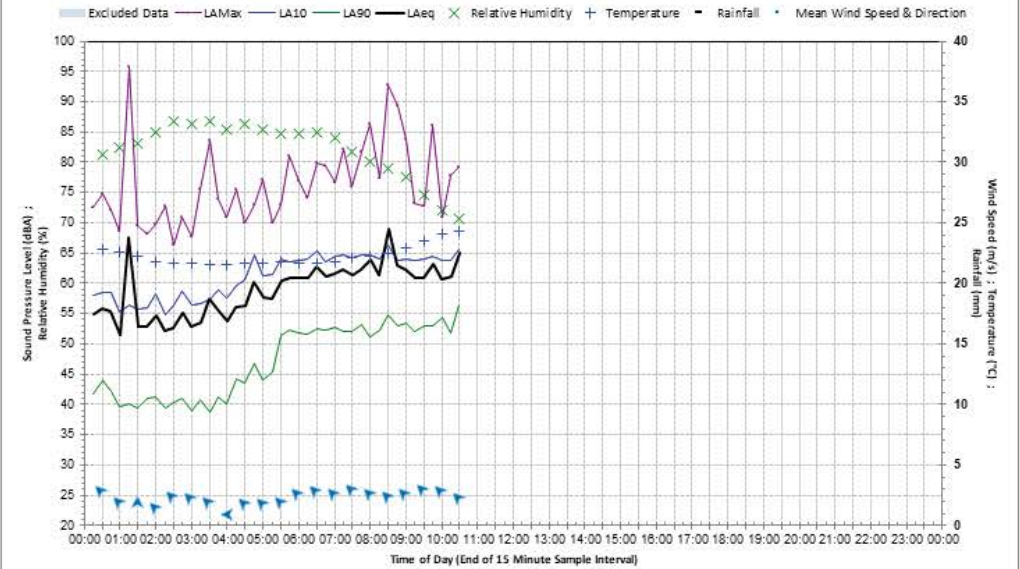
**Statistical Ambient Noise Levels - 5 Hope Street, Rosehill**  
**Monday 20 December 2021**



### Statistical Ambient Noise Levels - 5 Hope Street, Rosehill Tuesday 21 December 2021

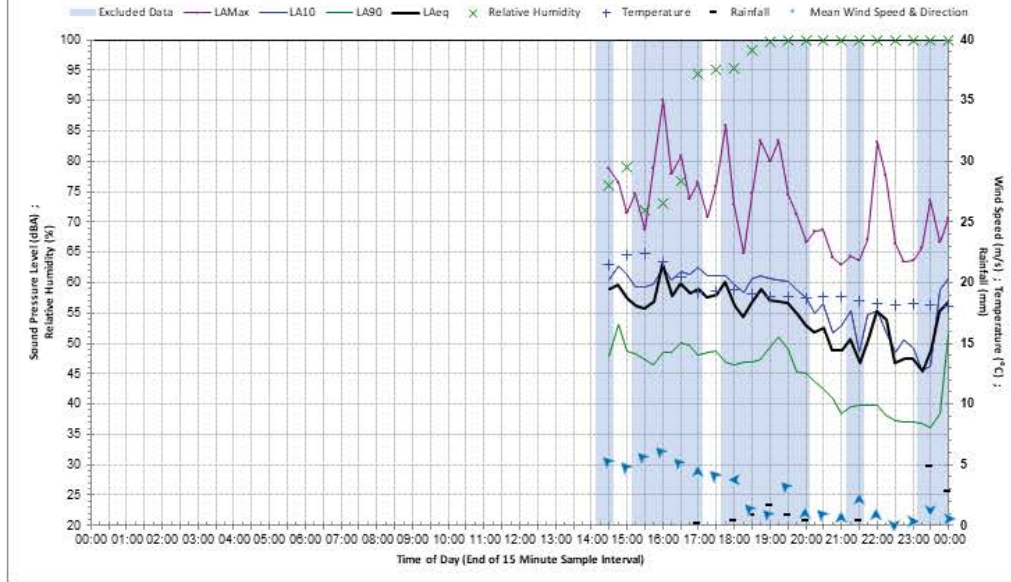


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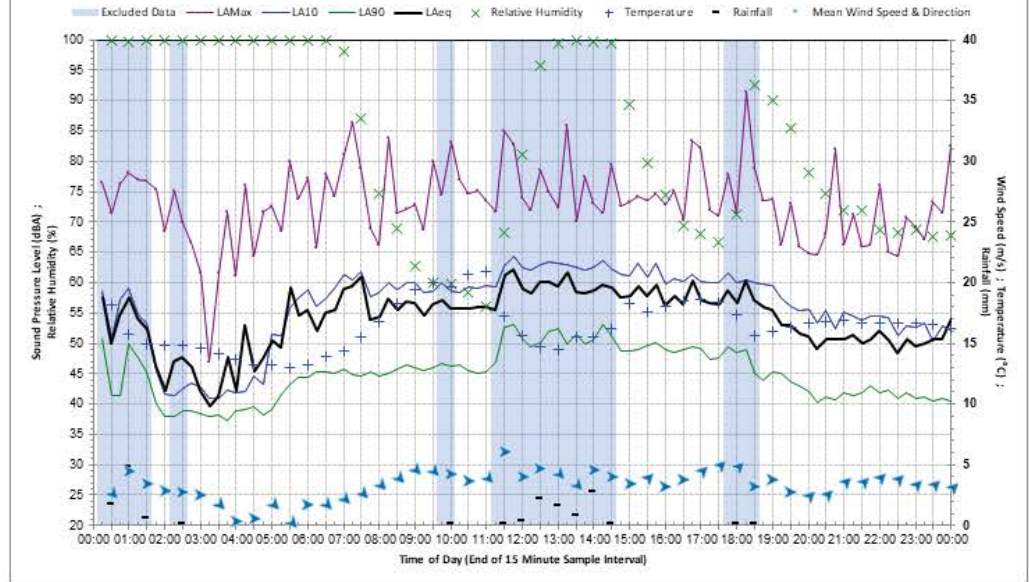




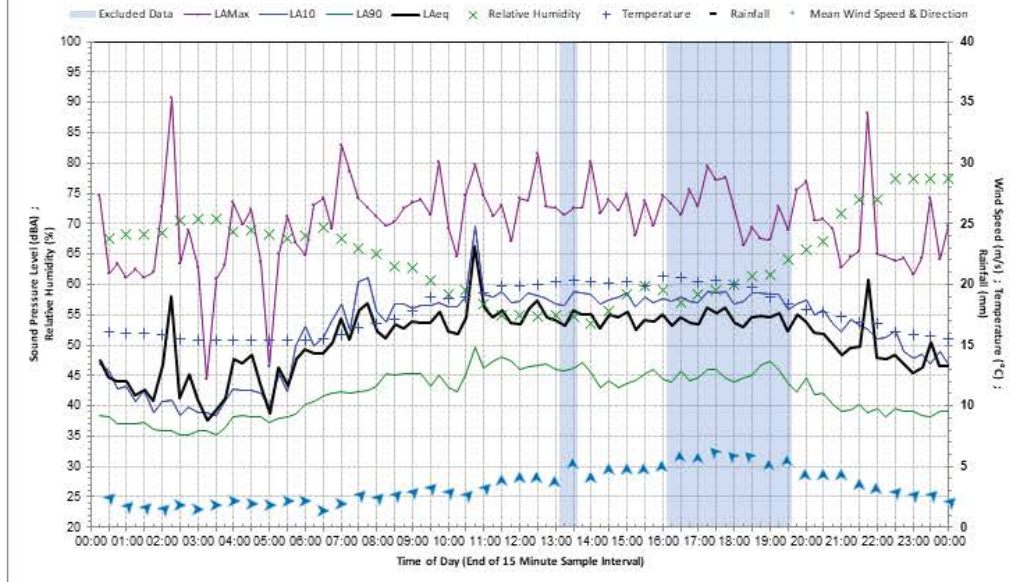
**Statistical Ambient Noise Levels - 100 South Street, Rydalmere**  
**Thursday 9 December 2021**



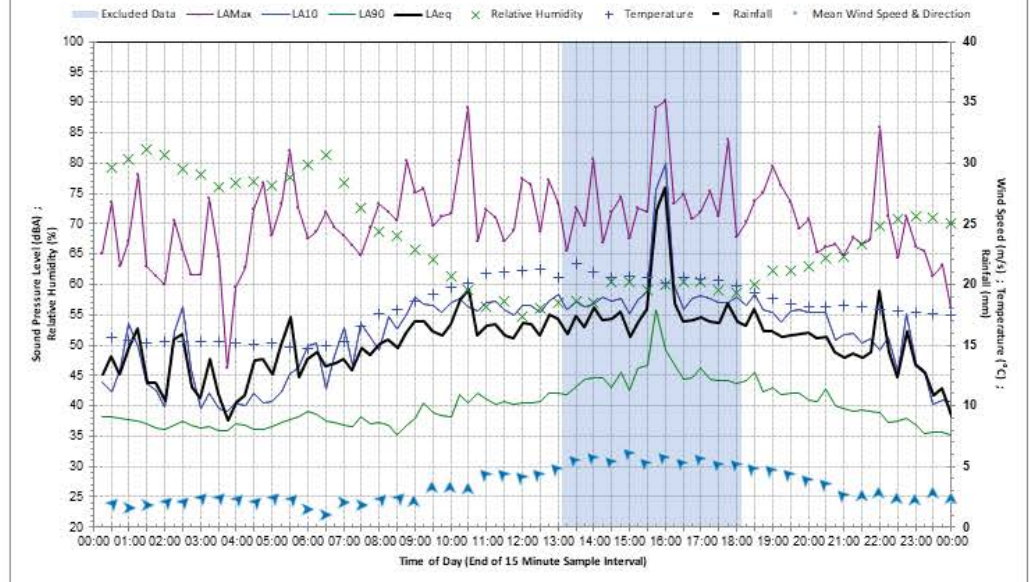
**Statistical Ambient Noise Levels - 100 South Street, Rydalmere**  
**Friday 10 December 2021**



**Statistical Ambient Noise Levels - 100 South Street, Rydalmere**  
**Saturday 11 December 2021**

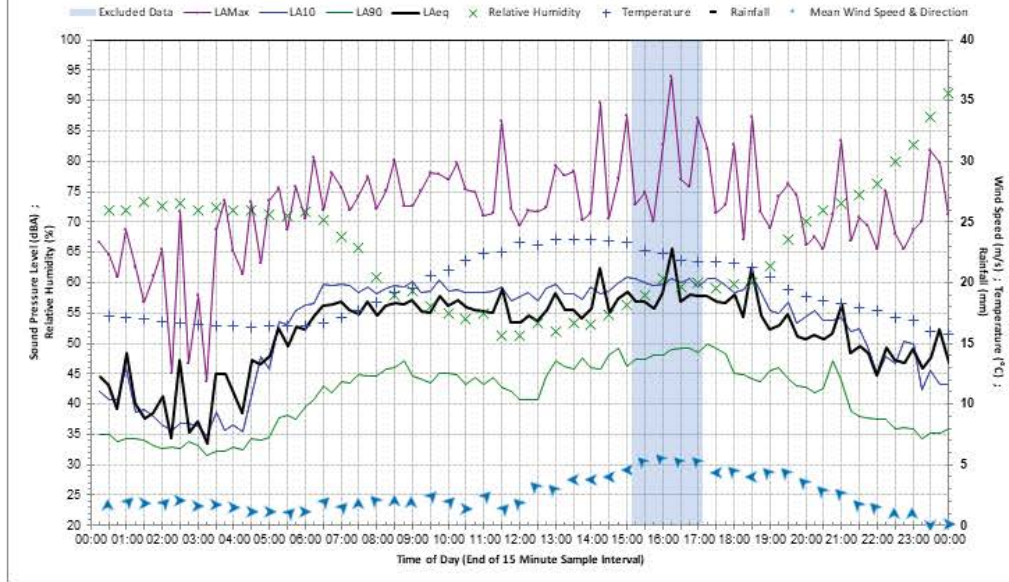


**Statistical Ambient Noise Levels - 100 South Street, Rydalmere**  
**Sunday 12 December 2021**

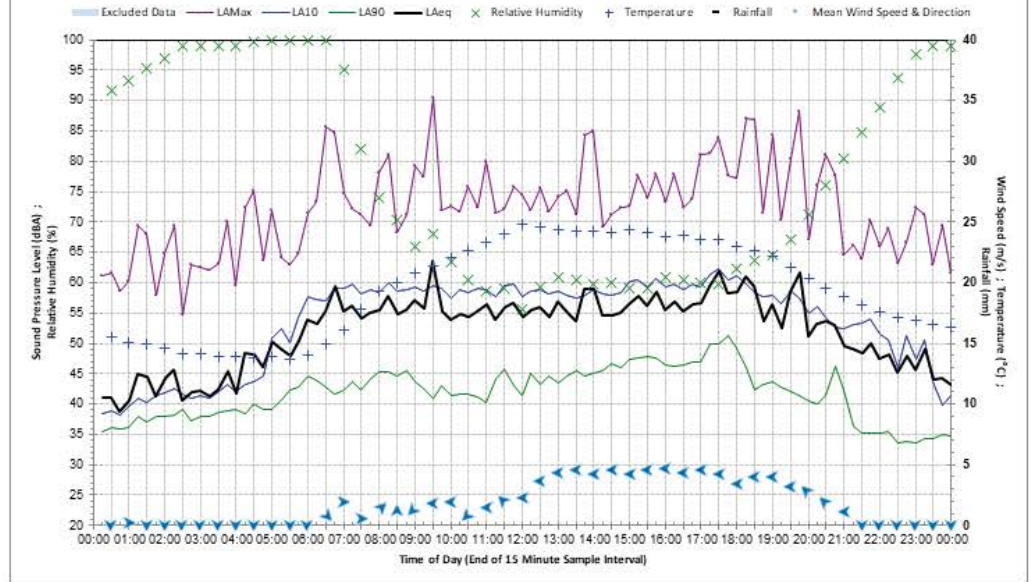




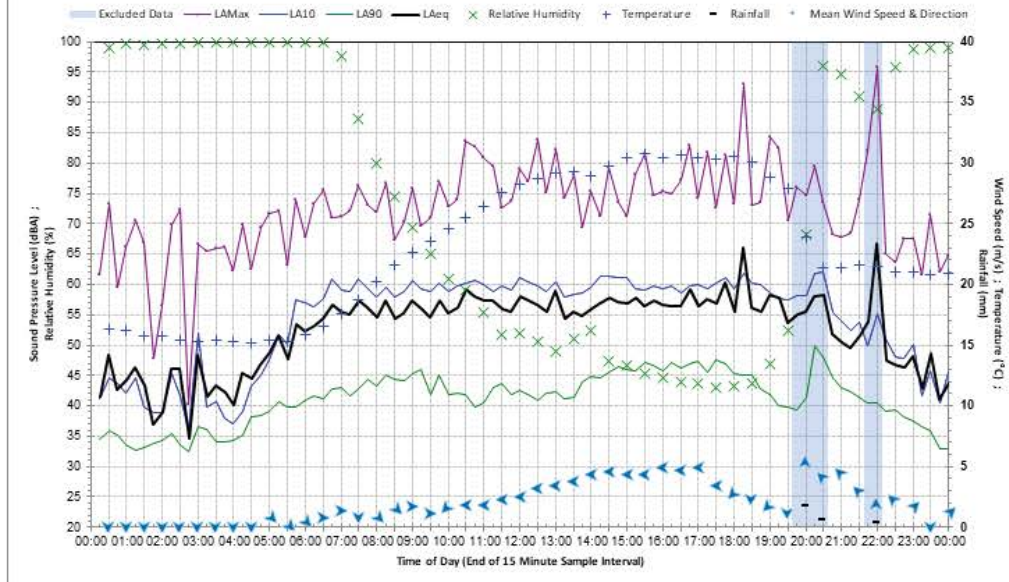
**Statistical Ambient Noise Levels - 100 South Street, Rydalmere**  
**Monday 13 December 2021**



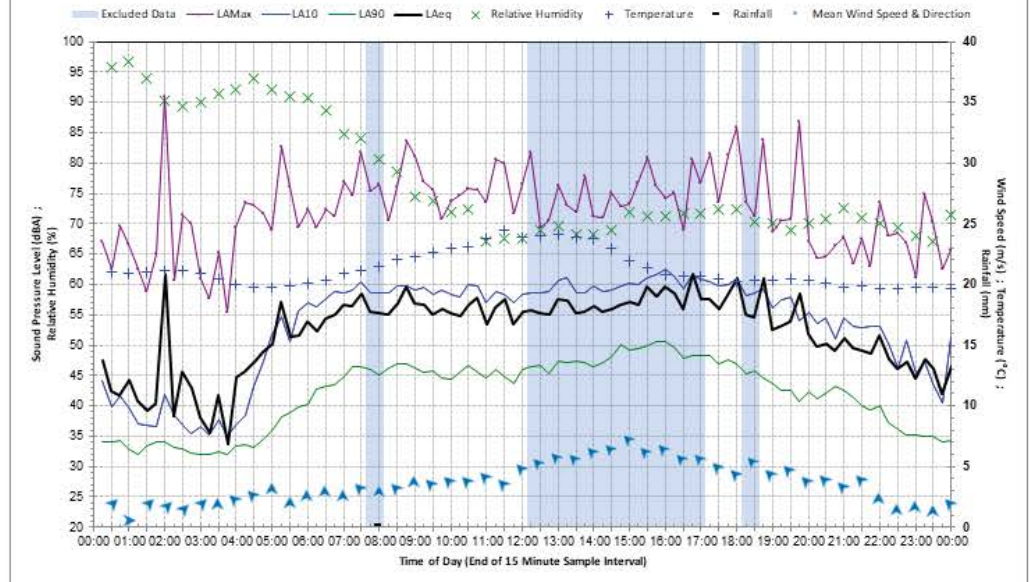
**Statistical Ambient Noise Levels - 100 South Street, Rydalmere**  
**Tuesday 14 December 2021**



**Statistical Ambient Noise Levels - 100 South Street, Rydalmere**  
**Wednesday 15 December 2021**

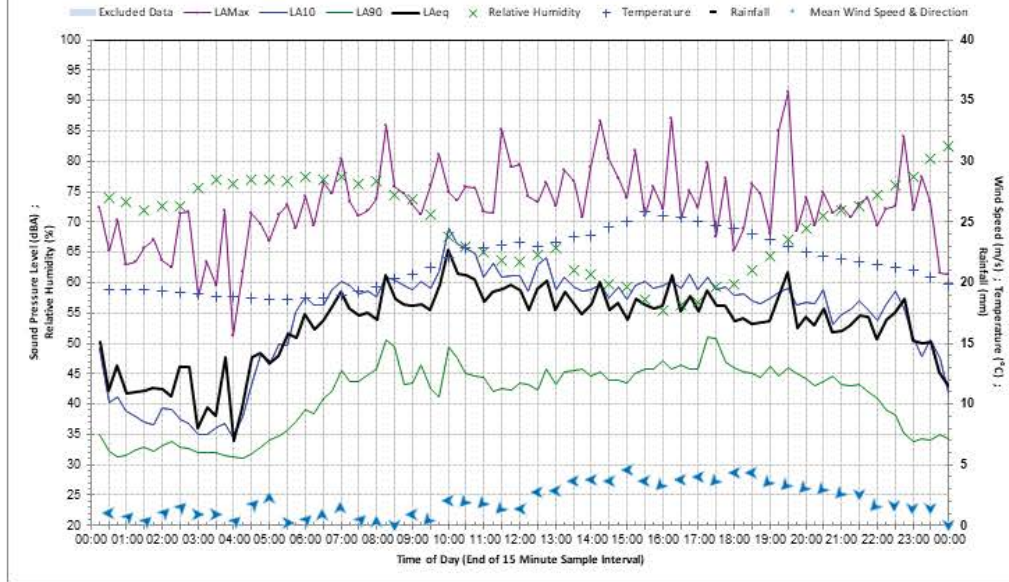


**Statistical Ambient Noise Levels - 100 South Street, Rydalmere**  
**Thursday 16 December 2021**

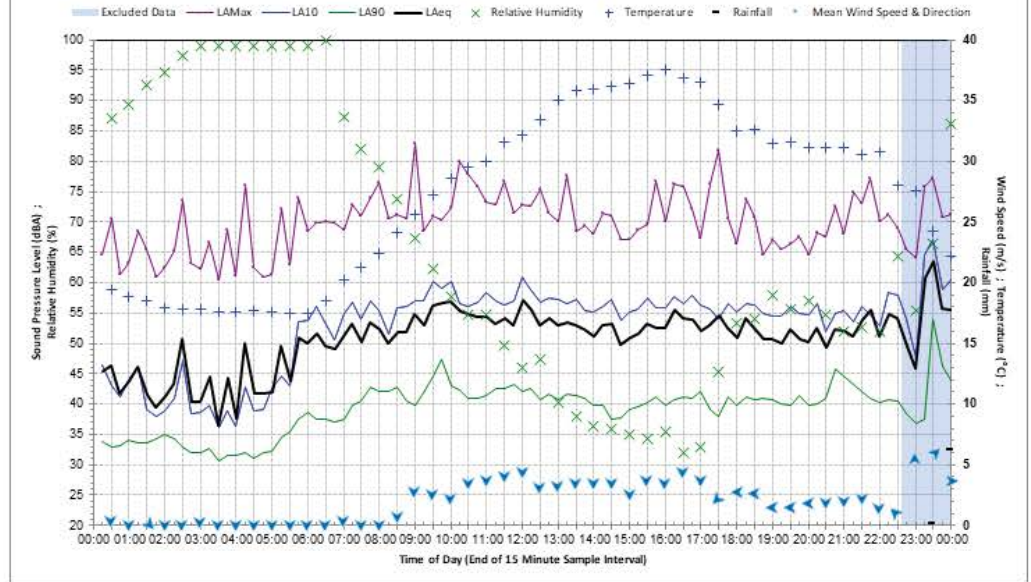




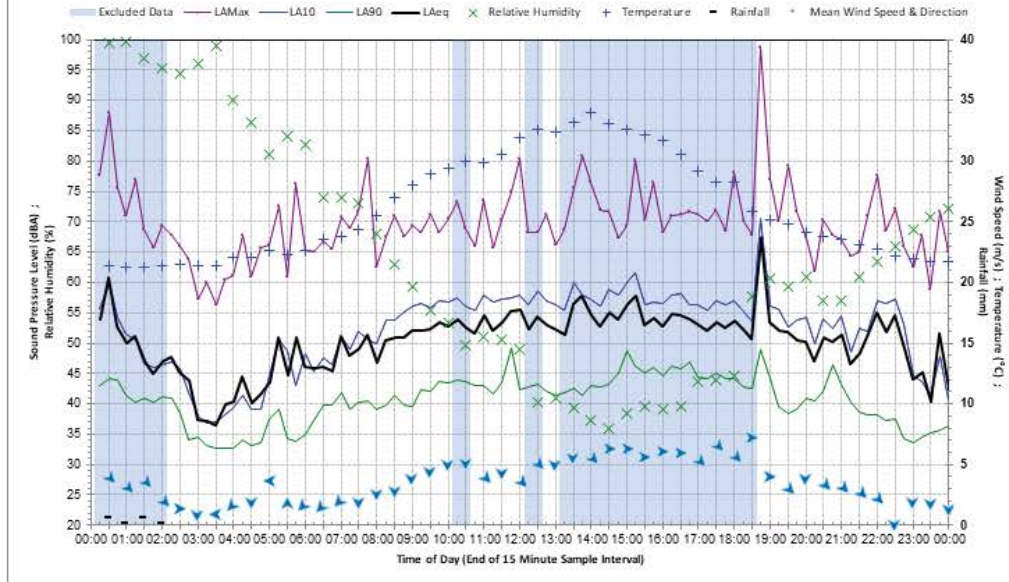
**Statistical Ambient Noise Levels - 100 South Street, Rydalmere**  
**Friday 17 December 2021**



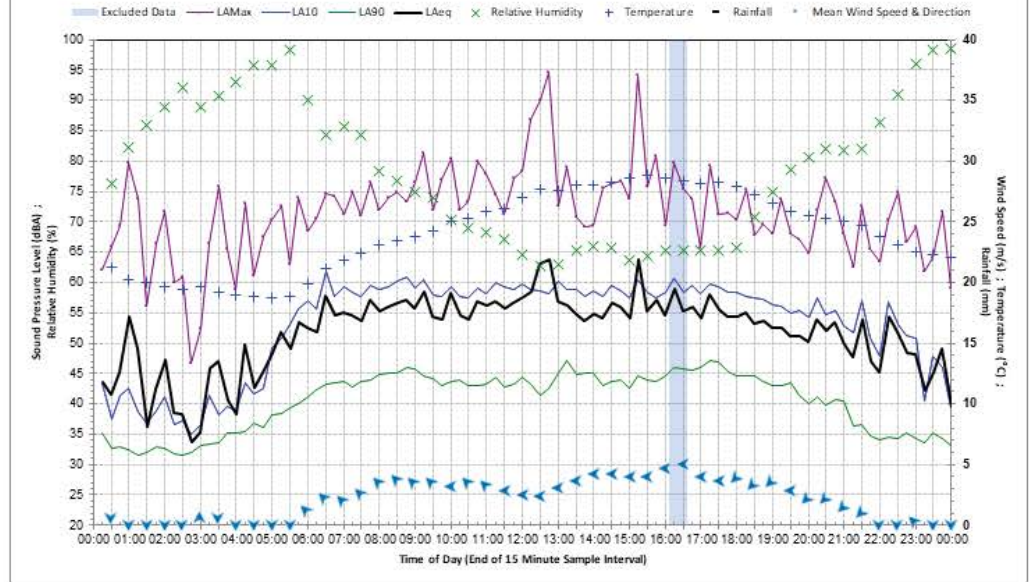
**Statistical Ambient Noise Levels - 100 South Street, Rydalmere**  
**Saturday 18 December 2021**



**Statistical Ambient Noise Levels - 100 South Street, Rydalmere**  
**Sunday 19 December 2021**

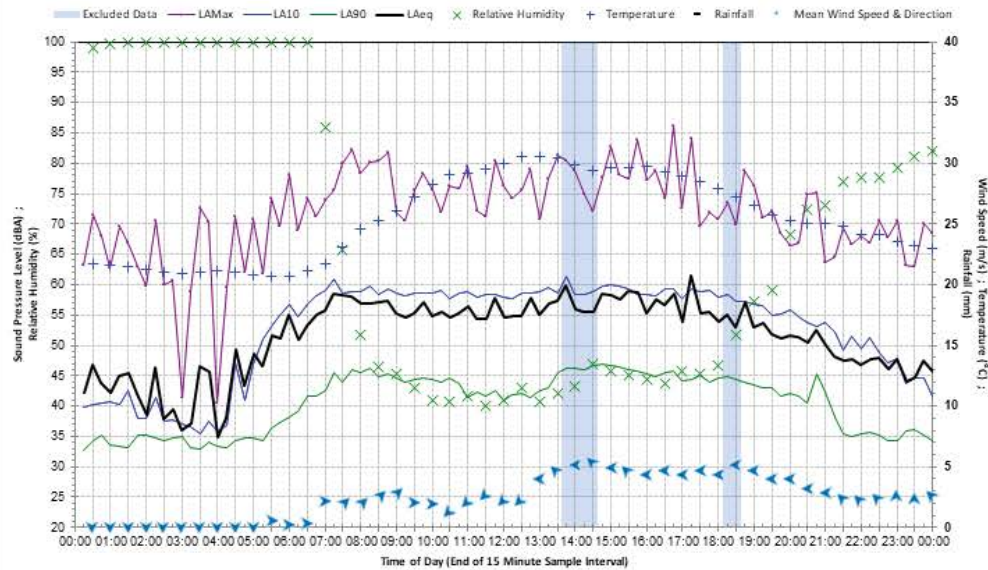


**Statistical Ambient Noise Levels - 100 South Street, Rydalmere**  
**Monday 20 December 2021**



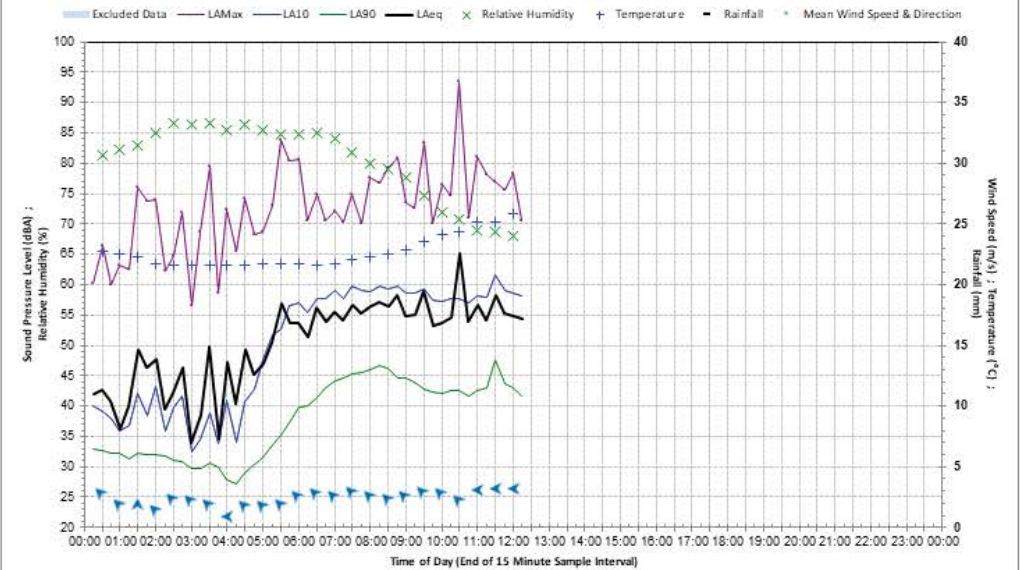
# Statistical Ambient Noise Levels - 100 South Street, Rydalmere

Tuesday 21 December 2021



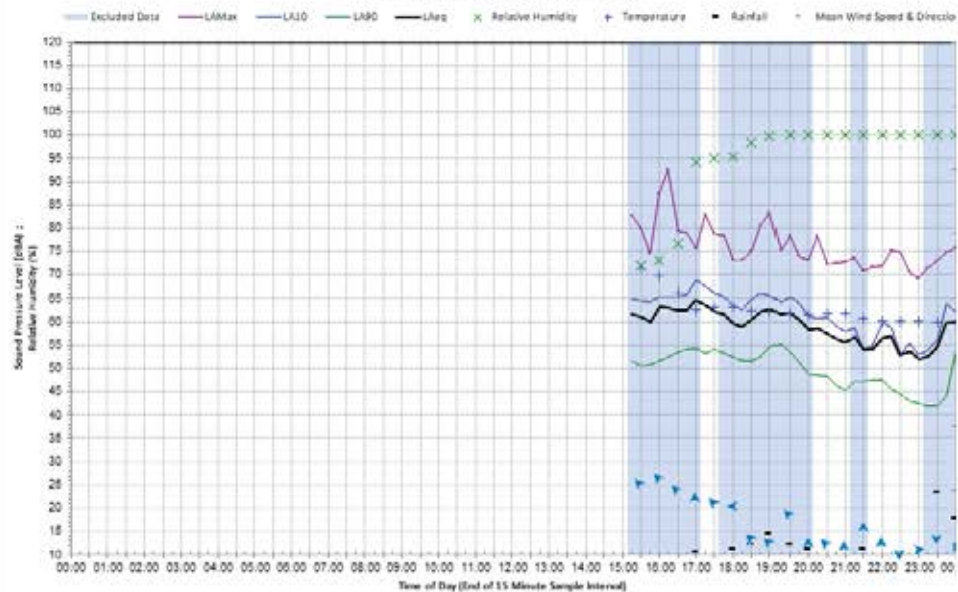
# Statistical Ambient Noise Levels - 100 South Street, Rydalmere

Wednesday 22 December 2021

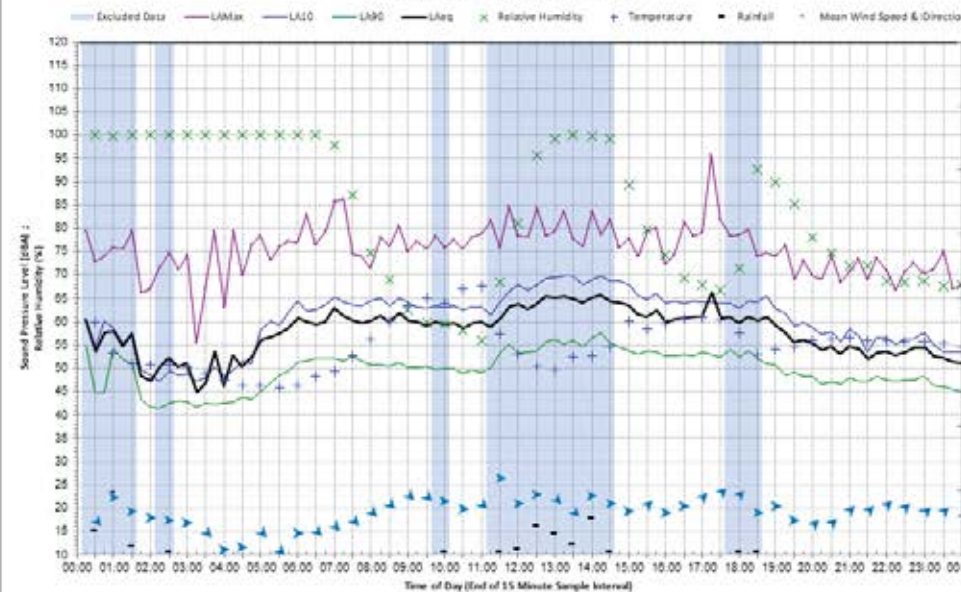




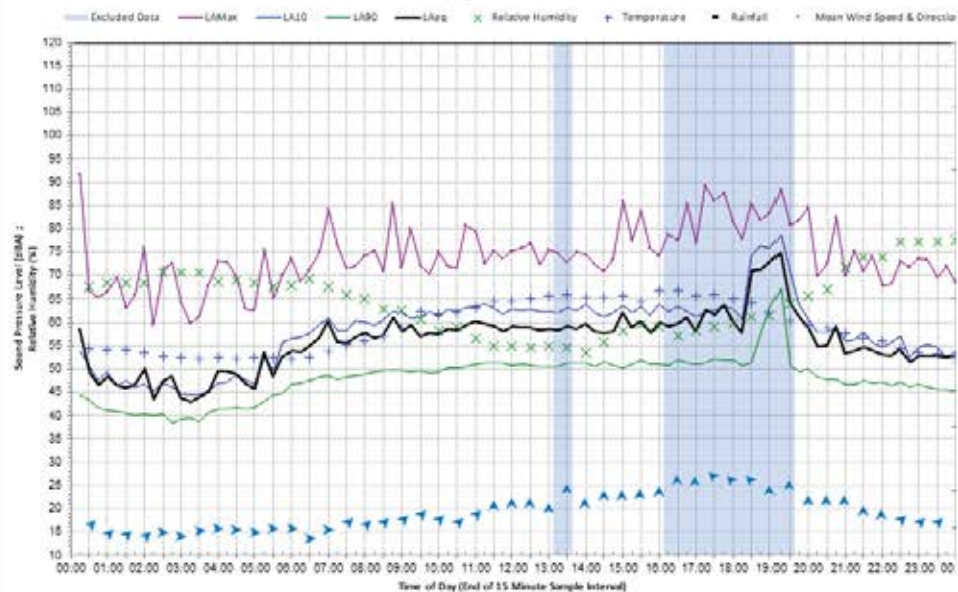
**Statistical Ambient Noise Levels - 168 South Street, Rydalmere**  
**Thursday 9 December 2021**



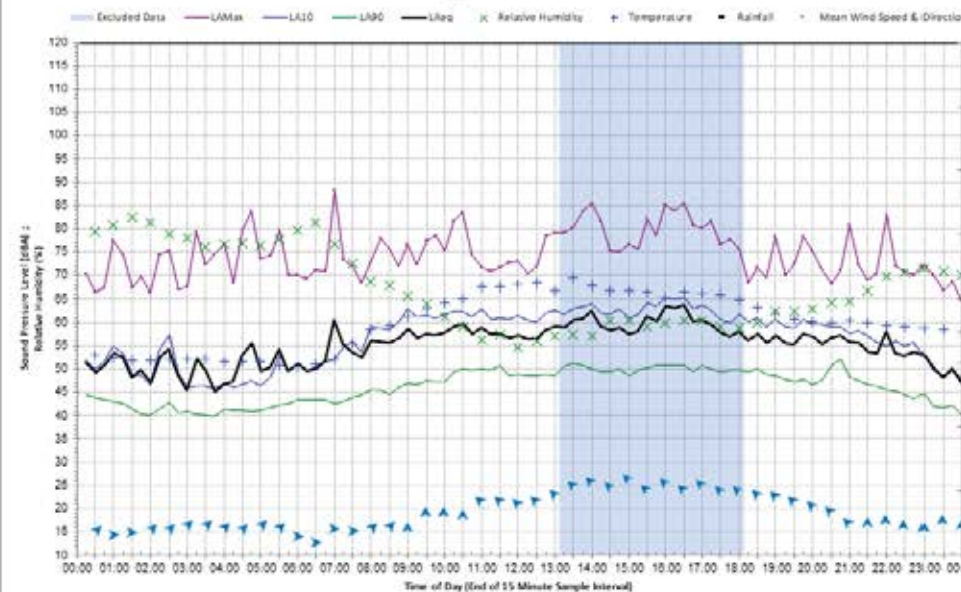
**Statistical Ambient Noise Levels - 168 South Street, Rydalmere**  
**Friday 10 December 2021**



**Statistical Ambient Noise Levels - 168 South Street, Rydalmere**  
**Saturday 11 December 2021**

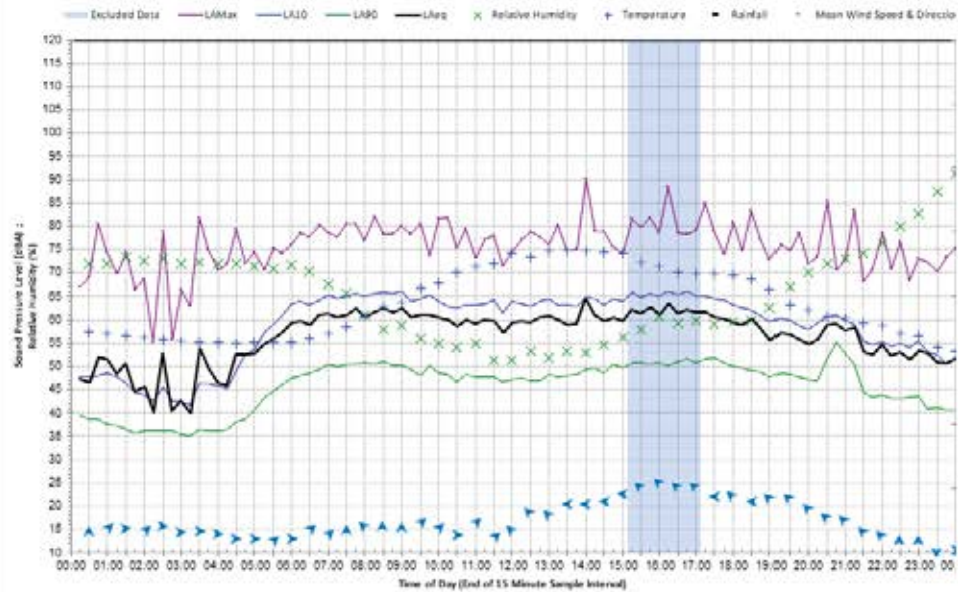


**Statistical Ambient Noise Levels - 168 South Street, Rydalmere**  
**Sunday 12 December 2021**

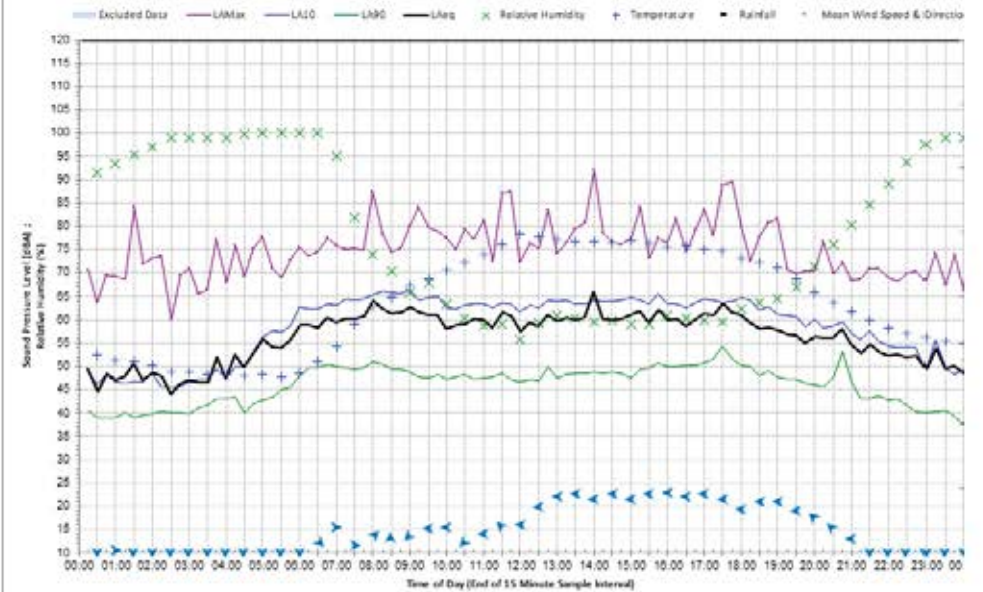




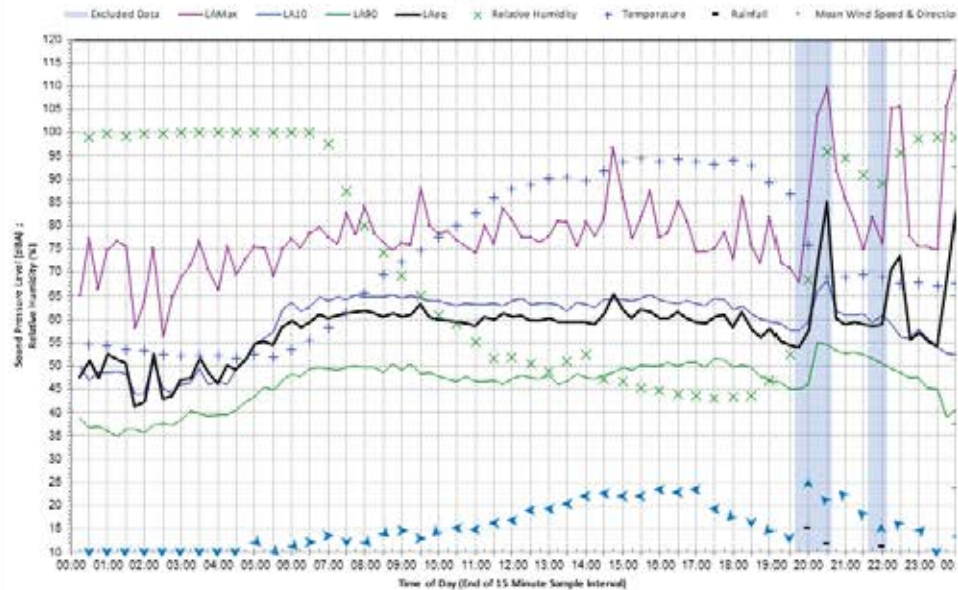
**Statistical Ambient Noise Levels - 168 South Street, Rydalmere**  
**Monday 13 December 2021**



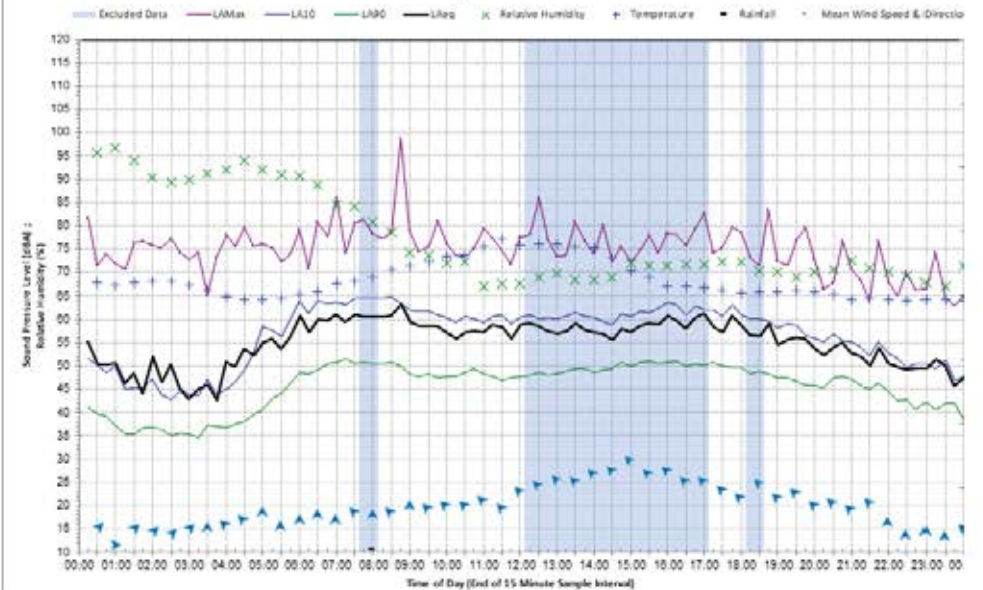
**Statistical Ambient Noise Levels - 168 South Street, Rydalmere**  
**Tuesday 14 December 2021**



**Statistical Ambient Noise Levels - 168 South Street, Rydalmere**  
**Wednesday 15 December 2021**

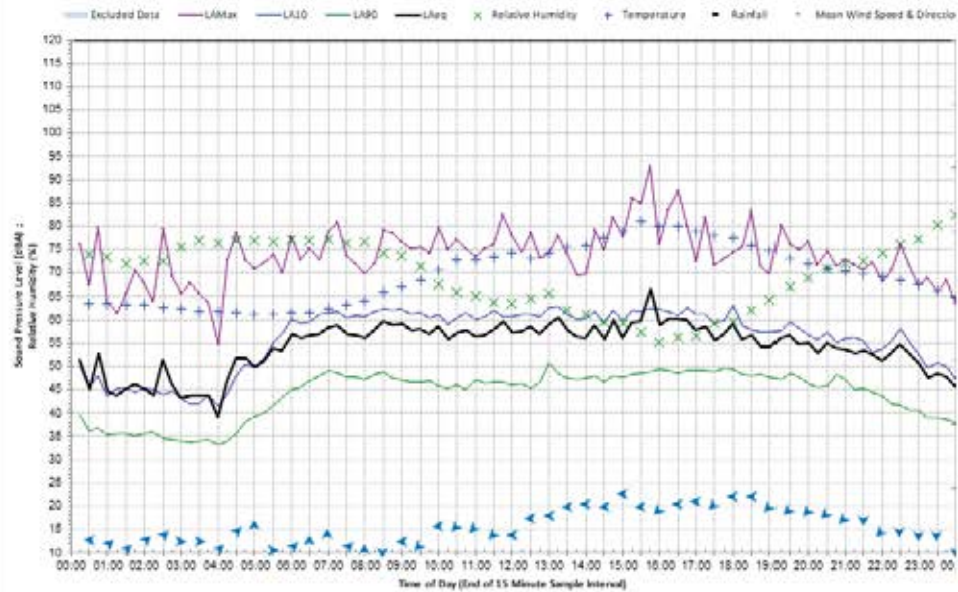


**Statistical Ambient Noise Levels - 168 South Street, Rydalmere**  
**Thursday 16 December 2021**

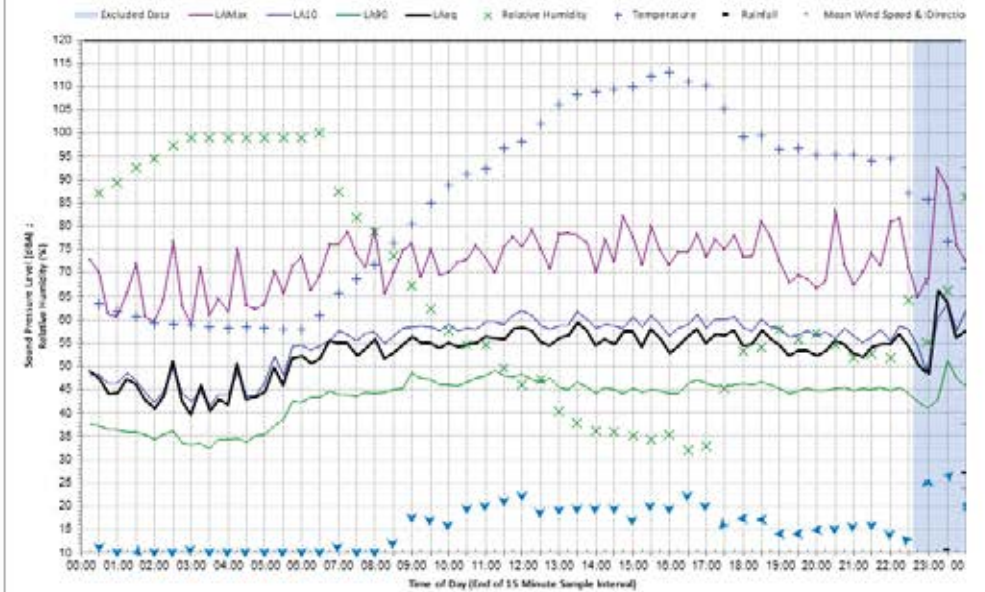




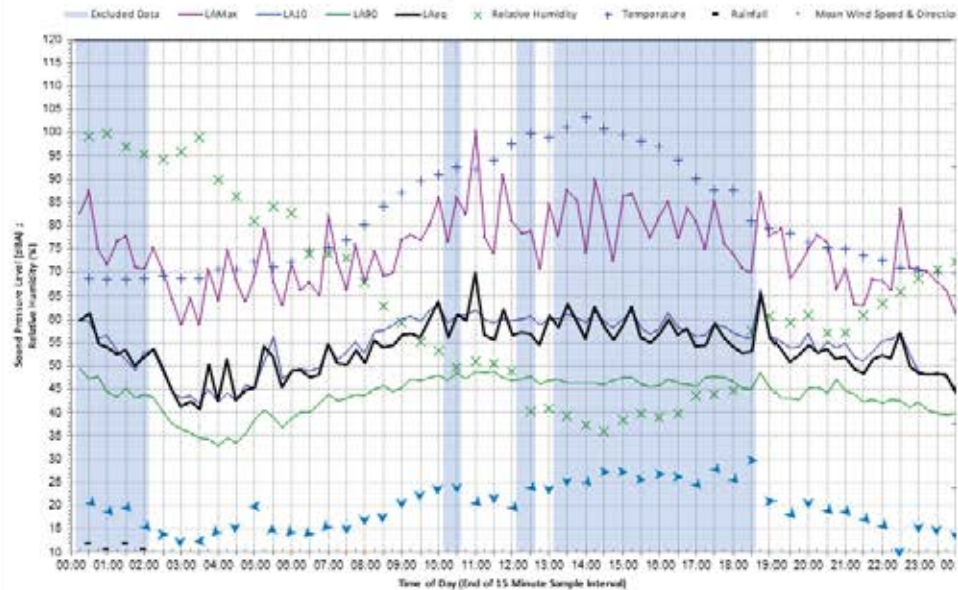
**Statistical Ambient Noise Levels - 168 South Street, Rydalmere**  
**Friday 17 December 2021**



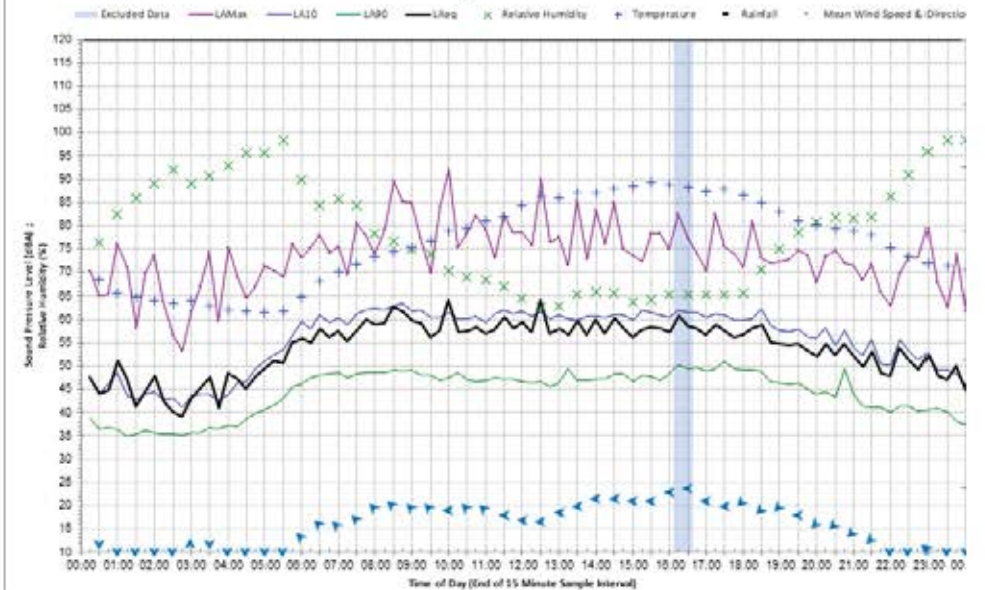
**Statistical Ambient Noise Levels - 168 South Street, Rydalmere**  
**Saturday 18 December 2021**



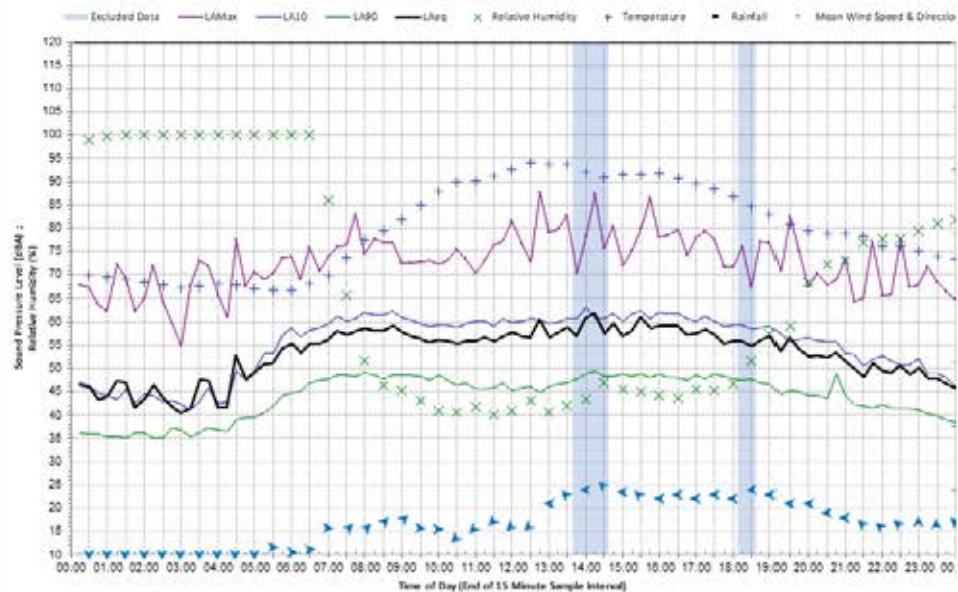
**Statistical Ambient Noise Levels - 168 South Street, Rydalmere**  
**Sunday 19 December 2021**



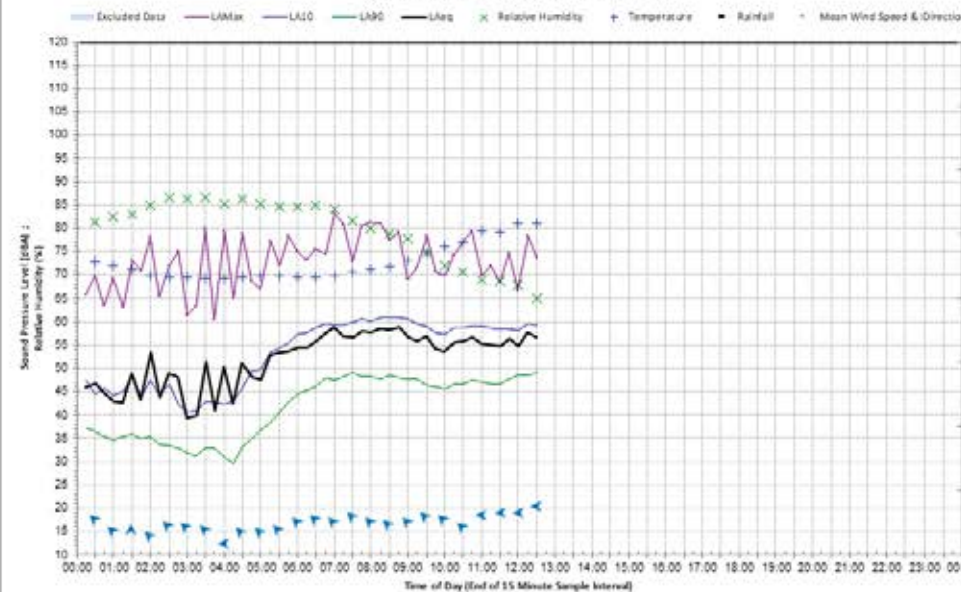
**Statistical Ambient Noise Levels - 168 South Street, Rydalmere**  
**Monday 20 December 2021**



### Statistical Ambient Noise Levels - 168 South Street, Rydalmere Tuesday 21 December 2021



### Statistical Ambient Noise Levels - 168 South Street, Rydalmere Wednesday 22 December 2021

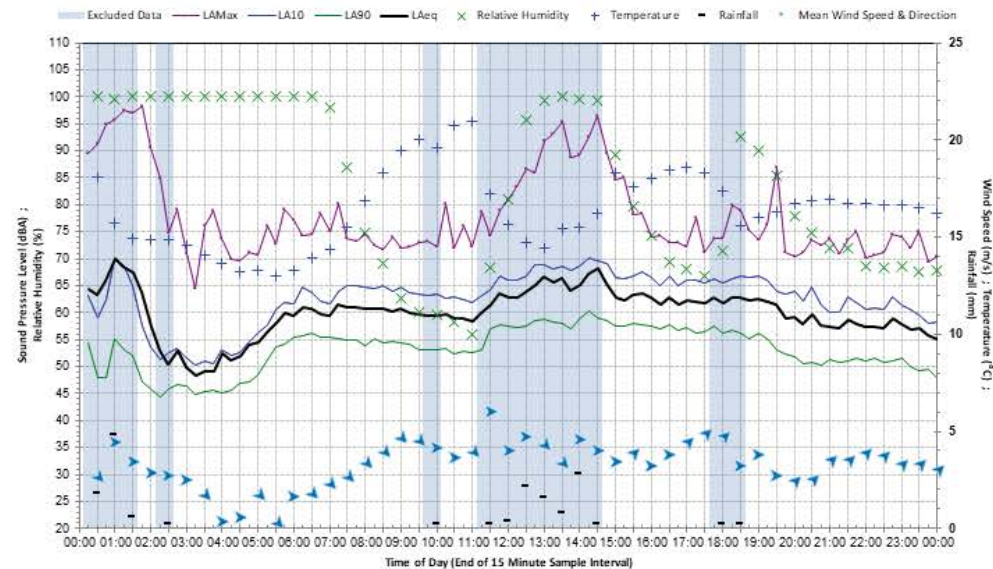




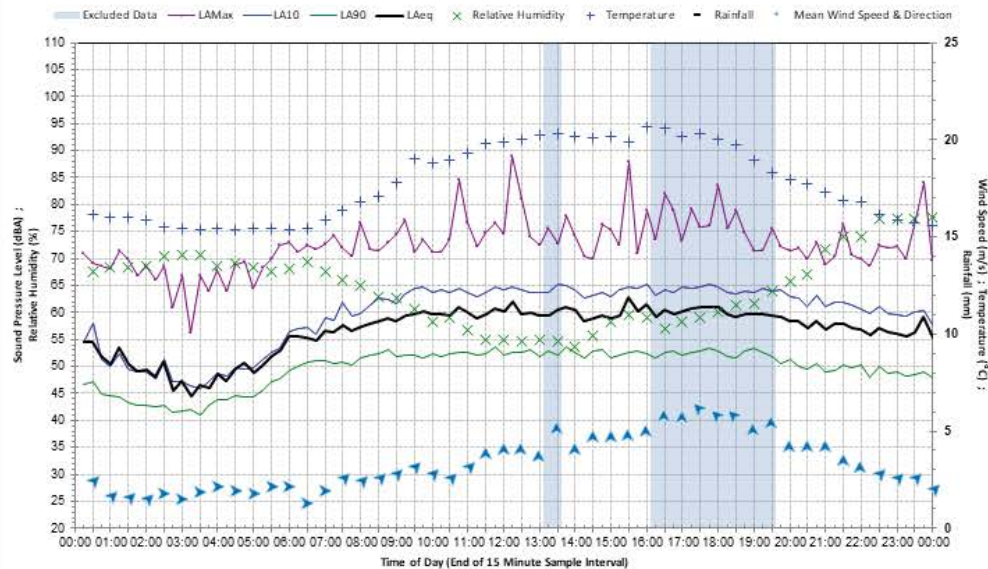
**Statistical Ambient Noise Levels - 33 River Road, Ermington**  
**Thursday 9 December 2021**



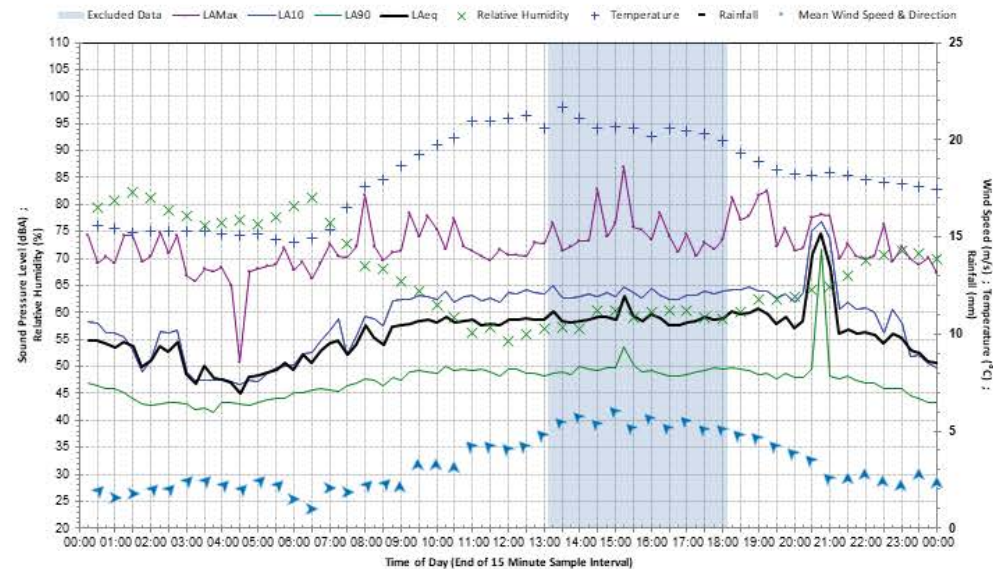
**Statistical Ambient Noise Levels - 33 River Road, Ermington**  
**Friday 10 December 2021**



**Statistical Ambient Noise Levels - 33 River Road, Ermington**  
**Saturday 11 December 2021**

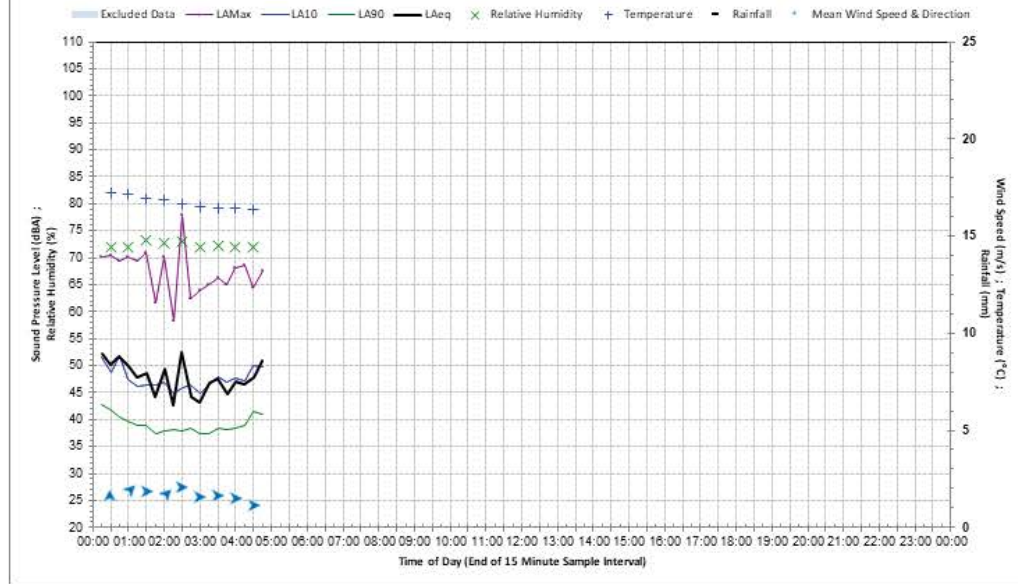


**Statistical Ambient Noise Levels - 33 River Road, Ermington**  
**Sunday 12 December 2021**



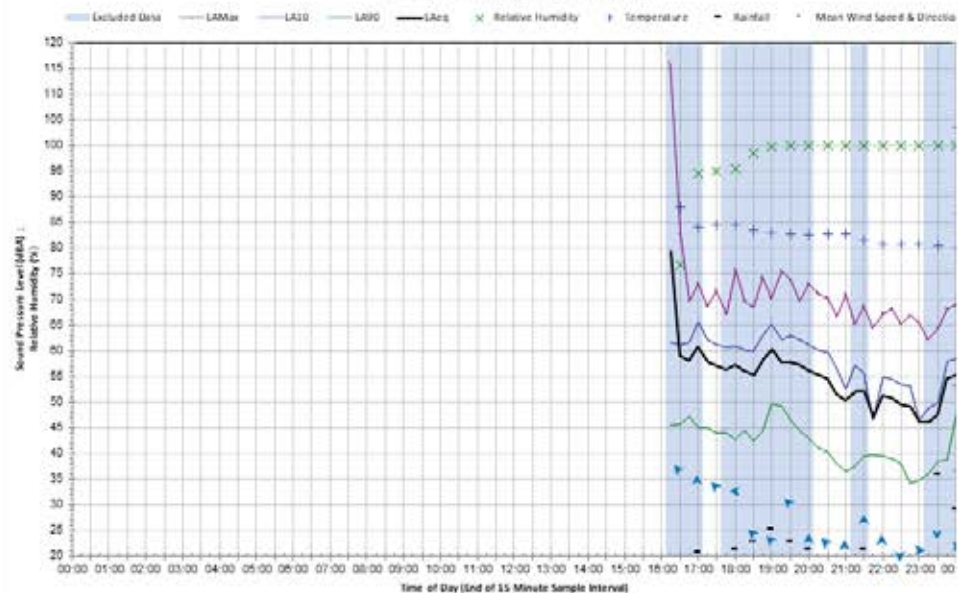
# Statistical Ambient Noise Levels - 33 River Road, Ermington

Monday 13 December 2021

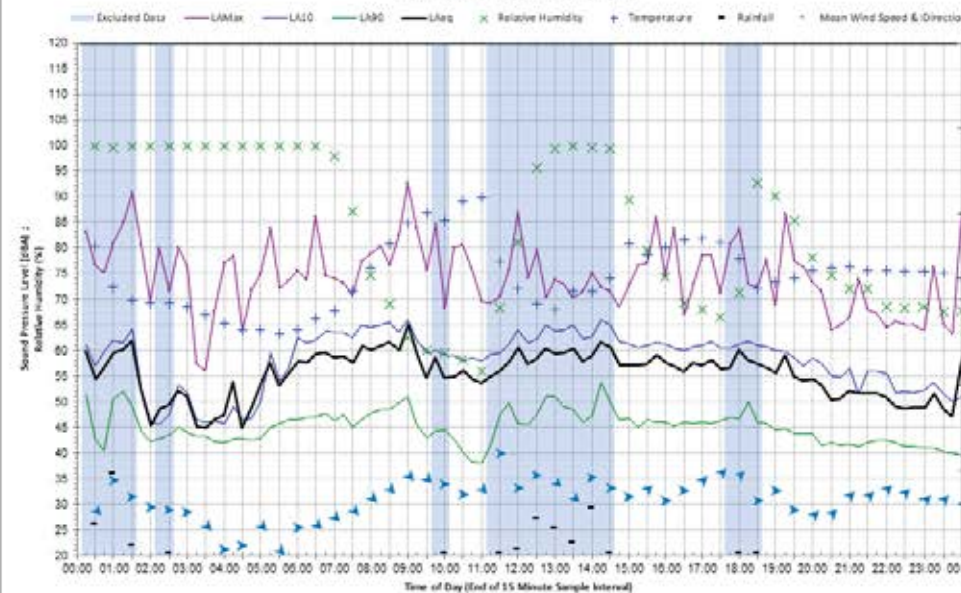




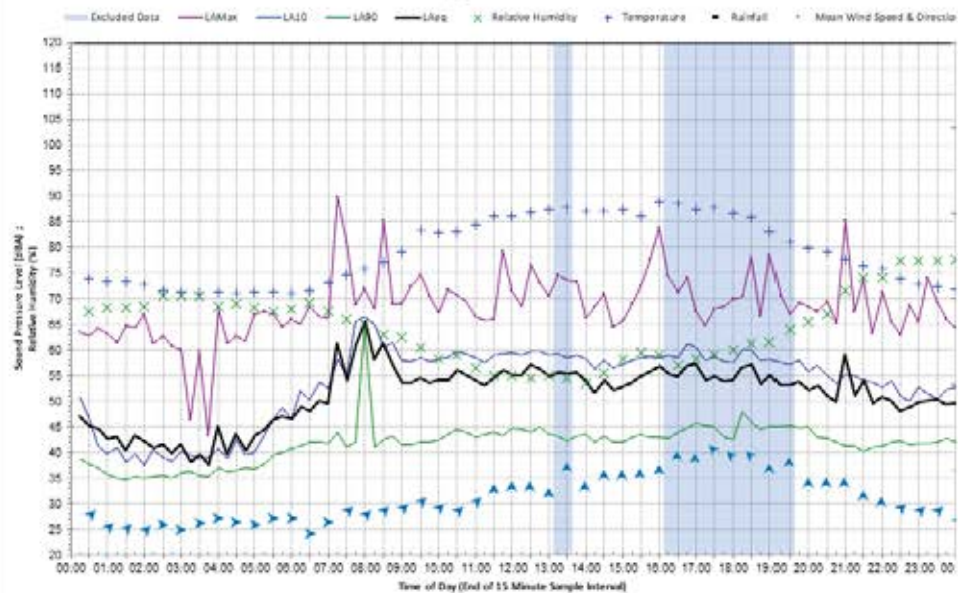
**Statistical Ambient Noise Levels - 55 Boronia Street, Ermington**  
**Thursday 9 December 2021**



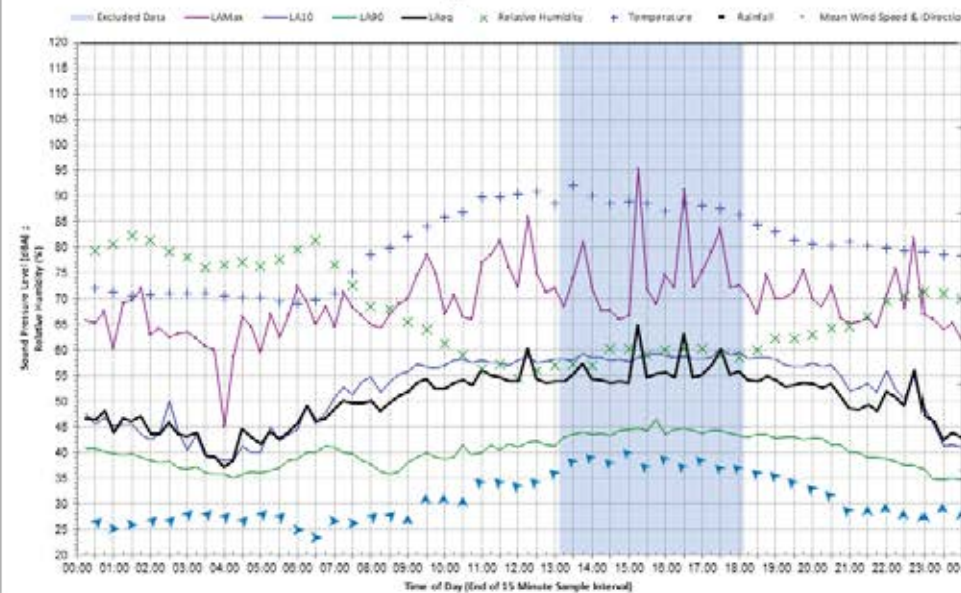
**Statistical Ambient Noise Levels - 55 Boronia Street, Ermington**  
**Friday 10 December 2021**



**Statistical Ambient Noise Levels - 55 Boronia Street, Ermington**  
**Saturday 11 December 2021**

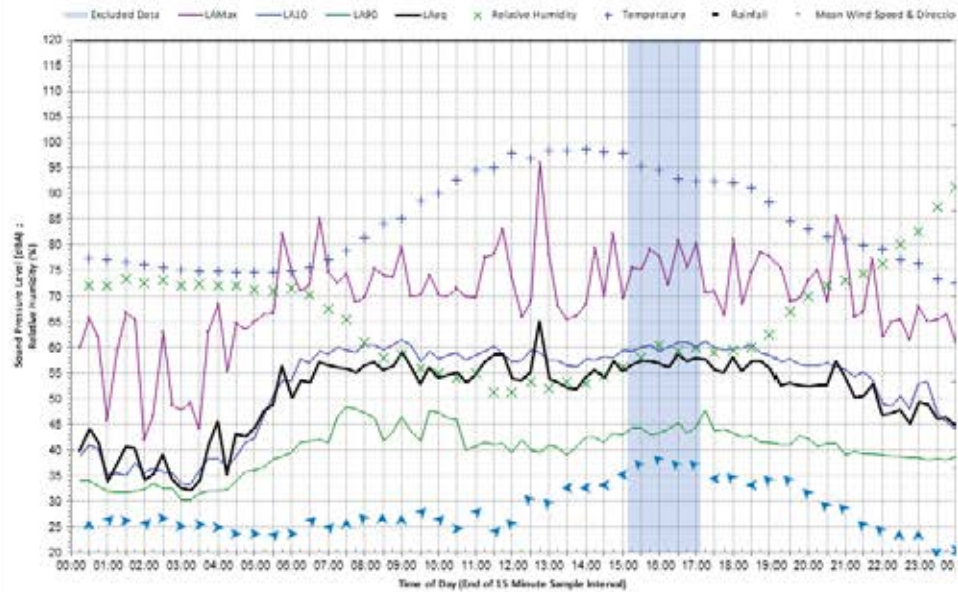


**Statistical Ambient Noise Levels - 55 Boronia Street, Ermington**  
**Sunday 12 December 2021**

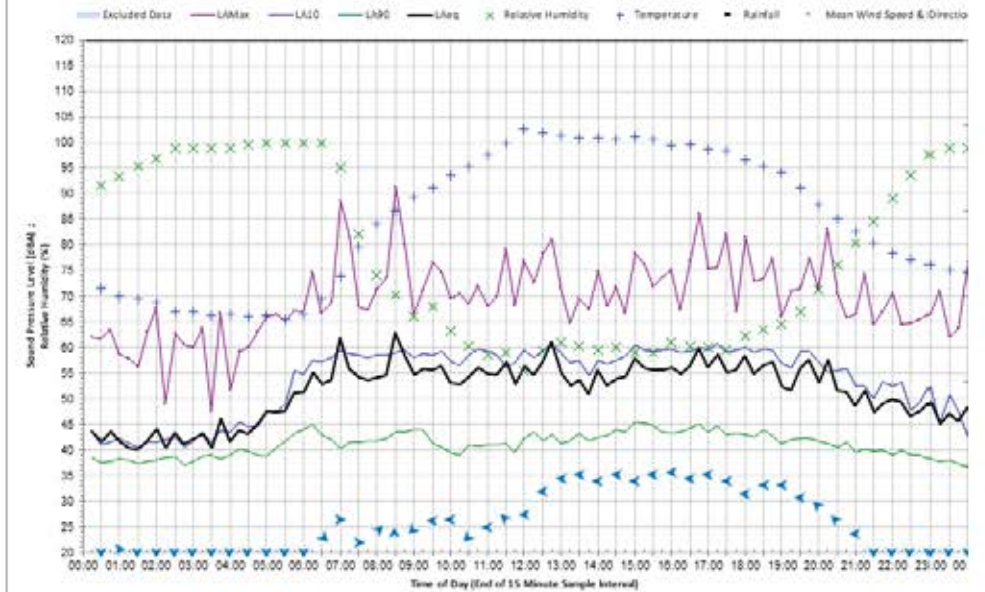




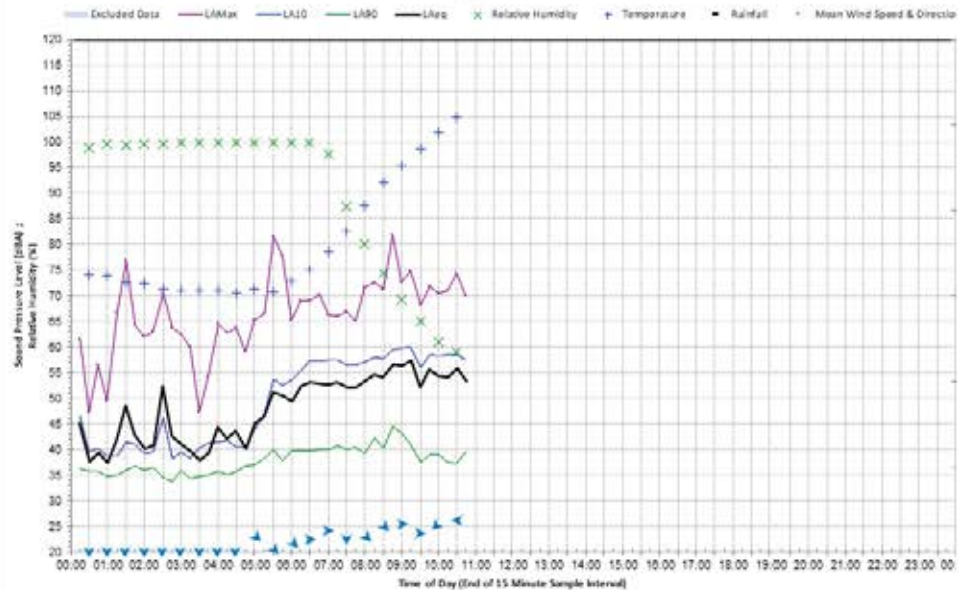
**Statistical Ambient Noise Levels - 55 Boronia Street, Ermington**  
**Monday 13 December 2021**



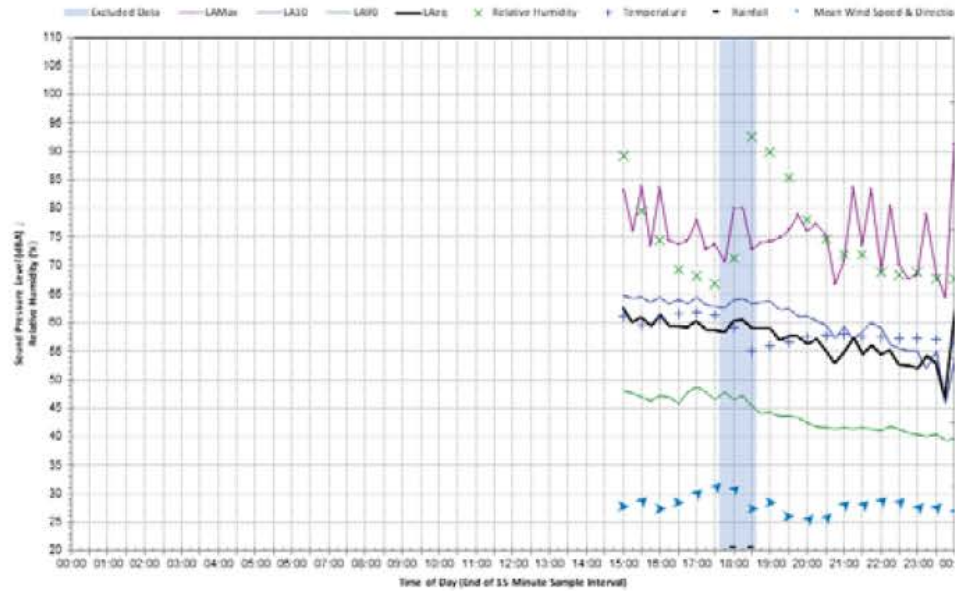
**Statistical Ambient Noise Levels - 55 Boronia Street, Ermington**  
**Tuesday 14 December 2021**



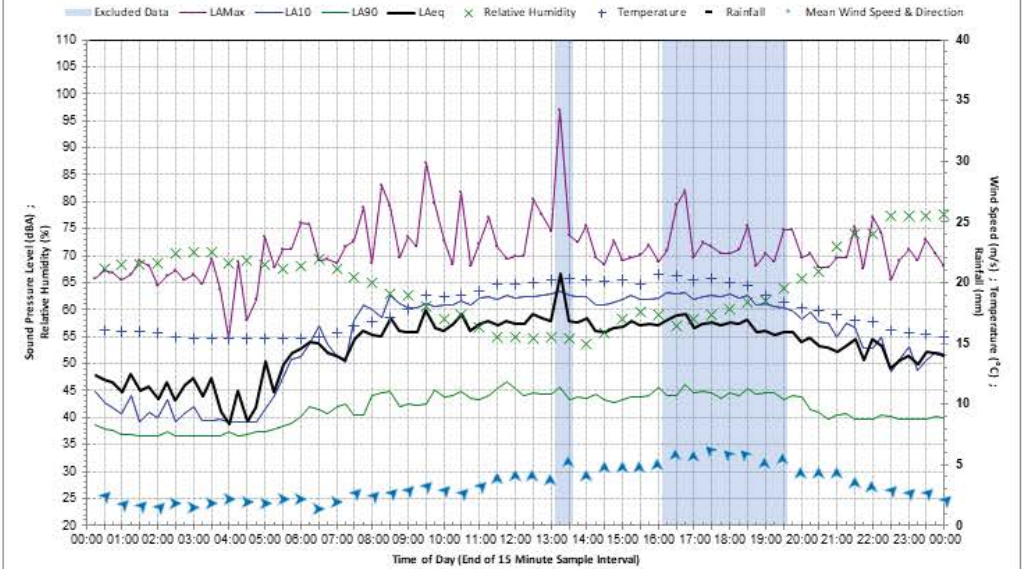
**Statistical Ambient Noise Levels - 55 Boronia Street, Ermington**  
**Wednesday 15 December 2021**



**Statistical Ambient Noise Levels - 9 Hope Street, Ermington**  
**Friday 10 December 2021**



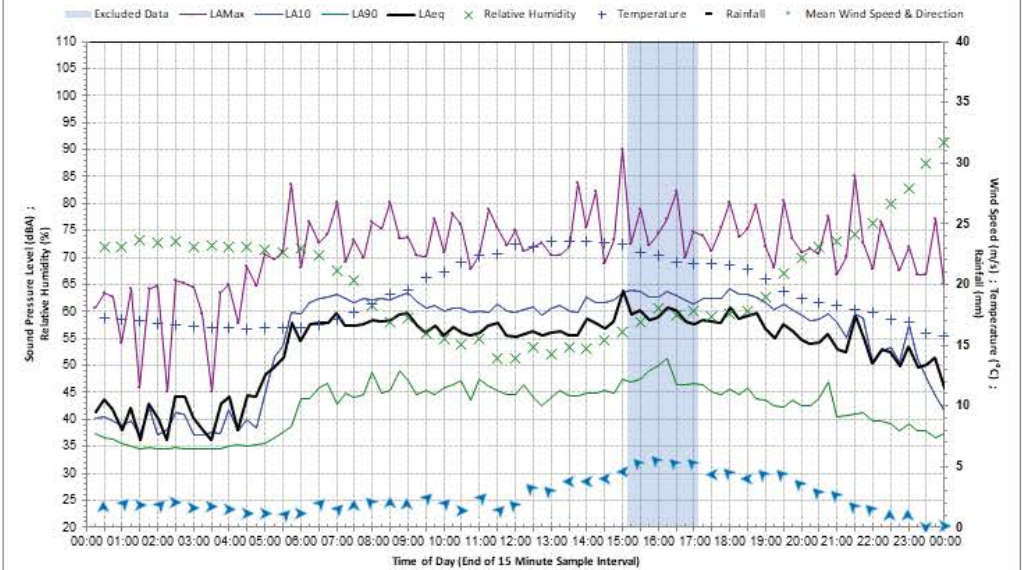
**Statistical Ambient Noise Levels - 9 Hope Street, Ermington**  
**Saturday 11 December 2021**



**Statistical Ambient Noise Levels - 9 Hope Street, Ermington**  
**Sunday 12 December 2021**

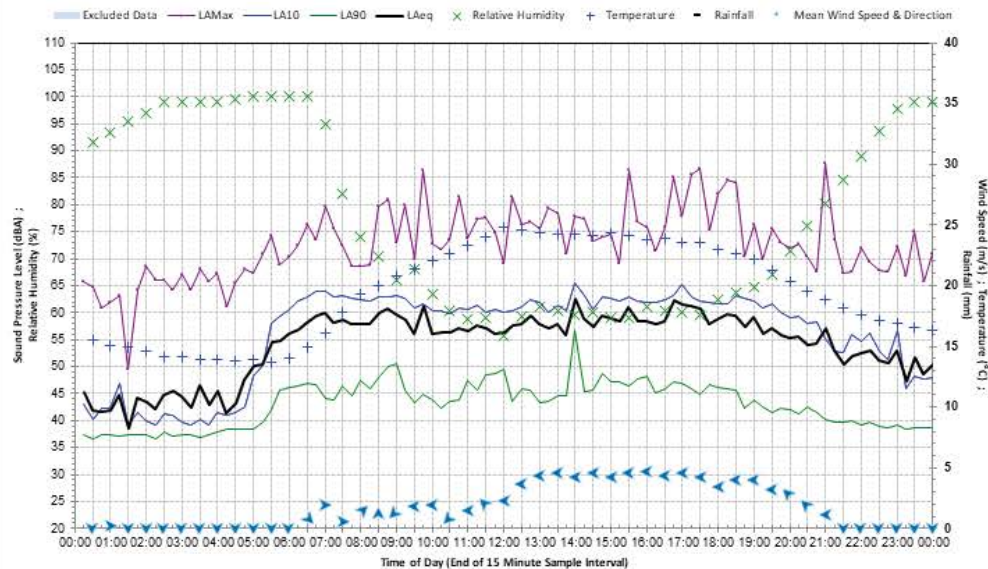


**Statistical Ambient Noise Levels - 9 Hope Street, Ermington**  
**Monday 13 December 2021**

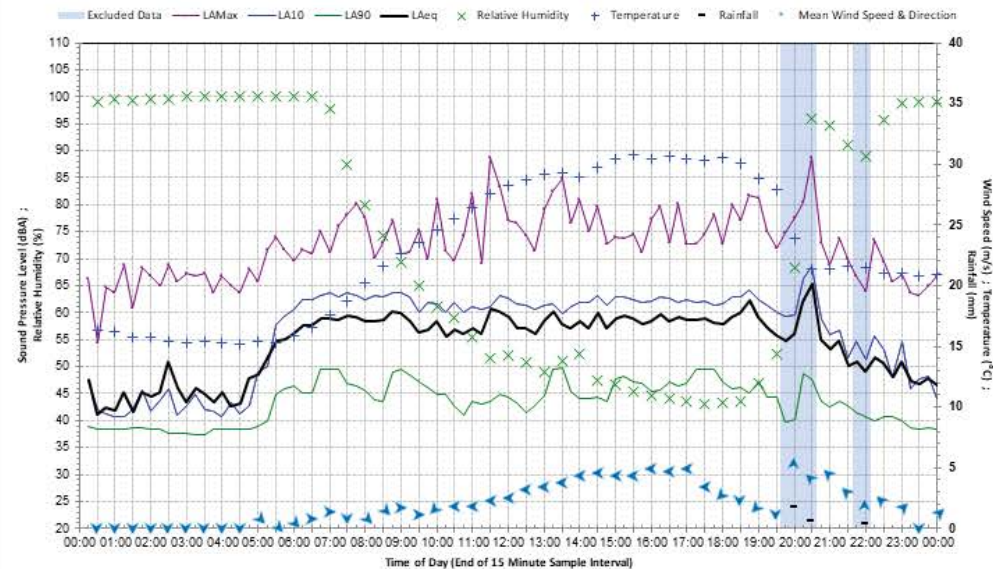




**Statistical Ambient Noise Levels - 9 Hope Street, Ermington**  
**Tuesday 14 December 2021**



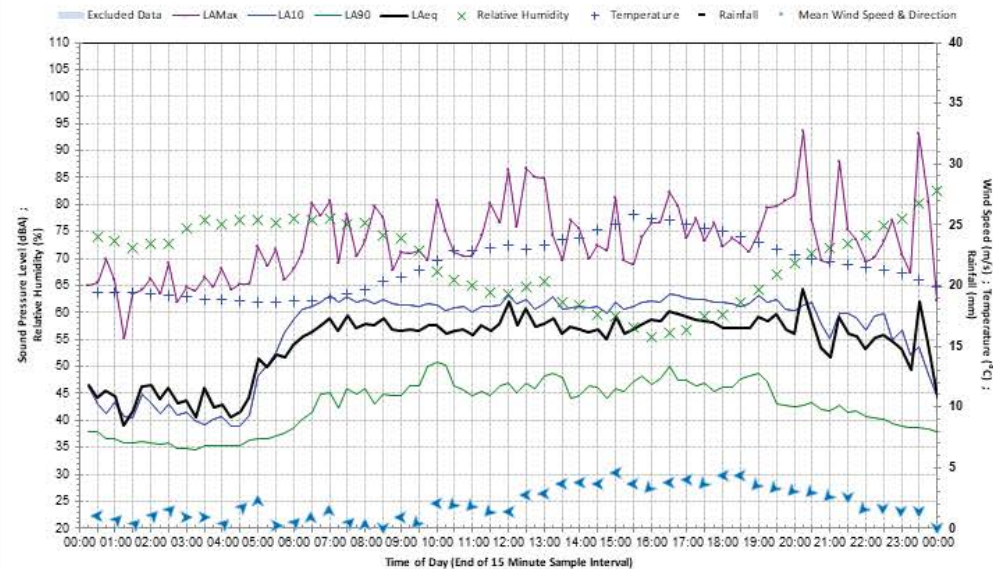
**Statistical Ambient Noise Levels - 9 Hope Street, Ermington**  
**Wednesday 15 December 2021**



**Statistical Ambient Noise Levels - 9 Hope Street, Ermington**  
**Thursday 16 December 2021**

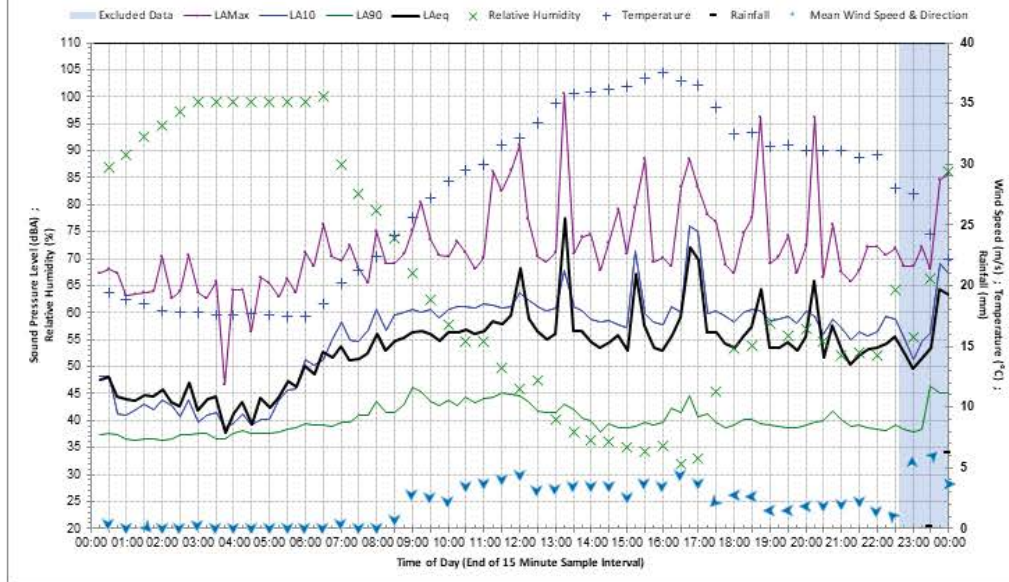


**Statistical Ambient Noise Levels - 9 Hope Street, Ermington**  
**Friday 17 December 2021**

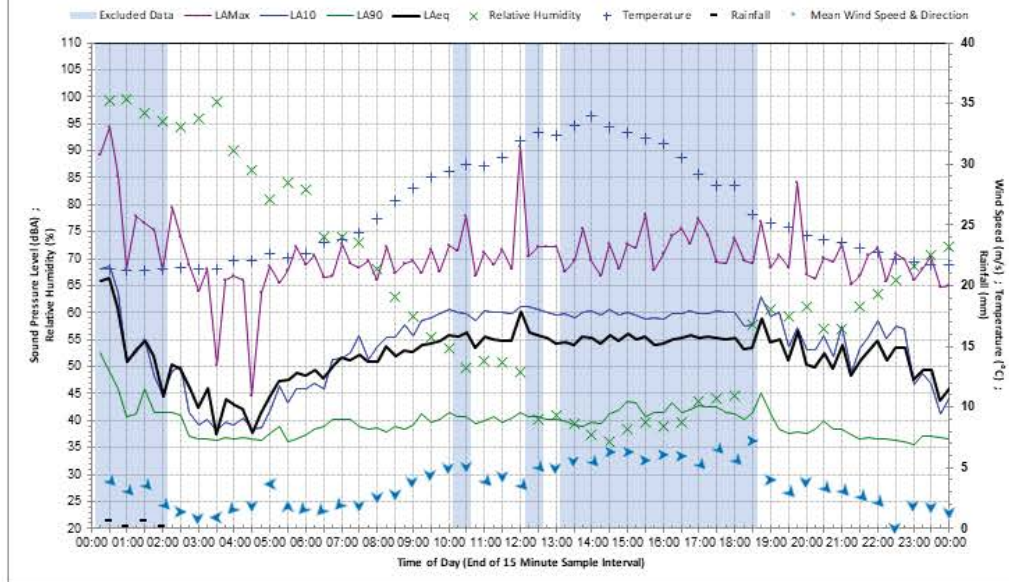




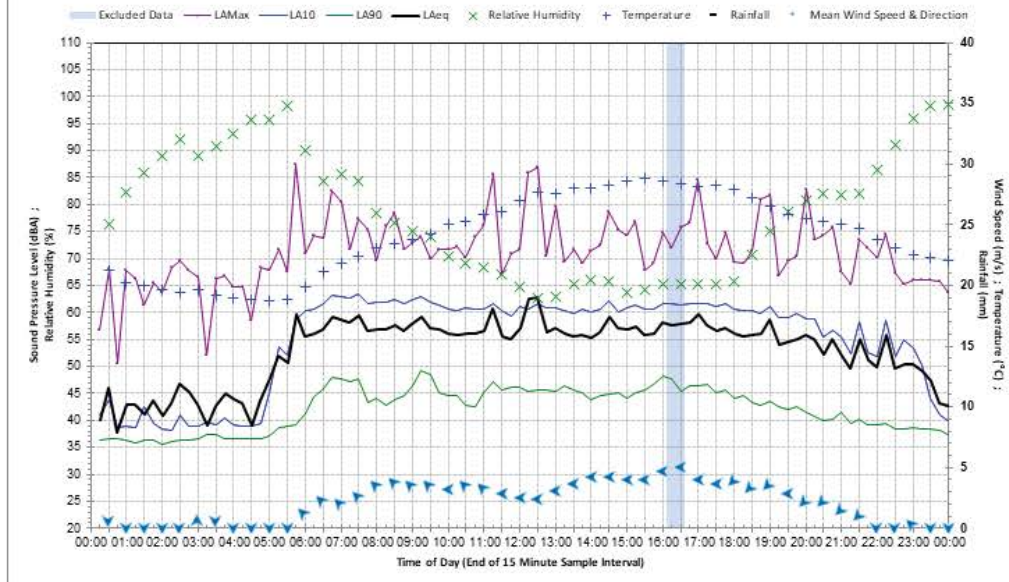
**Statistical Ambient Noise Levels - 9 Hope Street, Ermington**  
**Saturday 18 December 2021**



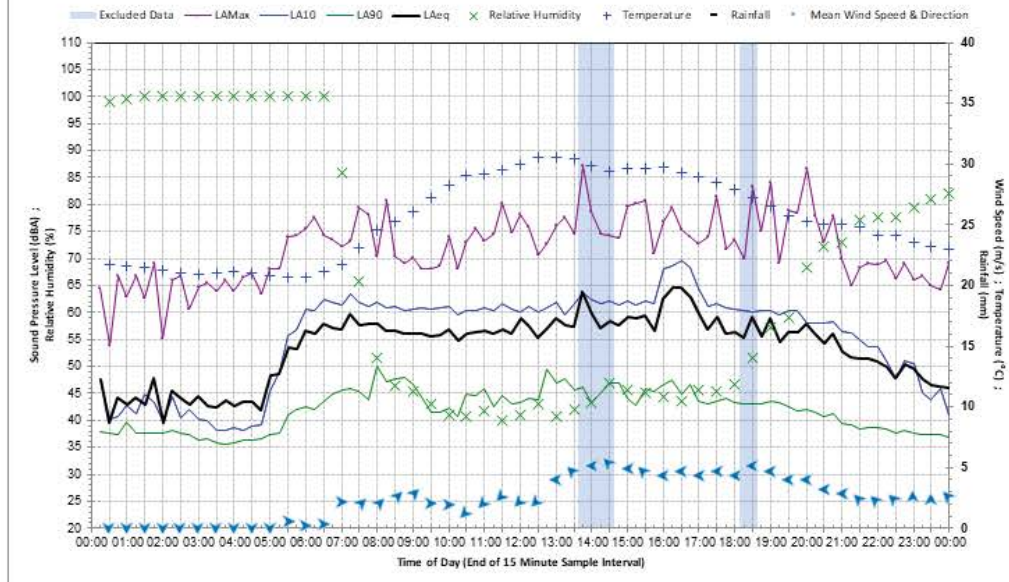
**Statistical Ambient Noise Levels - 9 Hope Street, Ermington**  
**Sunday 19 December 2021**



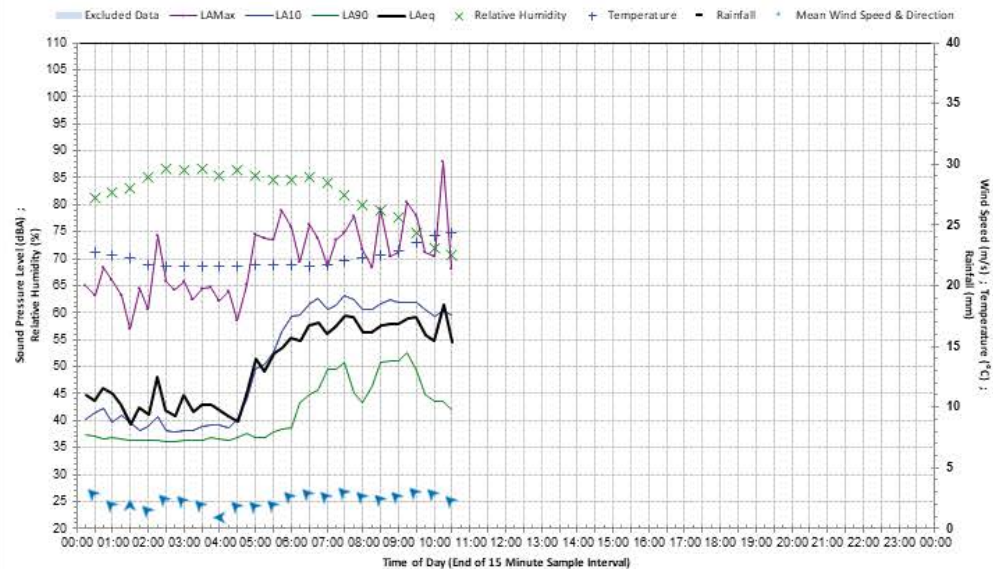
**Statistical Ambient Noise Levels - 9 Hope Street, Ermington**  
**Monday 20 December 2021**



**Statistical Ambient Noise Levels - 9 Hope Street, Ermington**  
**Tuesday 21 December 2021**

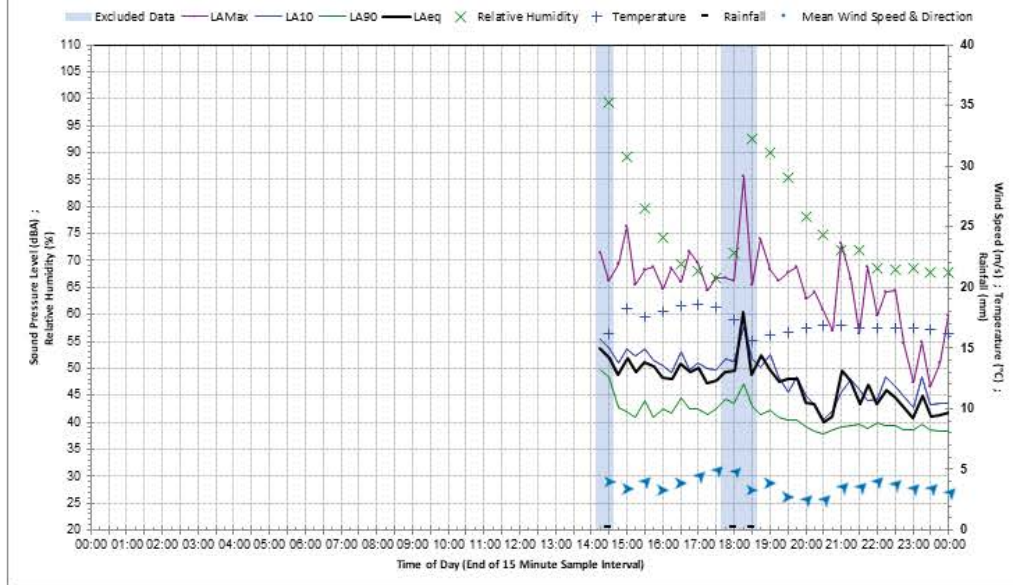


# Statistical Ambient Noise Levels - 9 Hope Street, Ermington Wednesday 22 December 2021

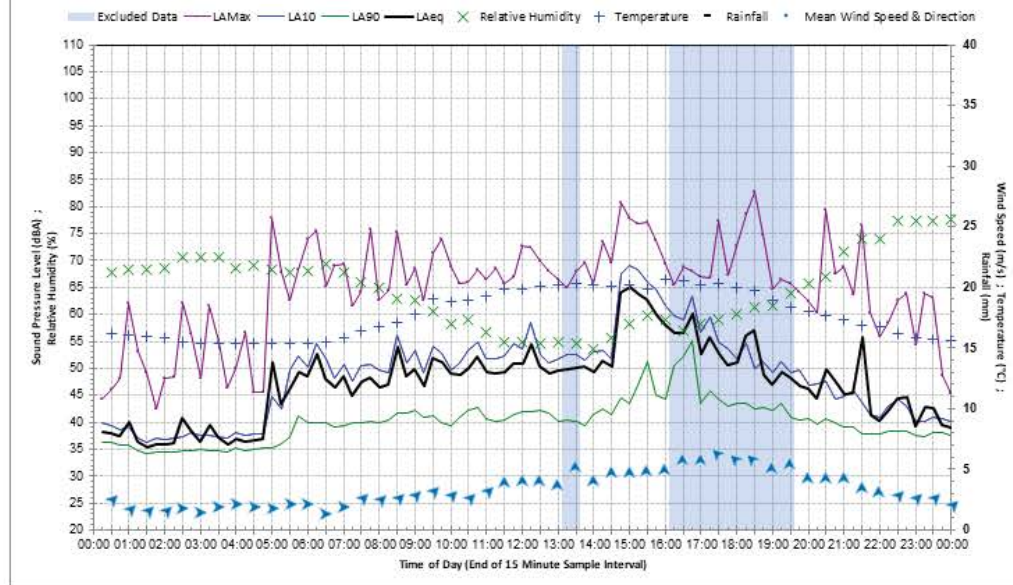




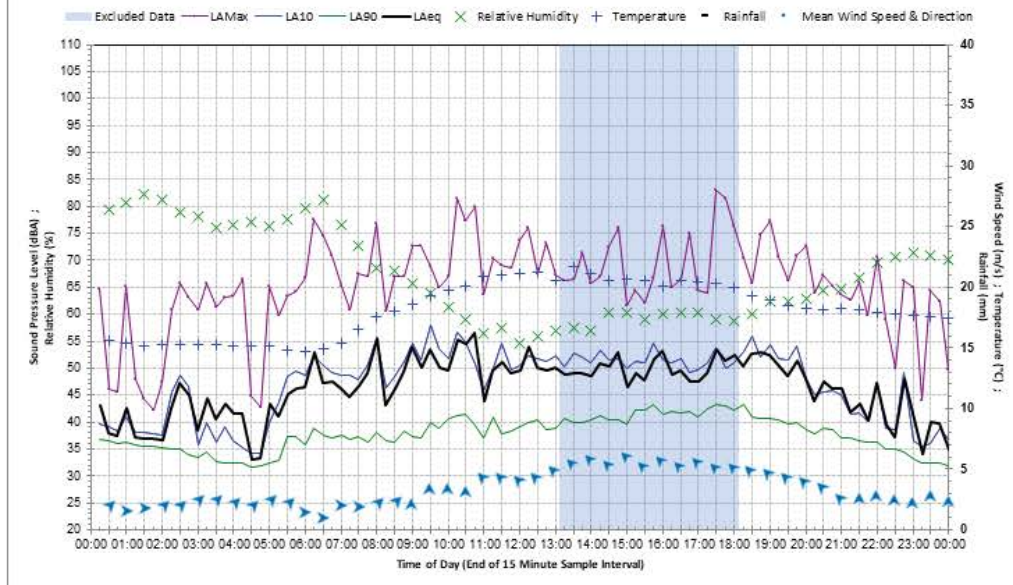
**Statistical Ambient Noise Levels - 78 Lancaster Avenue, Melrose Park**  
**Friday 10 December 2021**



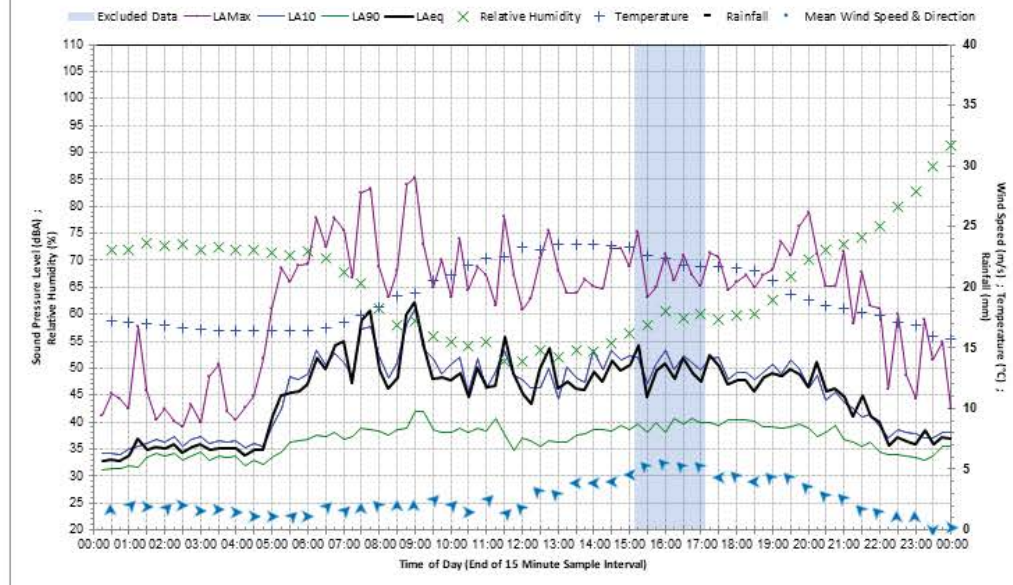
**Statistical Ambient Noise Levels - 78 Lancaster Avenue, Melrose Park**  
**Saturday 11 December 2021**



**Statistical Ambient Noise Levels - 78 Lancaster Avenue, Melrose Park**  
**Sunday 12 December 2021**

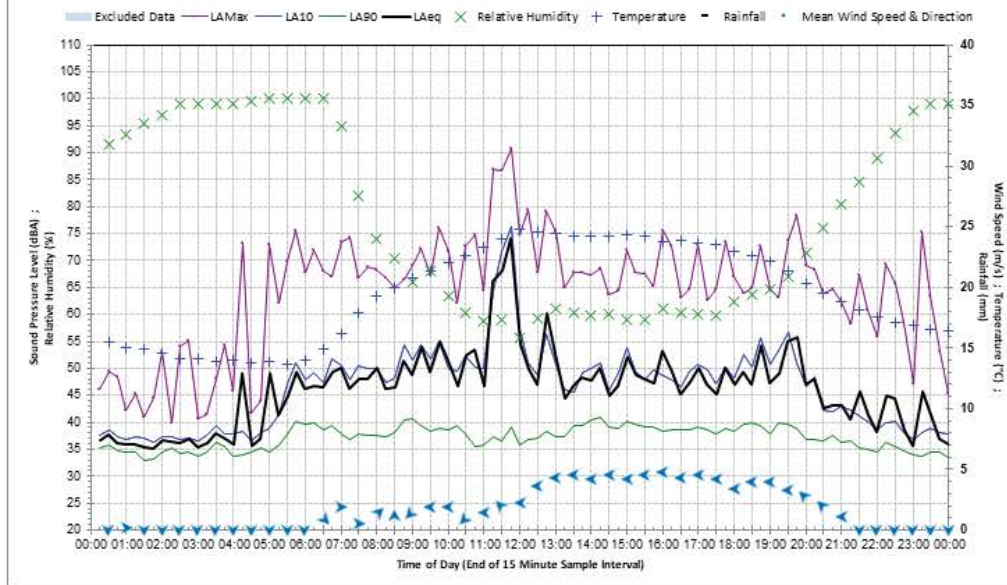


**Statistical Ambient Noise Levels - 78 Lancaster Avenue, Melrose Park**  
**Monday 13 December 2021**

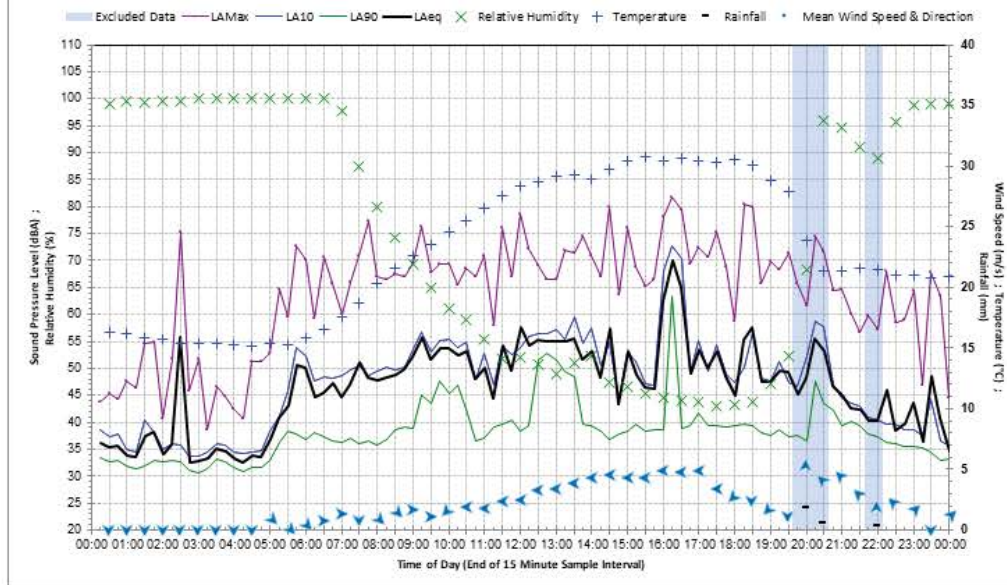




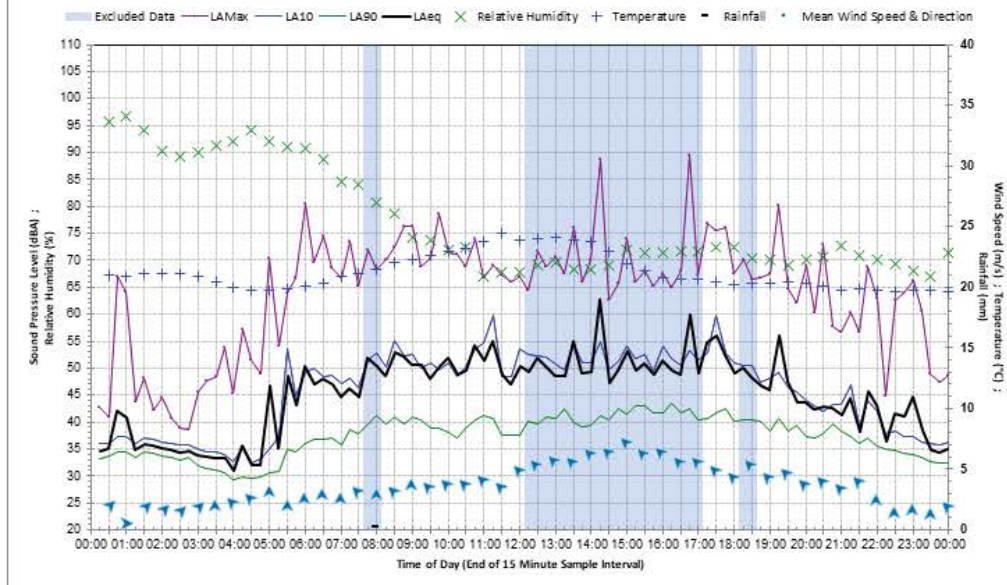
**Statistical Ambient Noise Levels - 78 Lancaster Avenue, Melrose Park**  
**Tuesday 14 December 2021**



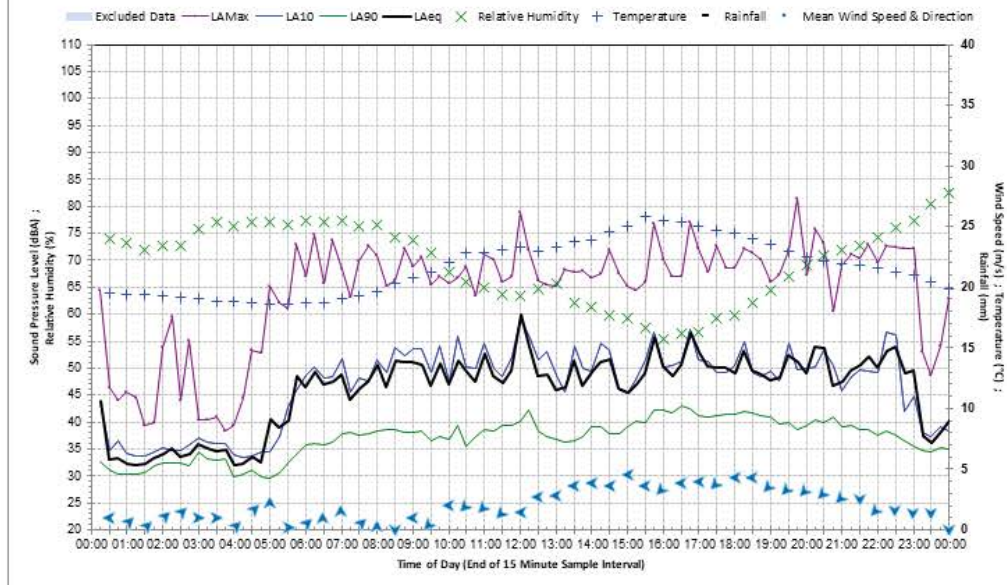
**Statistical Ambient Noise Levels - 78 Lancaster Avenue, Melrose Park**  
**Wednesday 15 December 2021**



**Statistical Ambient Noise Levels - 78 Lancaster Avenue, Melrose Park**  
**Thursday 16 December 2021**

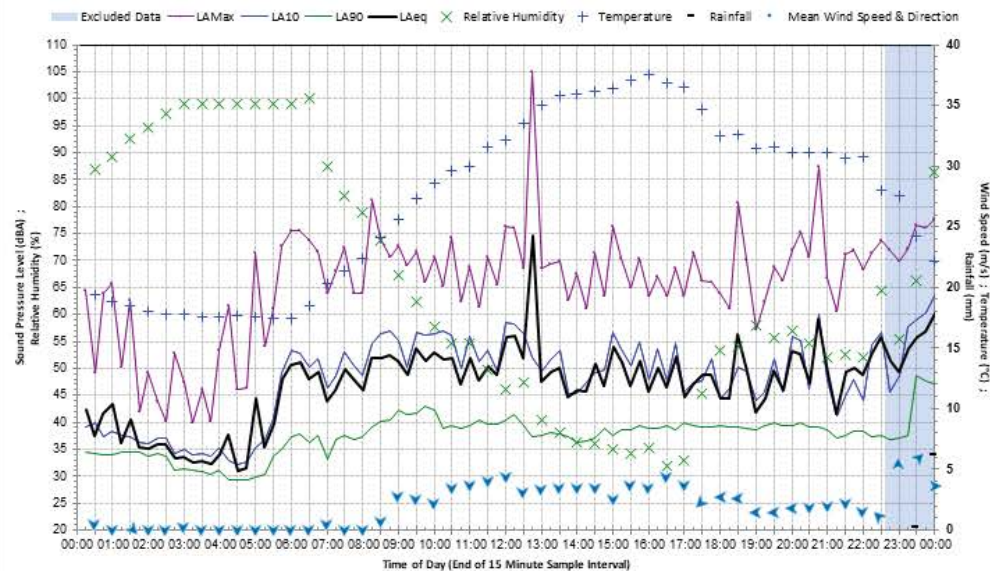


**Statistical Ambient Noise Levels - 78 Lancaster Avenue, Melrose Park**  
**Friday 17 December 2021**

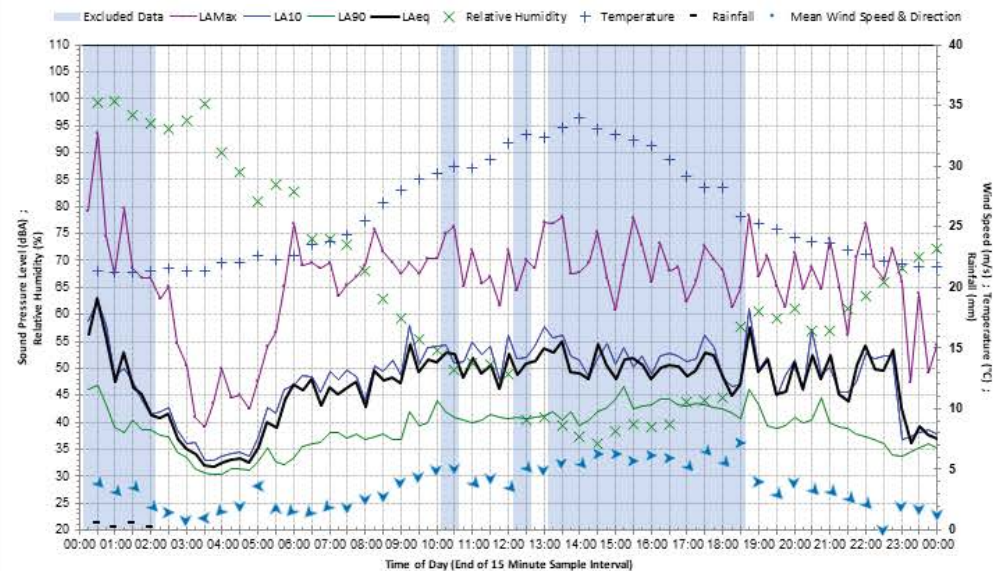




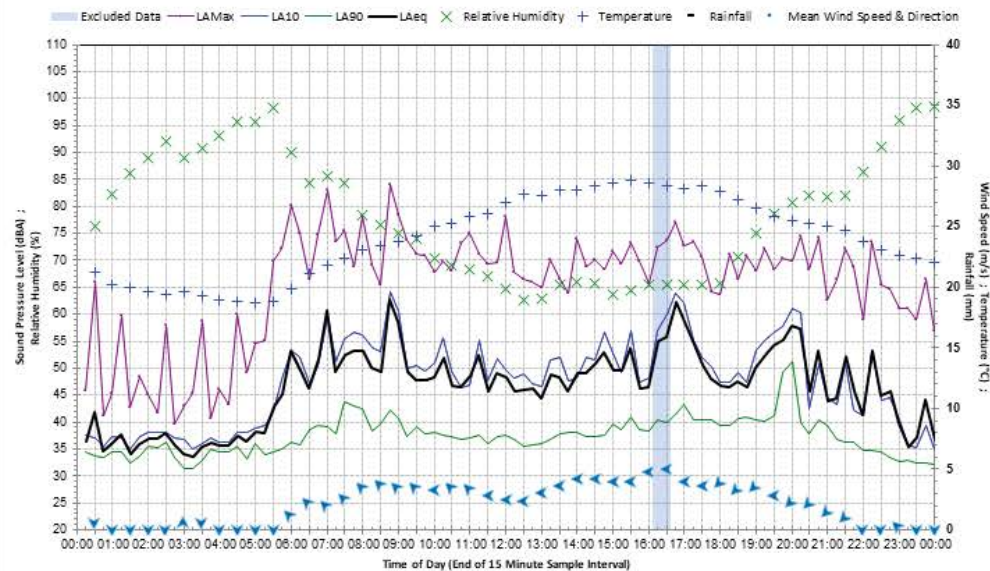
**Statistical Ambient Noise Levels - 78 Lancaster Avenue, Melrose Park**  
**Saturday 18 December 2021**



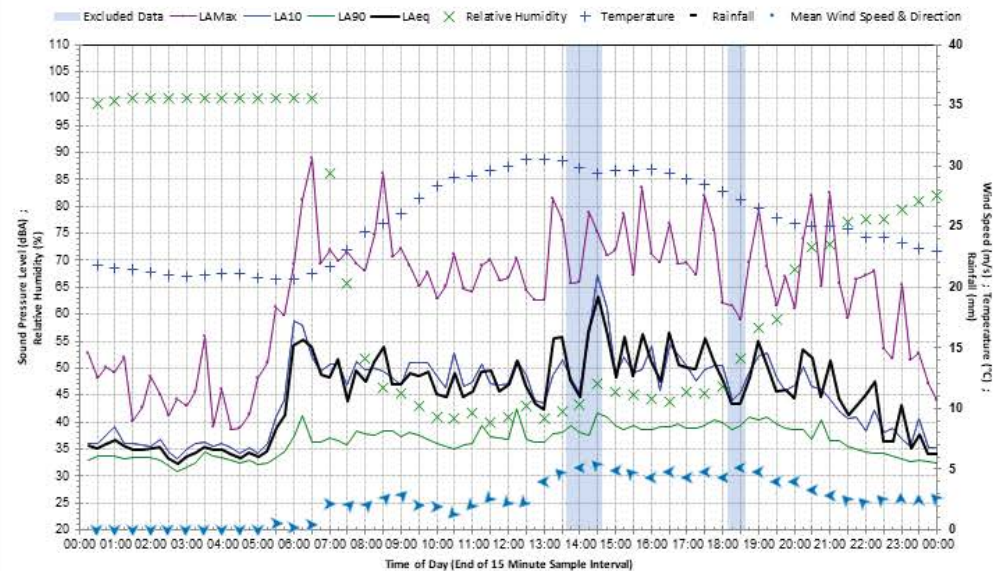
**Statistical Ambient Noise Levels - 78 Lancaster Avenue, Melrose Park**  
**Sunday 19 December 2021**



**Statistical Ambient Noise Levels - 78 Lancaster Avenue, Melrose Park**  
**Monday 20 December 2021**

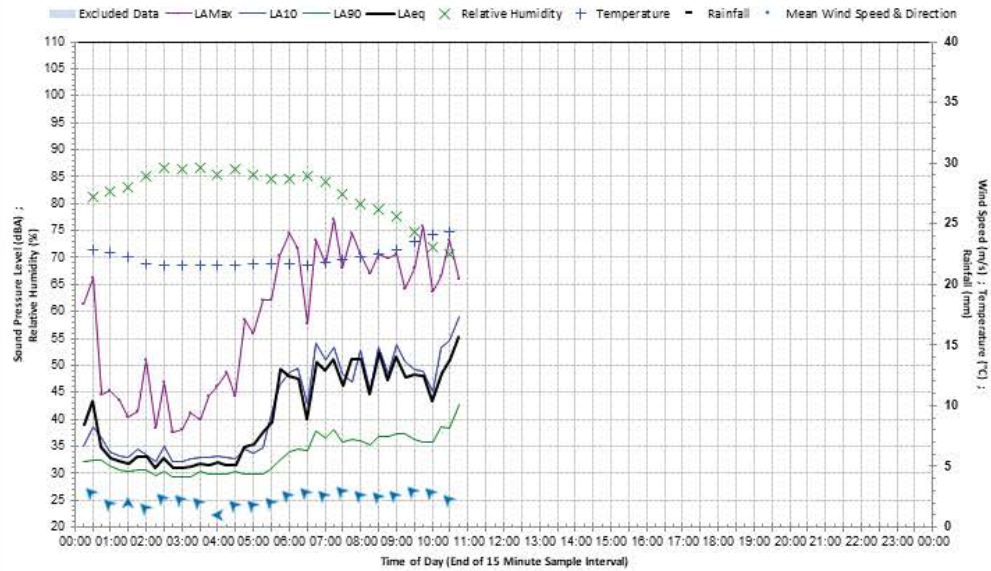


**Statistical Ambient Noise Levels - 78 Lancaster Avenue, Melrose Park**  
**Tuesday 21 December 2021**



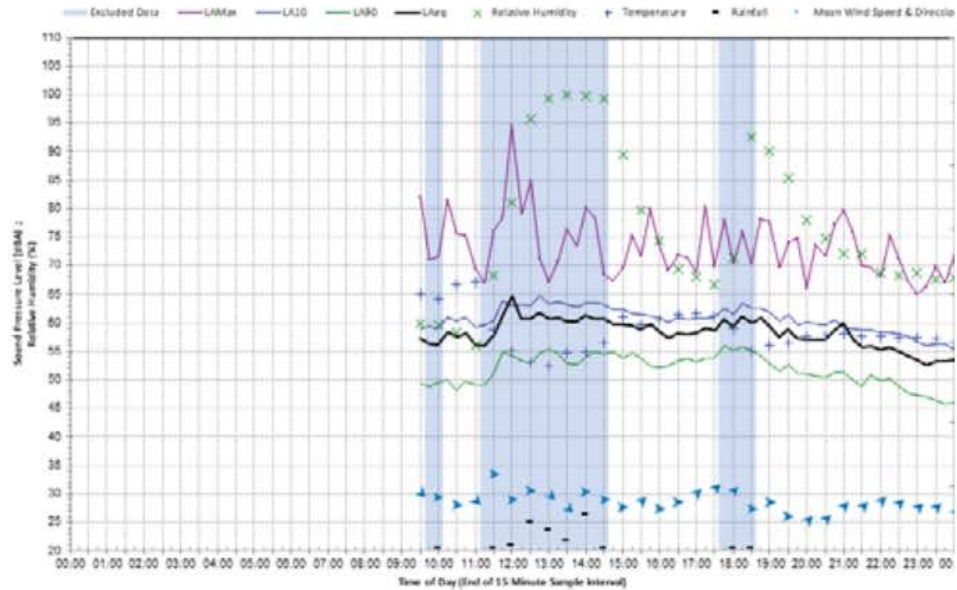
# Statistical Ambient Noise Levels - 78 Lancaster Avenue, Melrose Park

Wednesday 22 December 2021

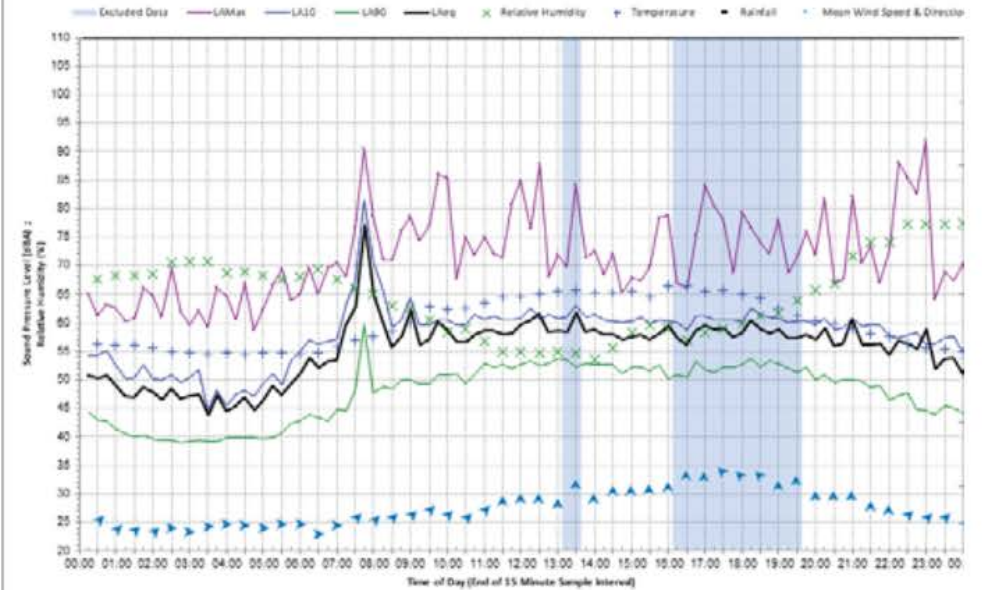




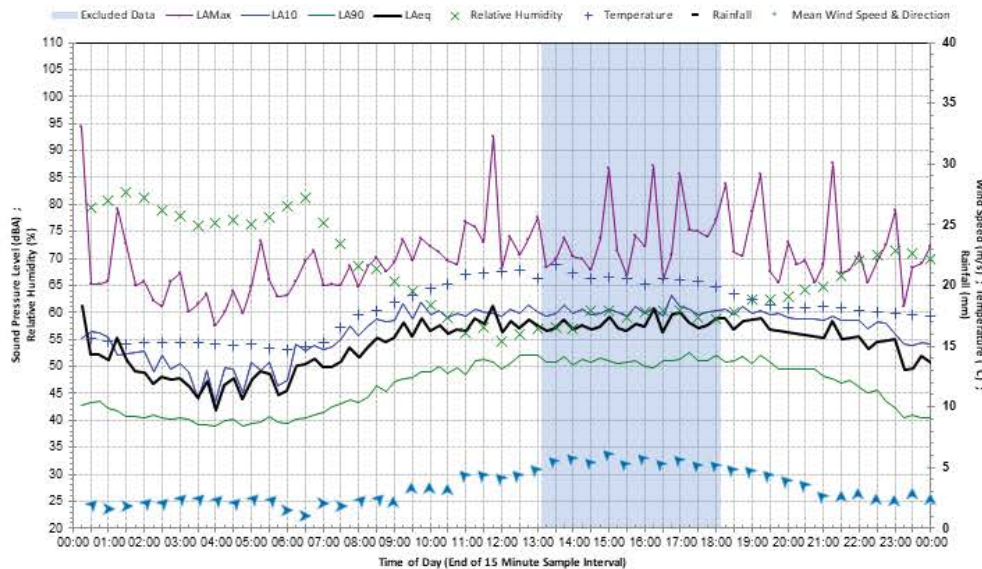
**Statistical Ambient Noise Levels - 105/16 Hill Road, Wentworth Point**  
**Friday 10 December 2021**



**Statistical Ambient Noise Levels - 105/16 Hill Road, Wentworth Point**  
**Saturday 11 December 2021**



**Statistical Ambient Noise Levels - 105/16 Hill Road, Wentworth Point**  
**Sunday 12 December 2021**

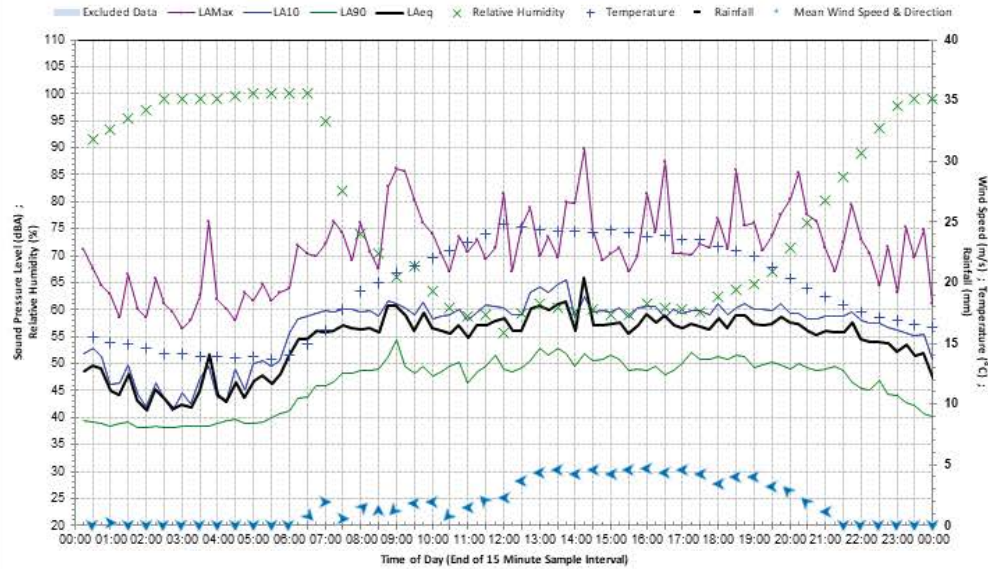


**Statistical Ambient Noise Levels - 105/16 Hill Road, Wentworth Point**  
**Monday 13 December 2021**

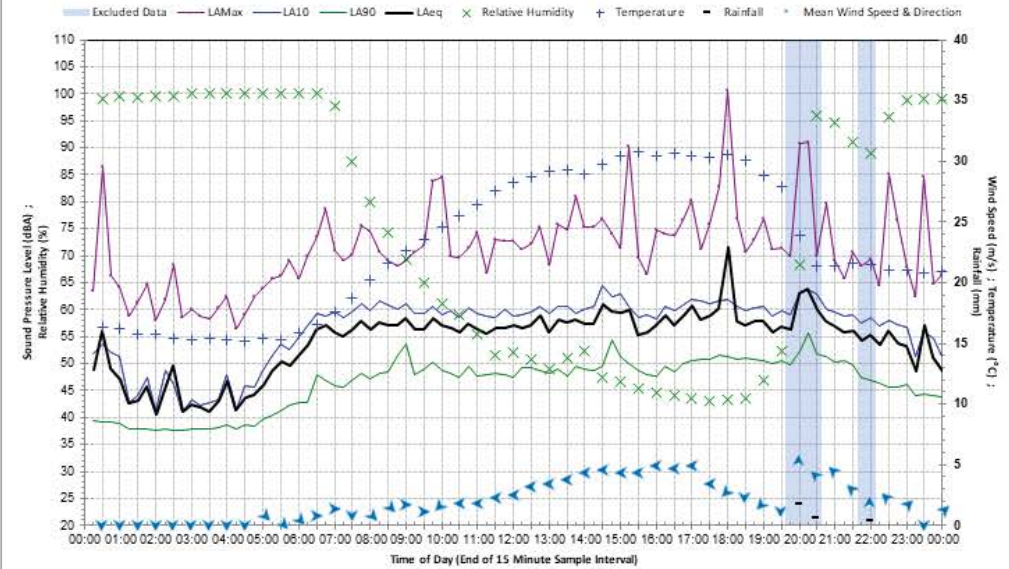




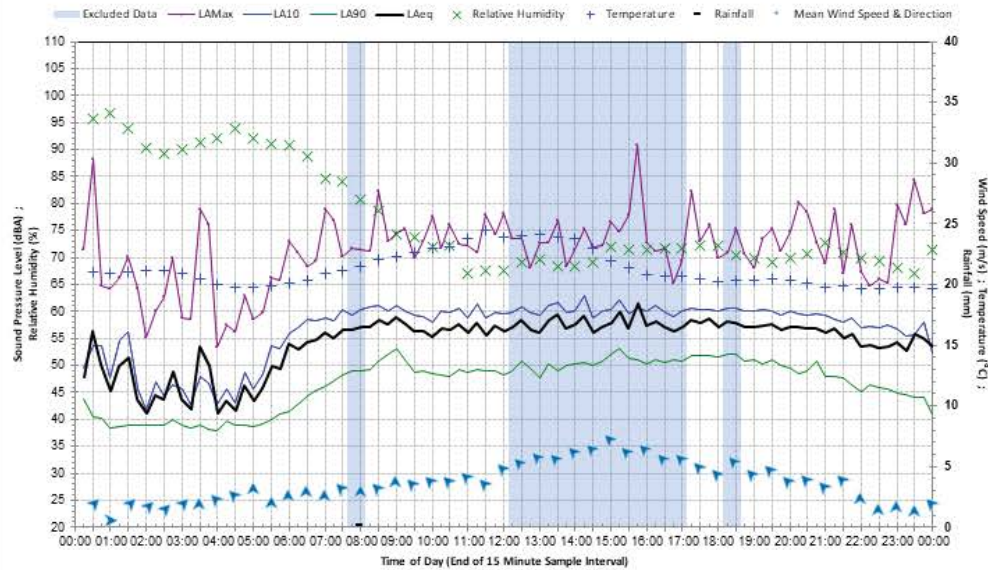
**Statistical Ambient Noise Levels - 105/16 Hill Road, Wentworth Point**  
**Tuesday 14 December 2021**



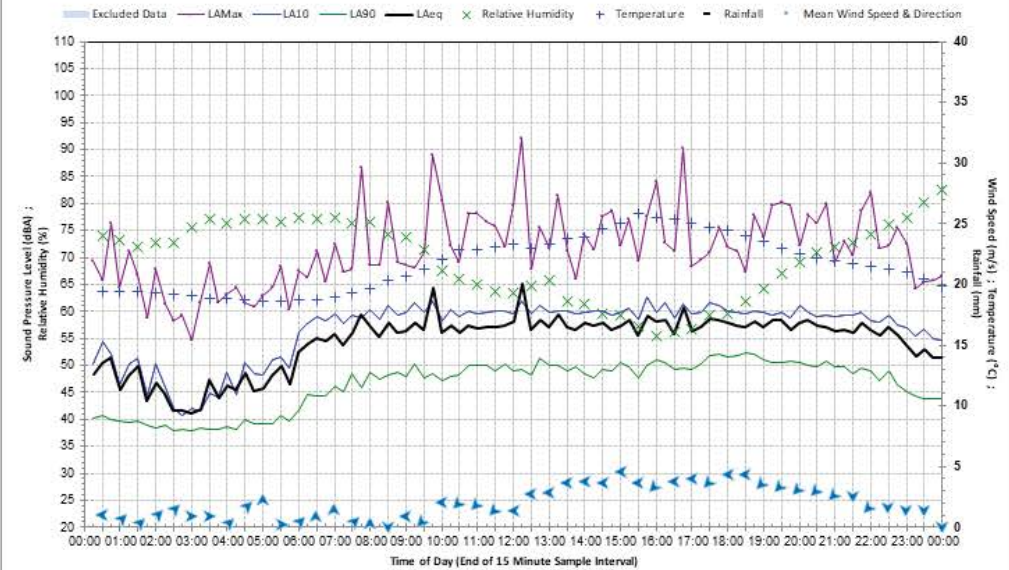
**Statistical Ambient Noise Levels - 105/16 Hill Road, Wentworth Point**  
**Wednesday 15 December 2021**



**Statistical Ambient Noise Levels - 105/16 Hill Road, Wentworth Point**  
**Thursday 16 December 2021**

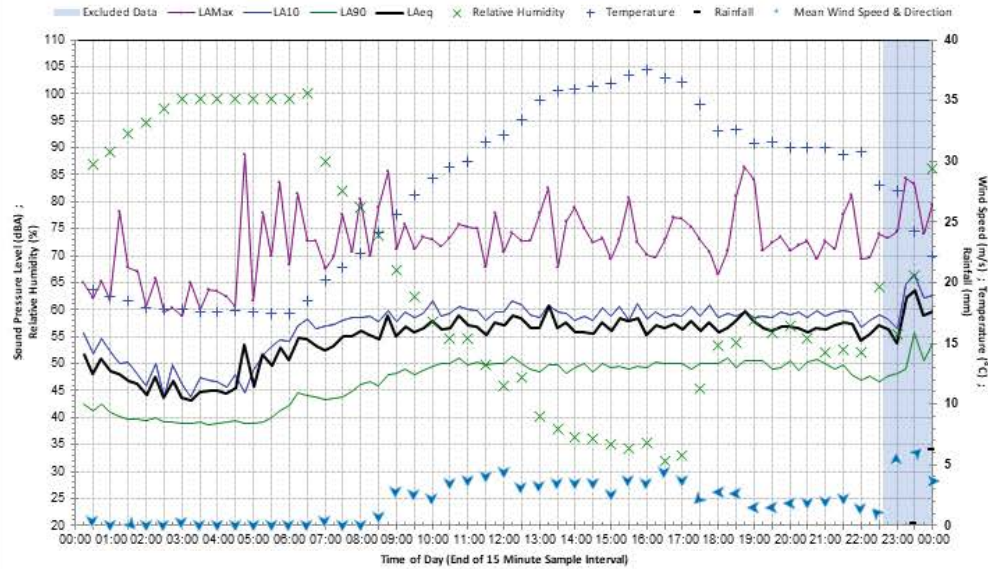


**Statistical Ambient Noise Levels - 105/16 Hill Road, Wentworth Point**  
**Friday 17 December 2021**

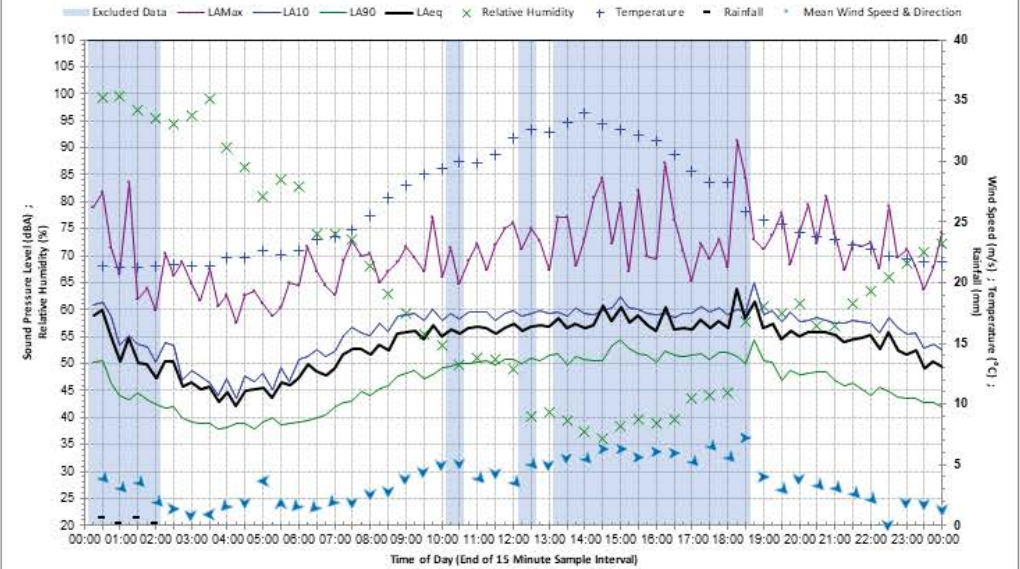




**Statistical Ambient Noise Levels - 105/16 Hill Road, Wentworth Point**  
**Saturday 18 December 2021**



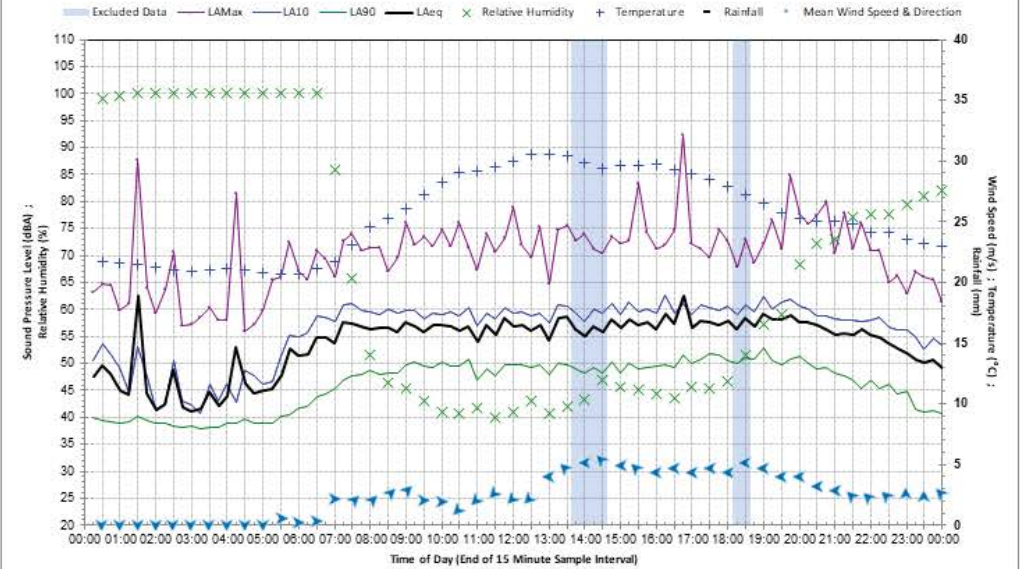
**Statistical Ambient Noise Levels - 105/16 Hill Road, Wentworth Point**  
**Sunday 19 December 2021**



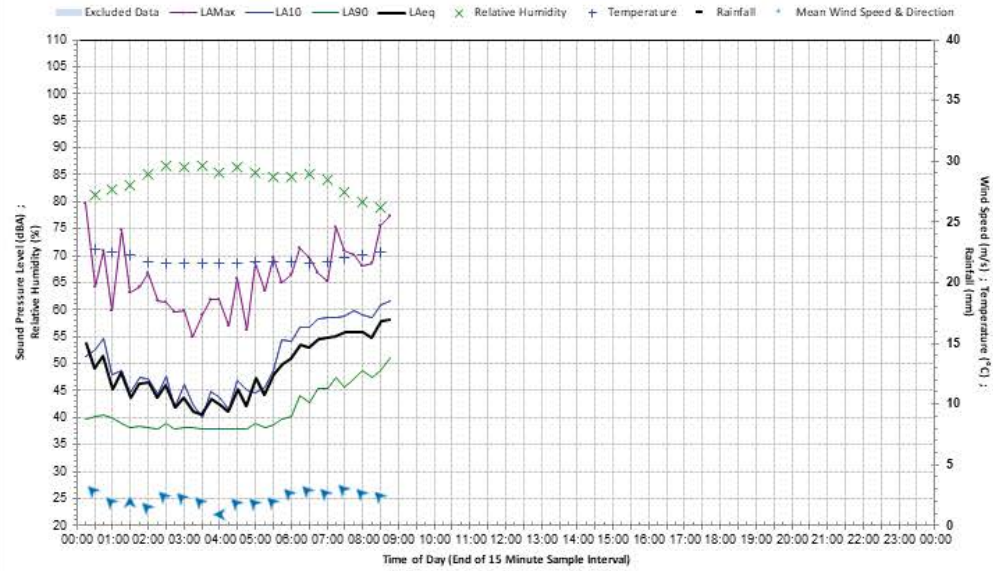
**Statistical Ambient Noise Levels - 105/16 Hill Road, Wentworth Point**  
**Monday 20 December 2021**



**Statistical Ambient Noise Levels - 105/16 Hill Road, Wentworth Point**  
**Tuesday 21 December 2021**

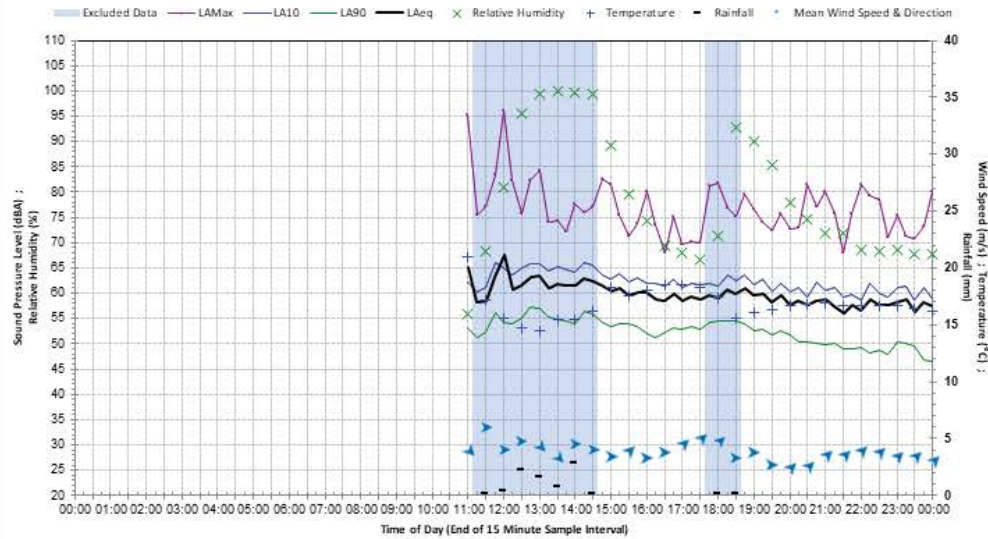


Statistical Ambient Noise Levels - 105/16 Hill Road, Wentworth Point  
Wednesday 22 December 2021

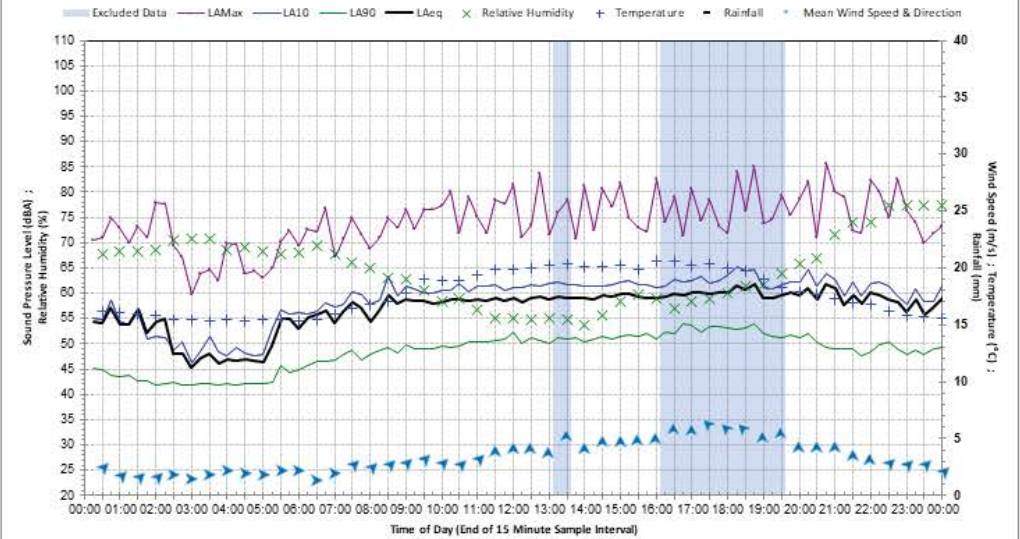




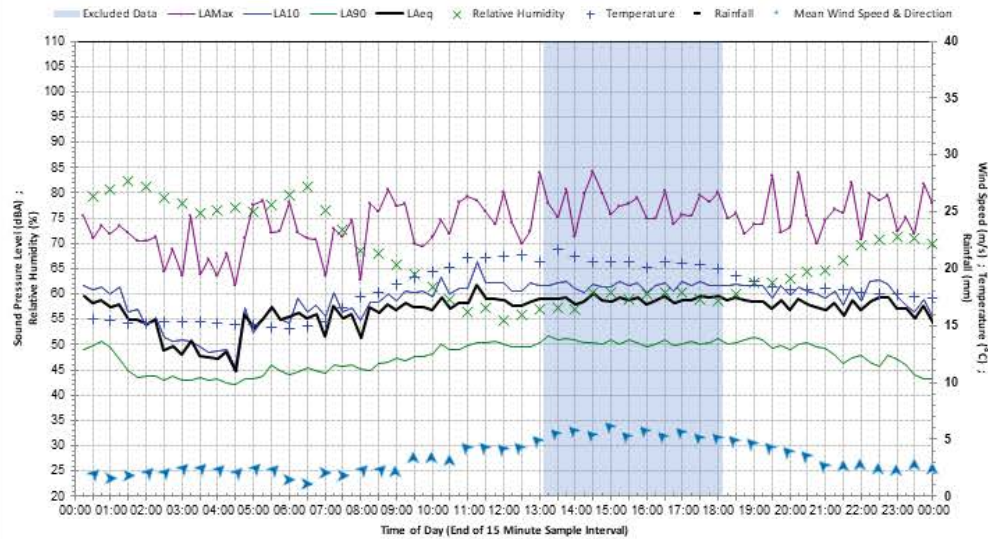
### Statistical Ambient Noise Levels - 101/9 Australia Avenue, Sydney Olympic Park Friday 10 December 2021



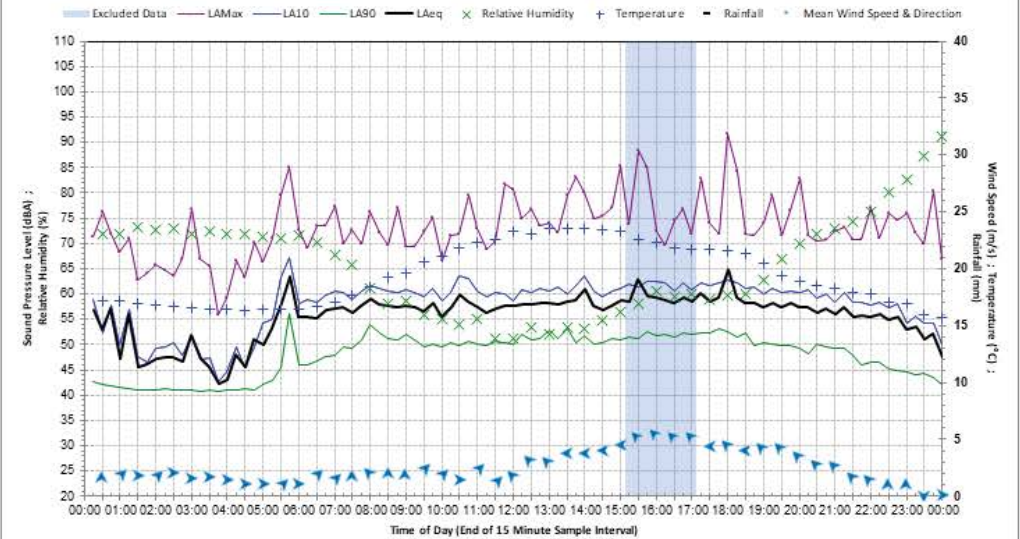
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### Statistical Ambient Noise Levels - 101/9 Australia Avenue, Sydney Olympic Park Sunday 12 December 2021

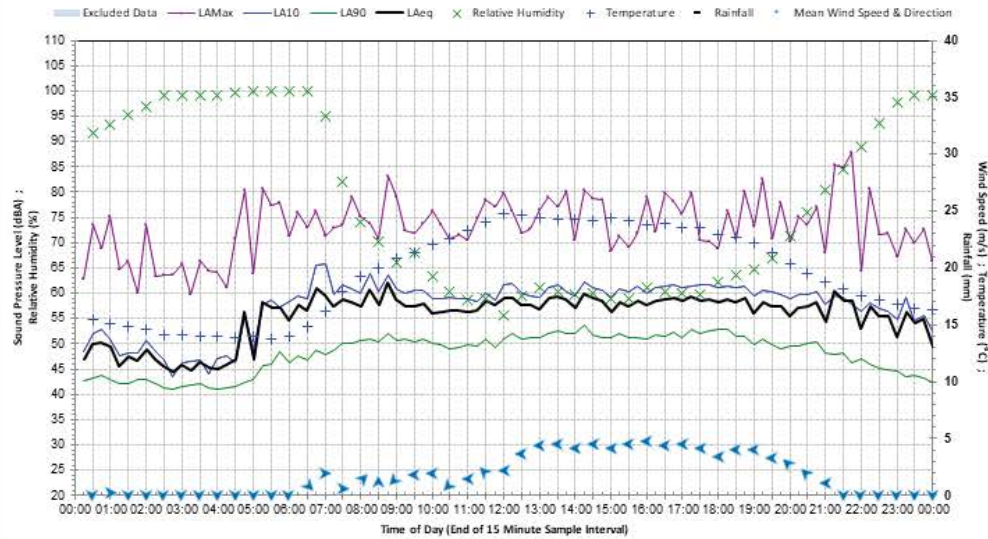


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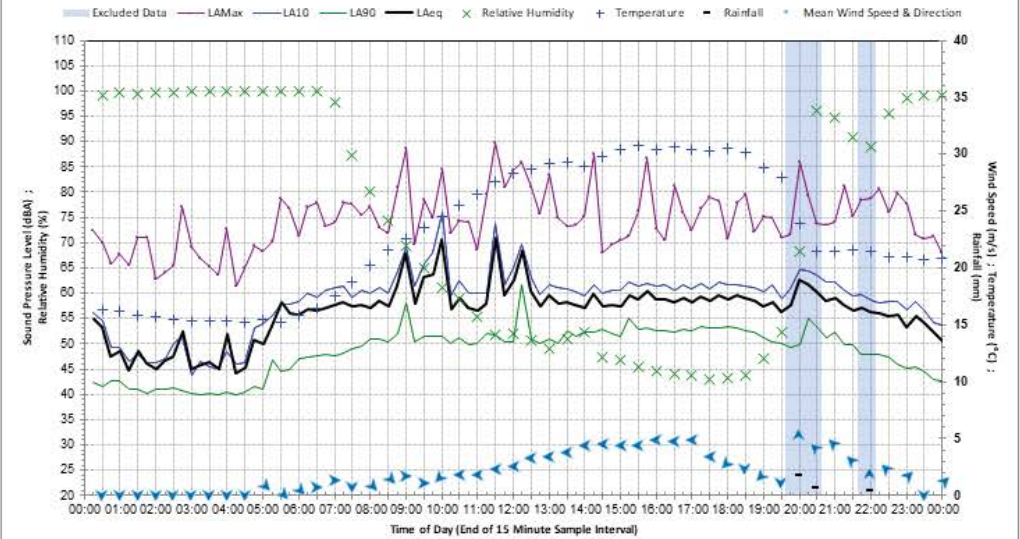




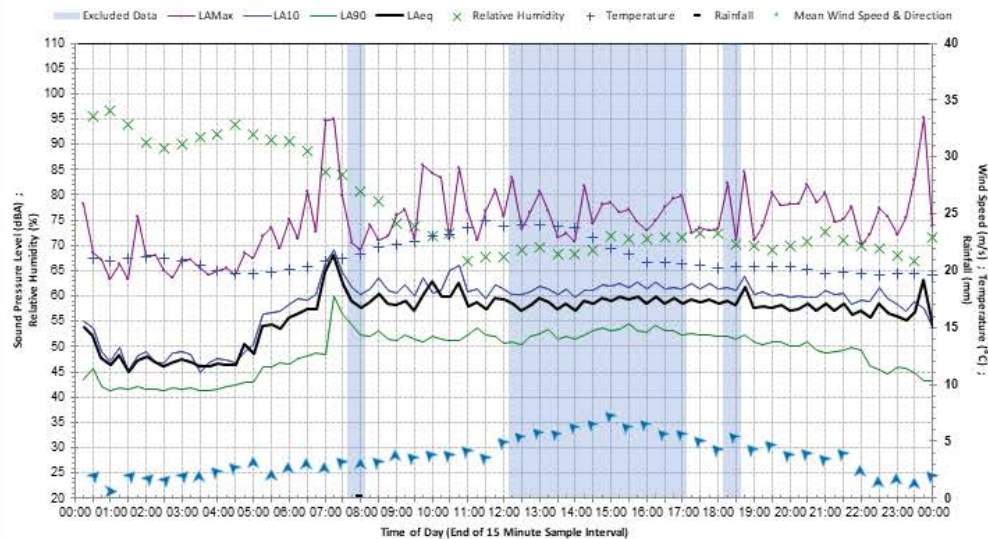
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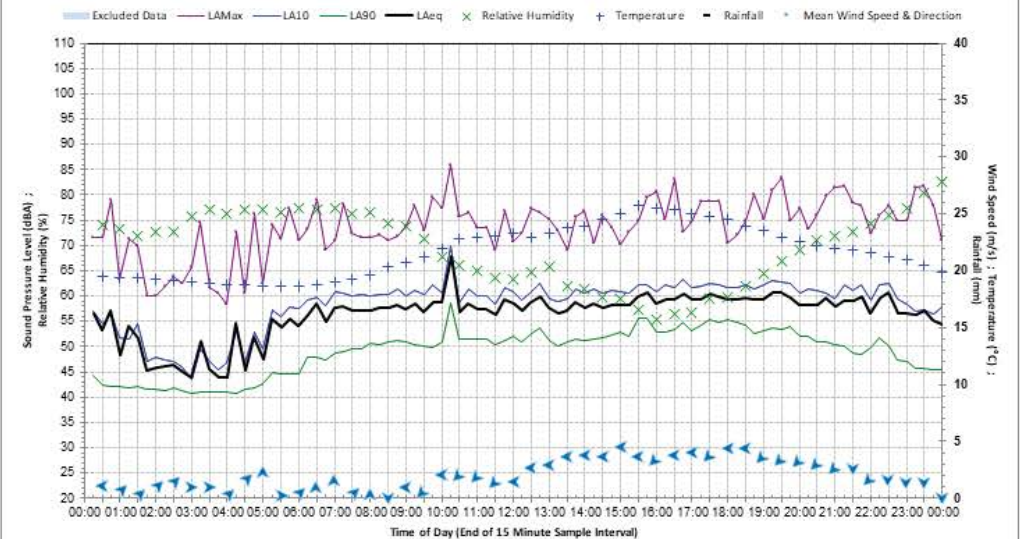
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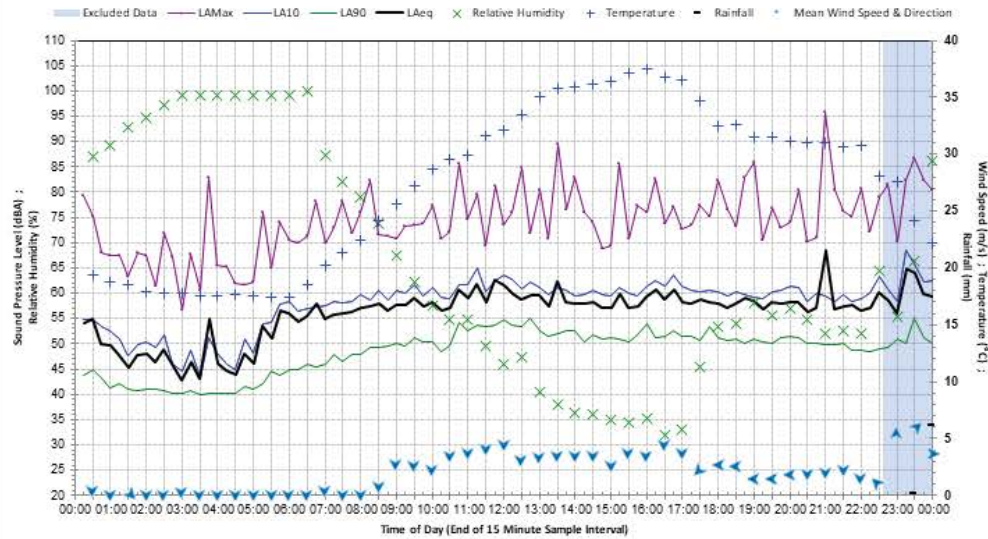


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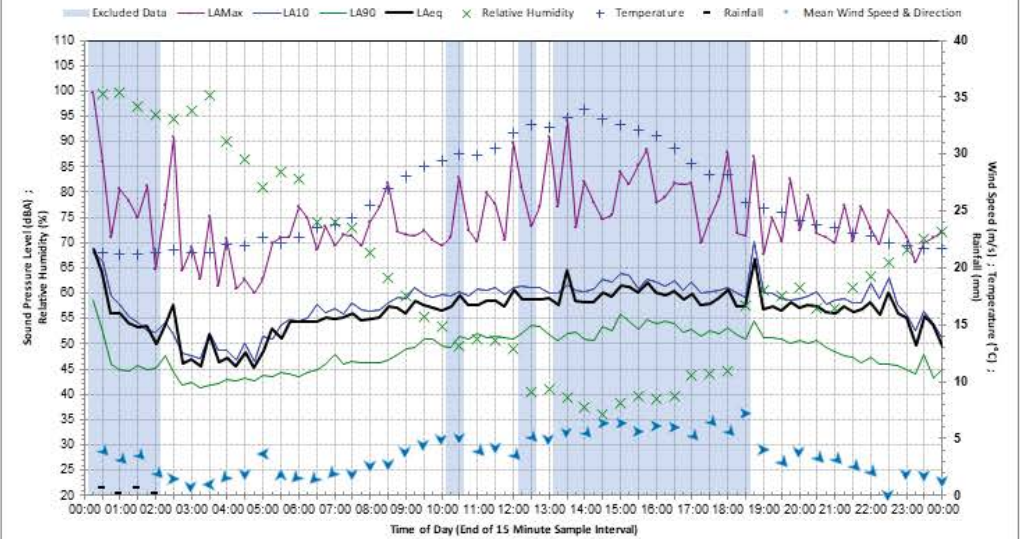




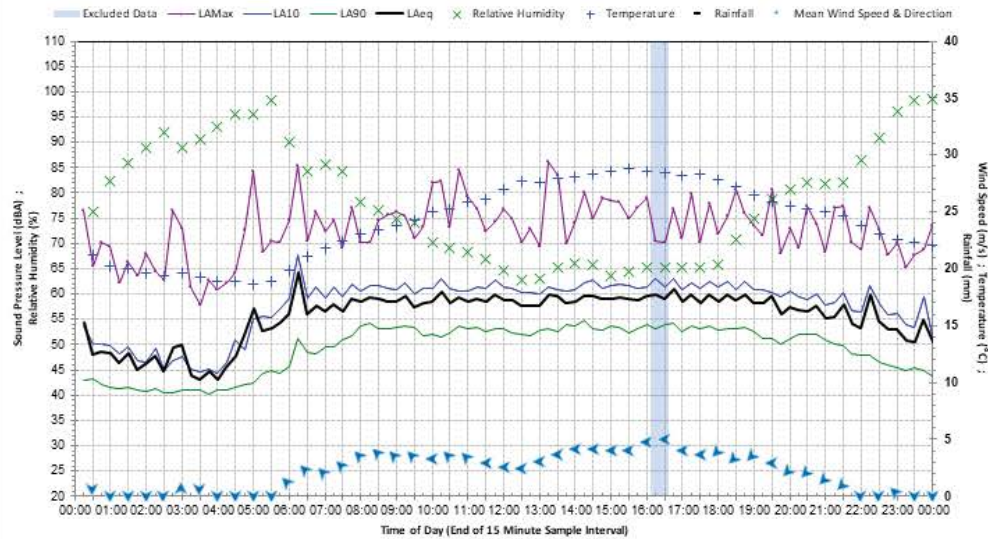
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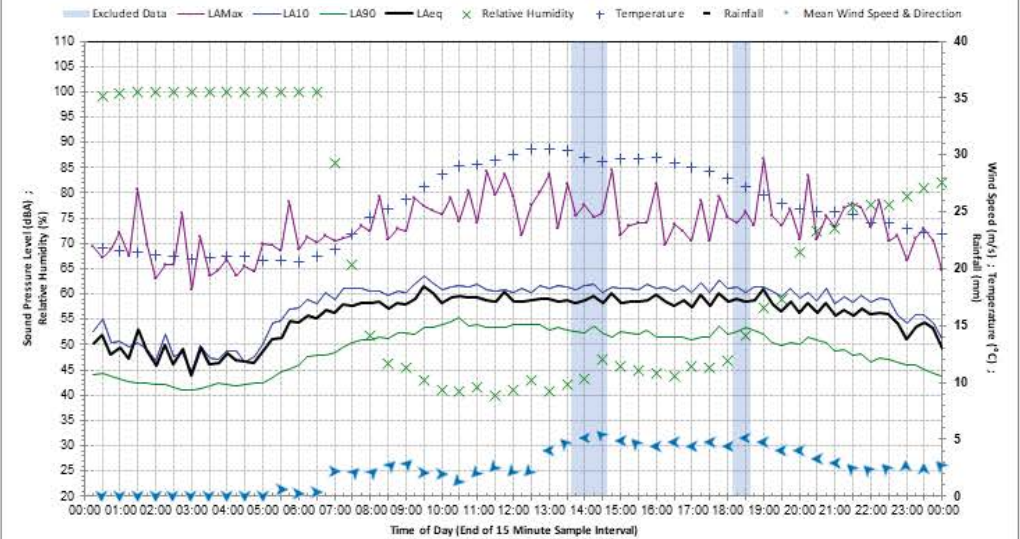
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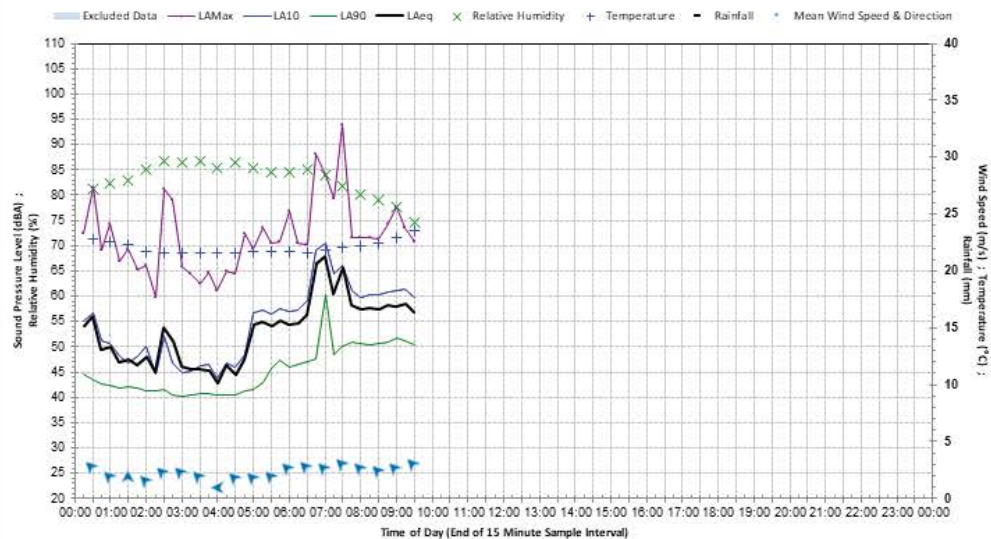


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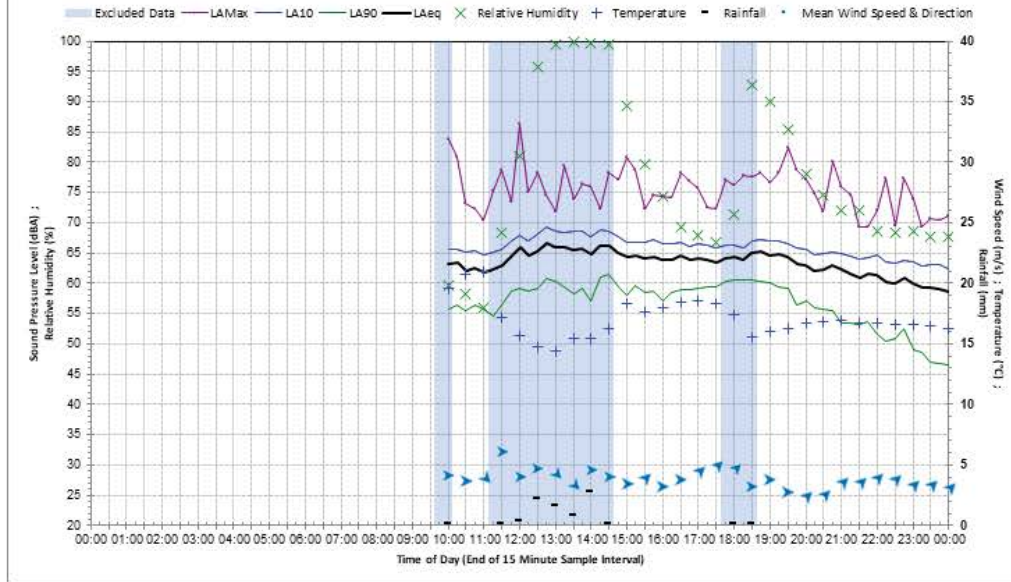
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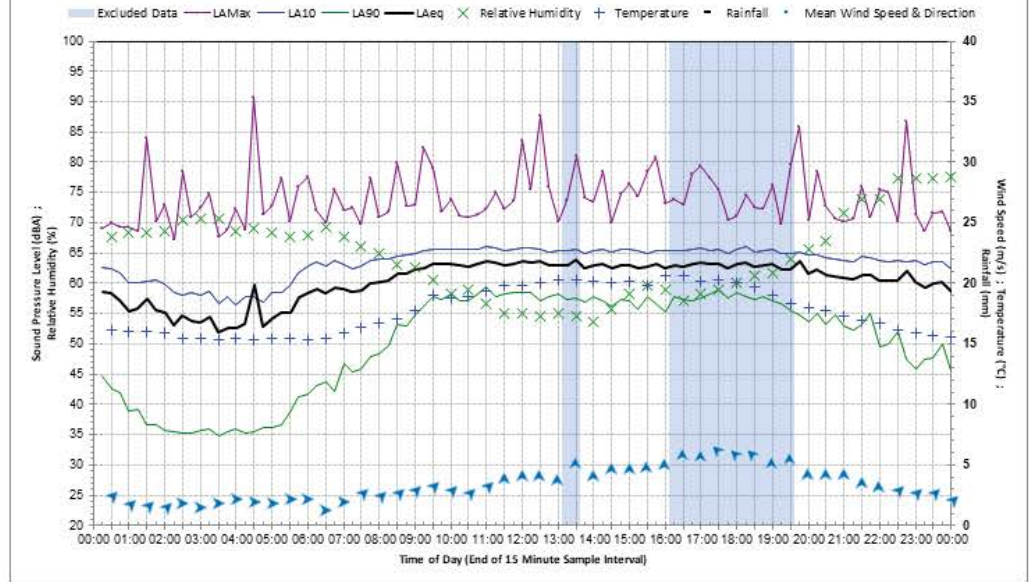




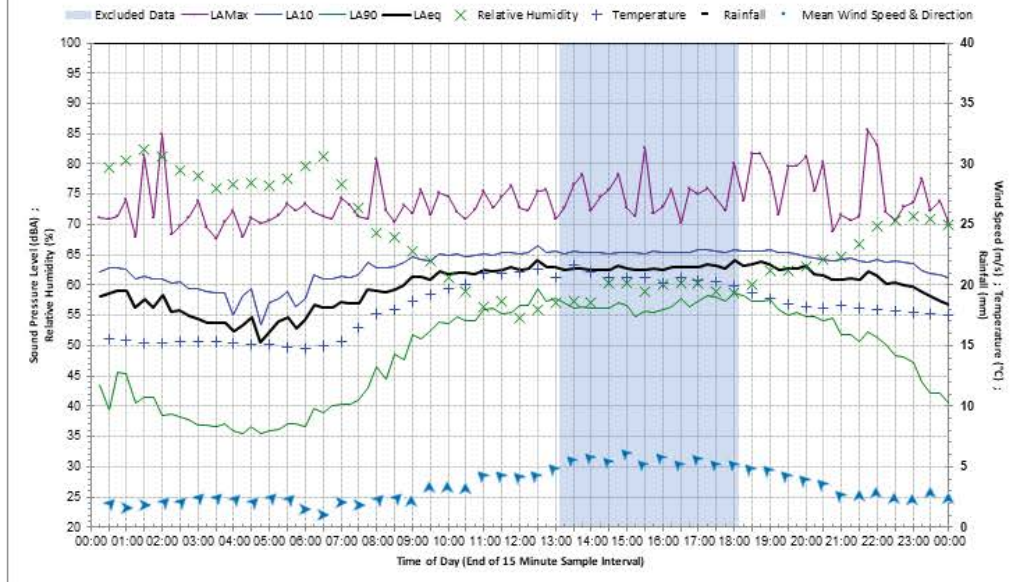
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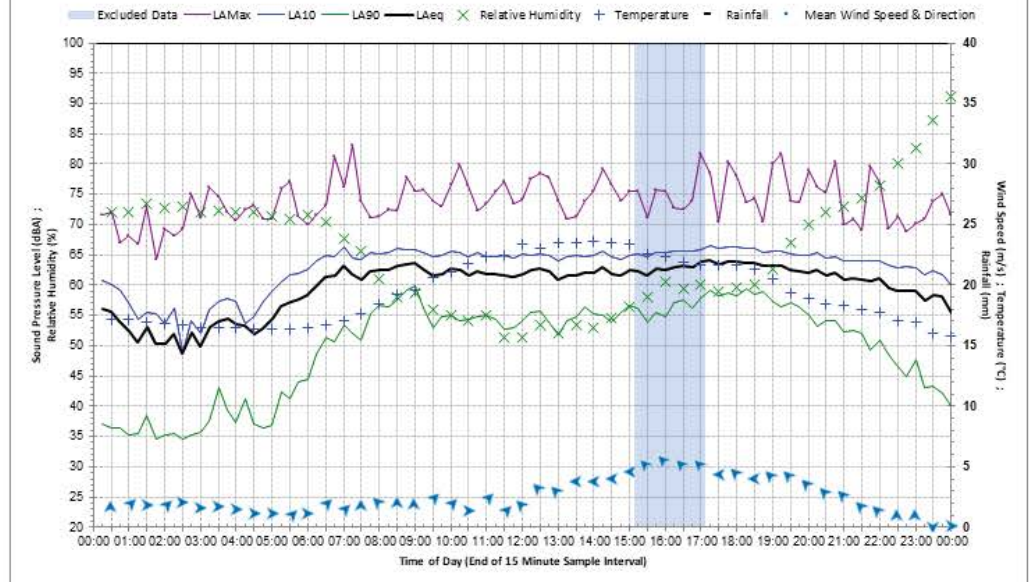
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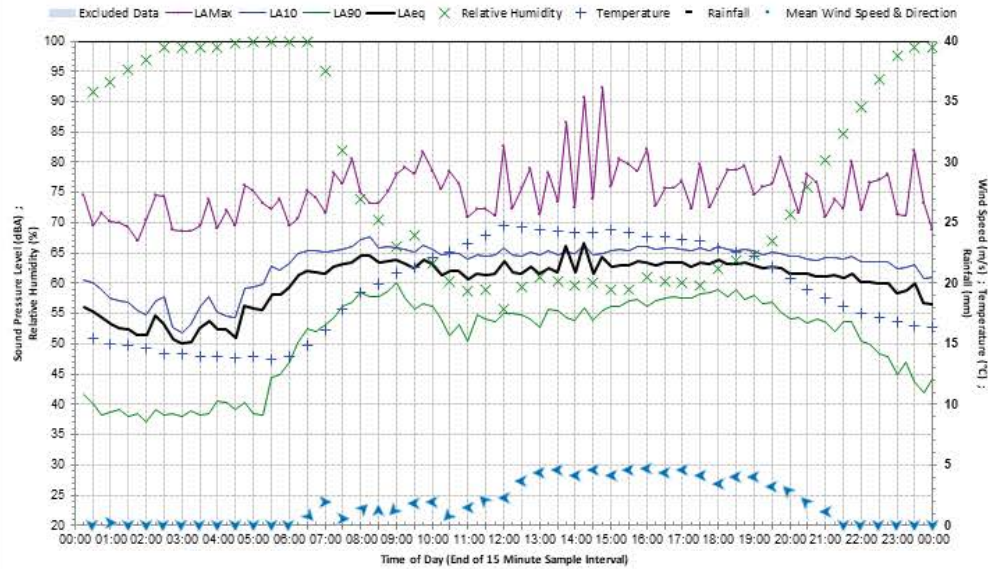


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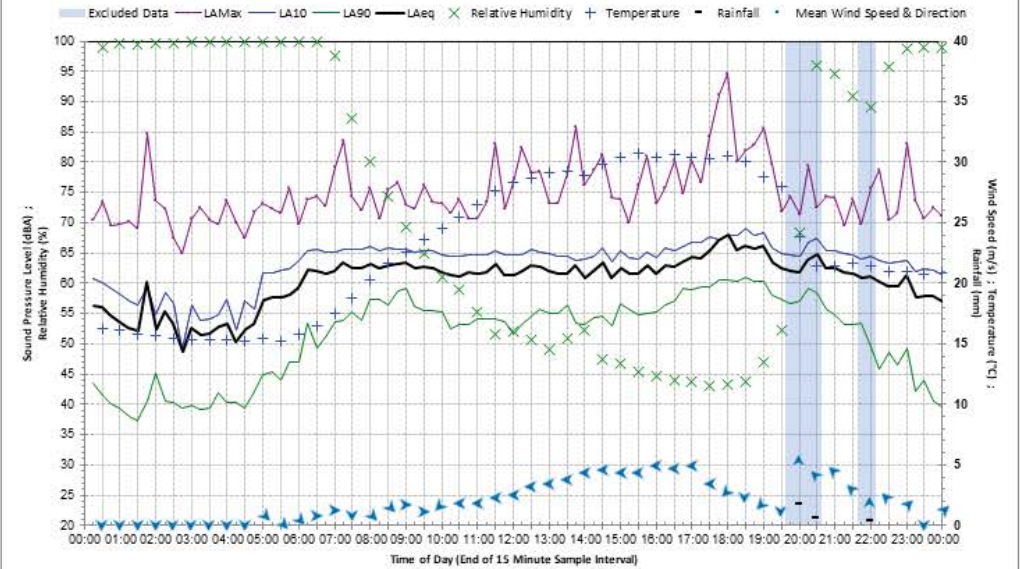




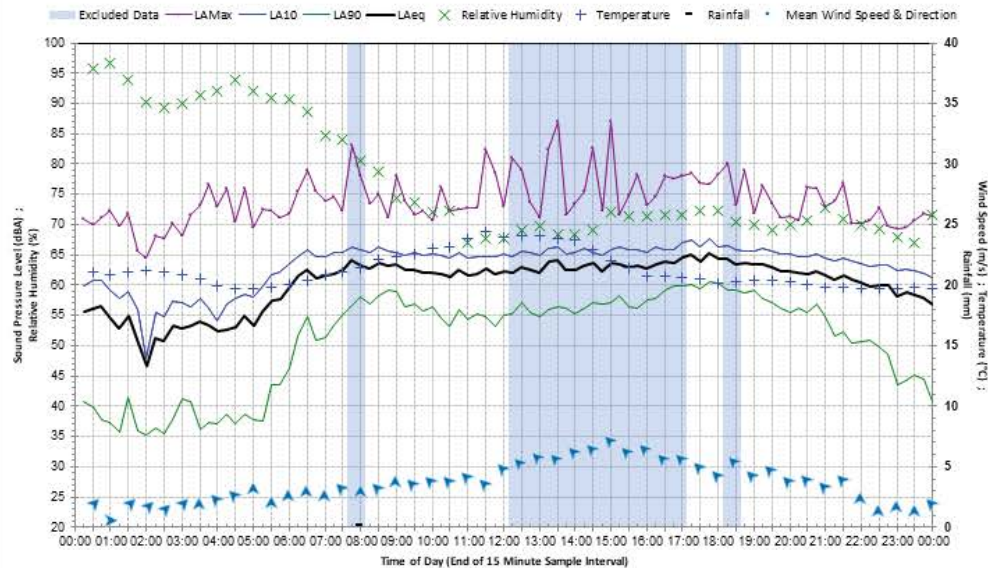
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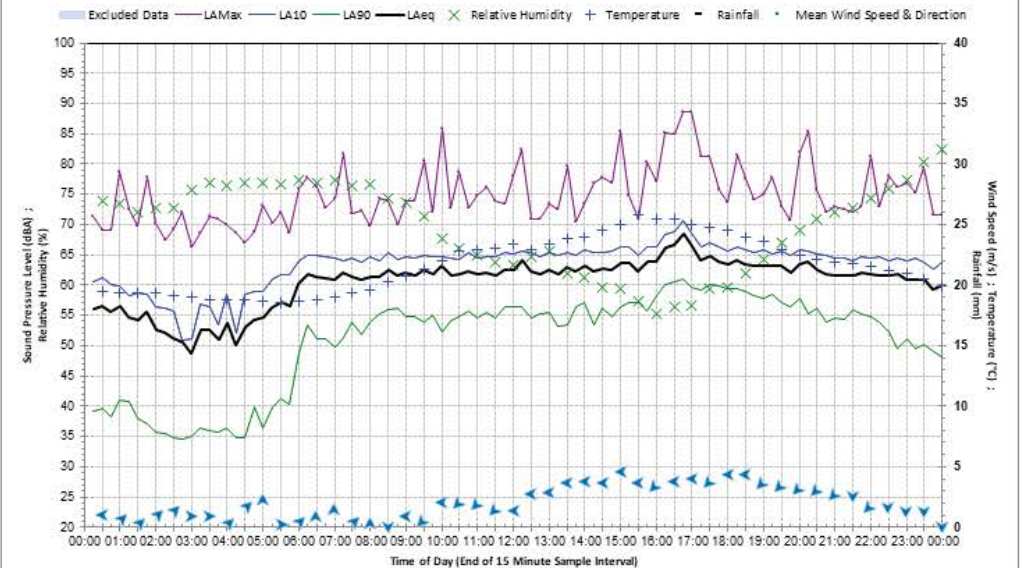
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**Wednesday 15 December 2021**



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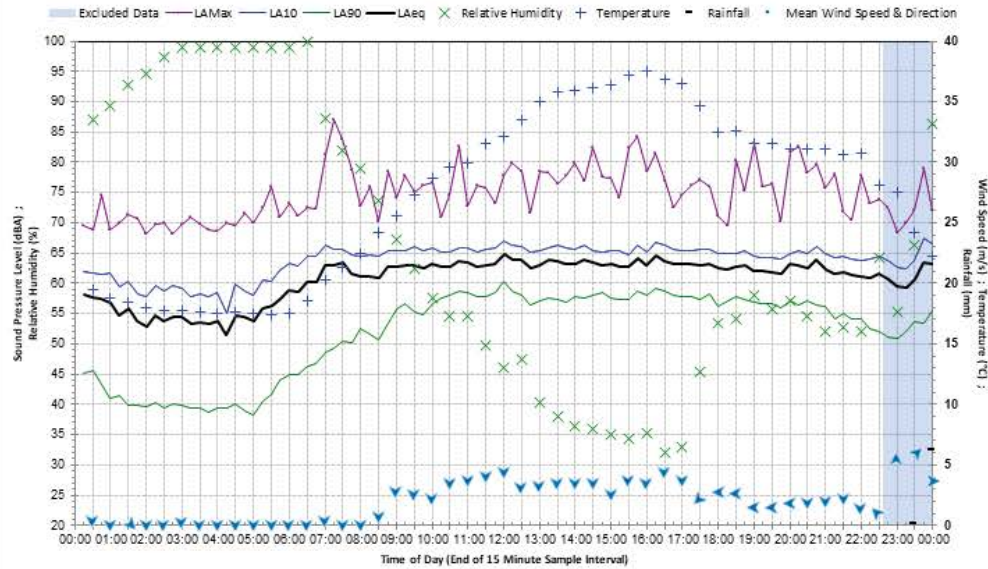


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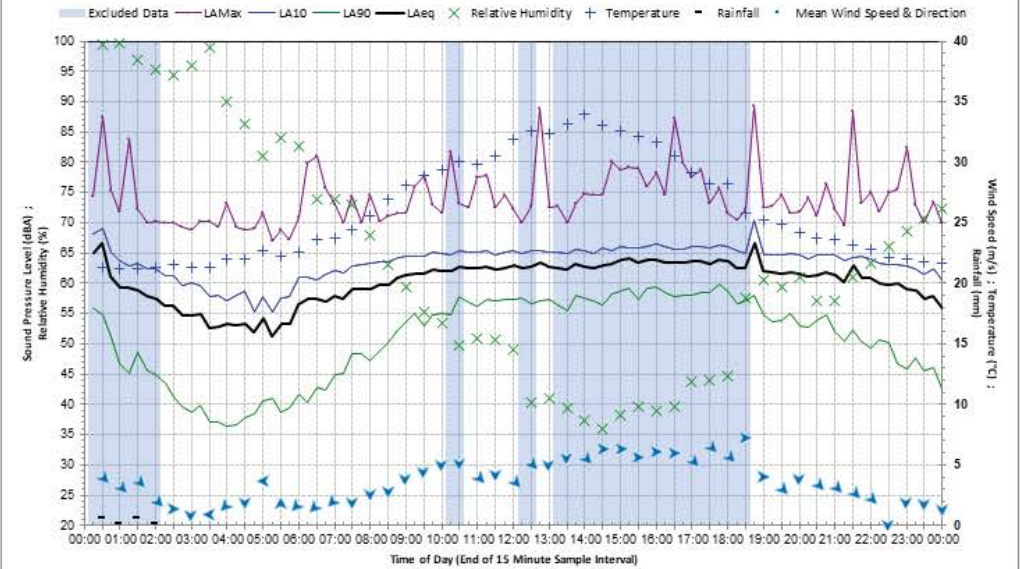




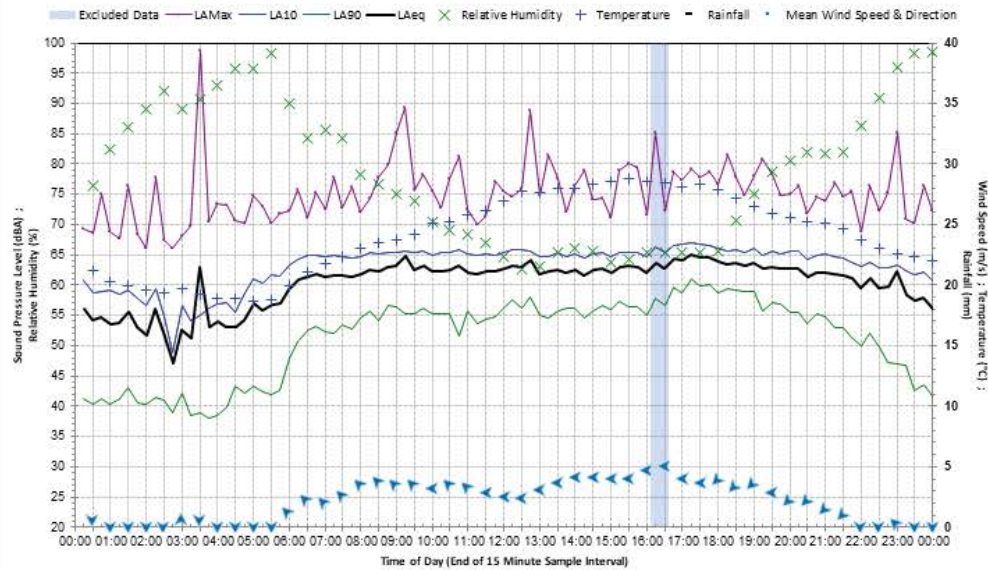
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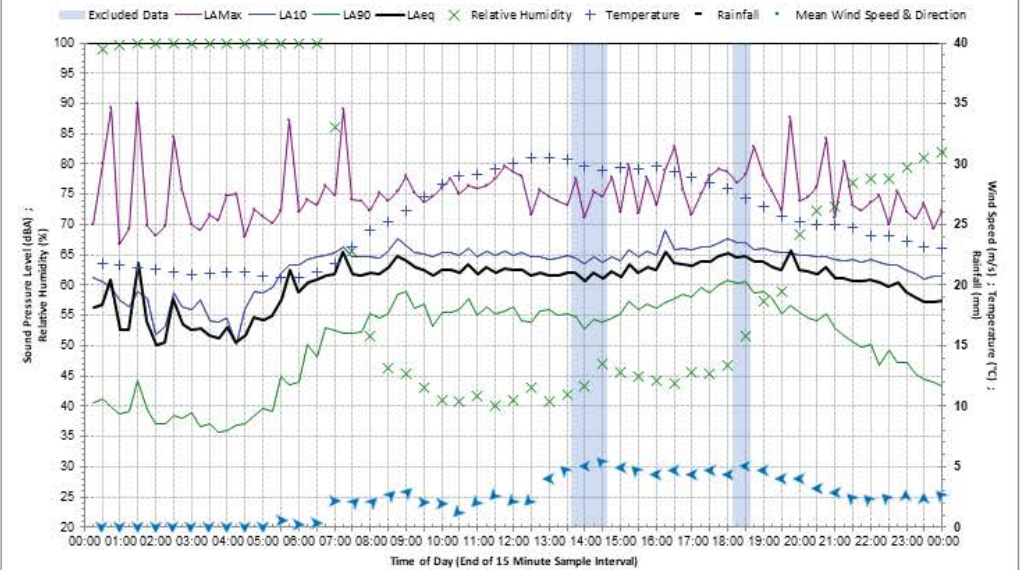
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**Sunday 19 December 2021**



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**Monday 20 December 2021**

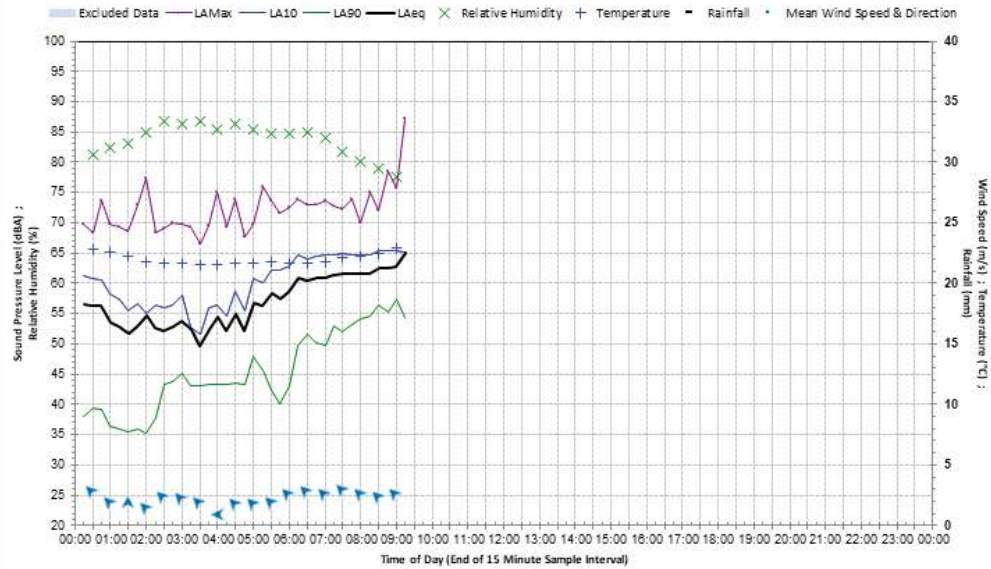


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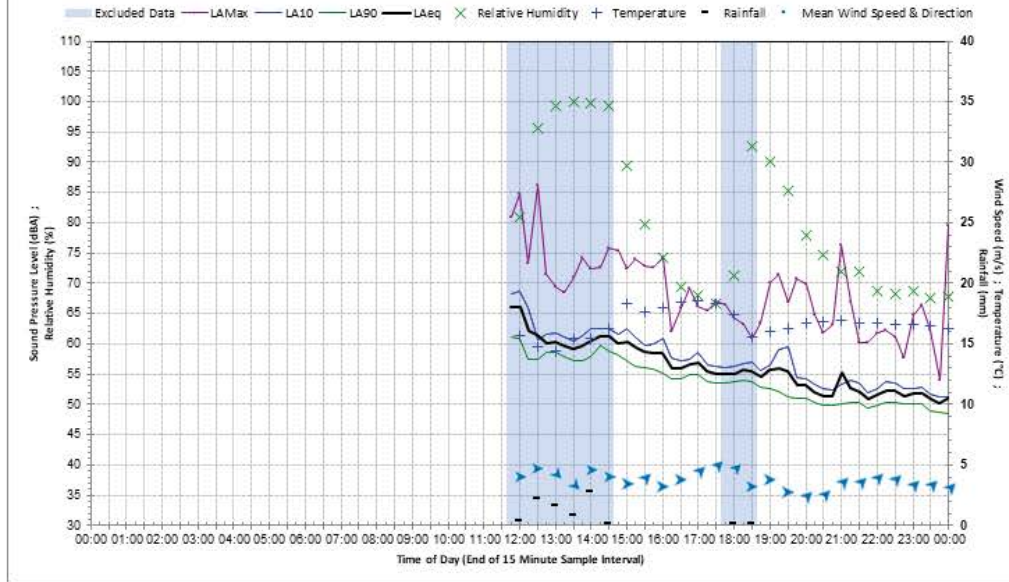
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Wednesday 22 December 2021

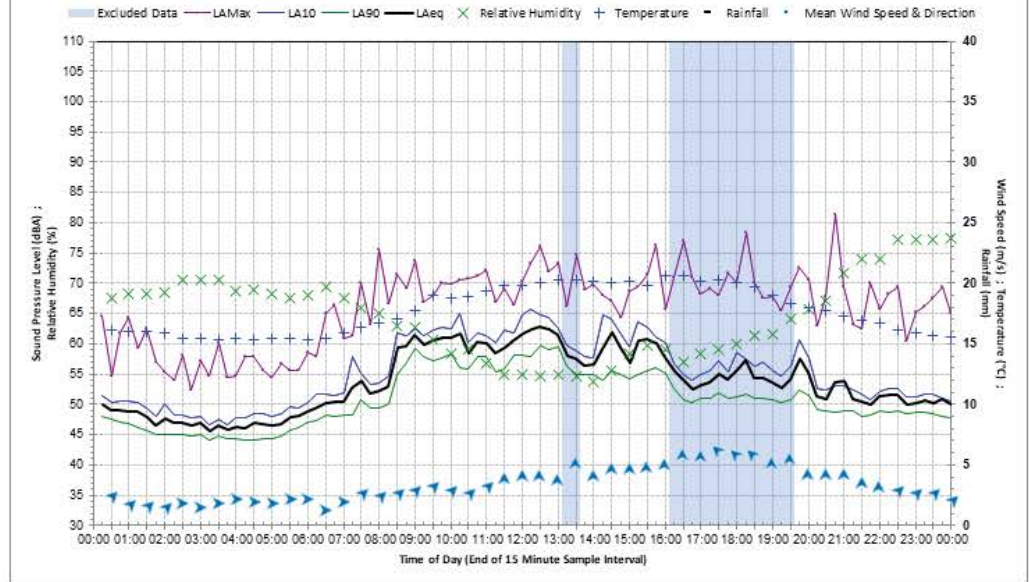




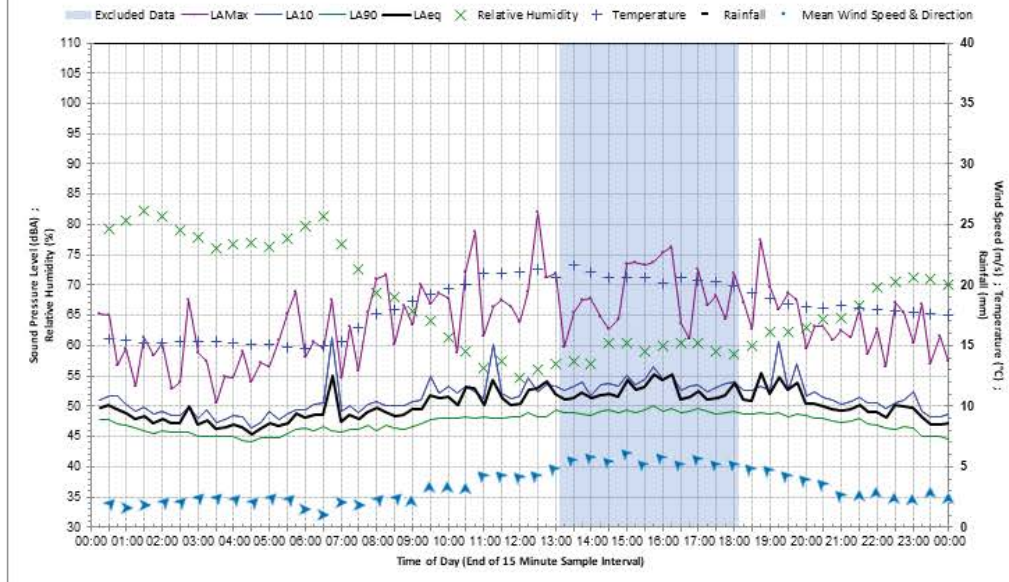
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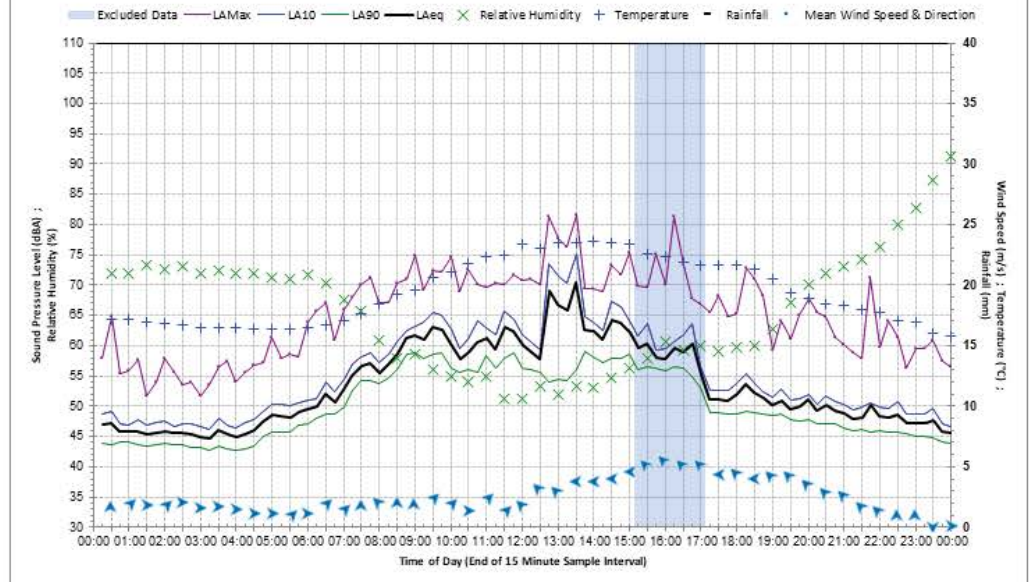
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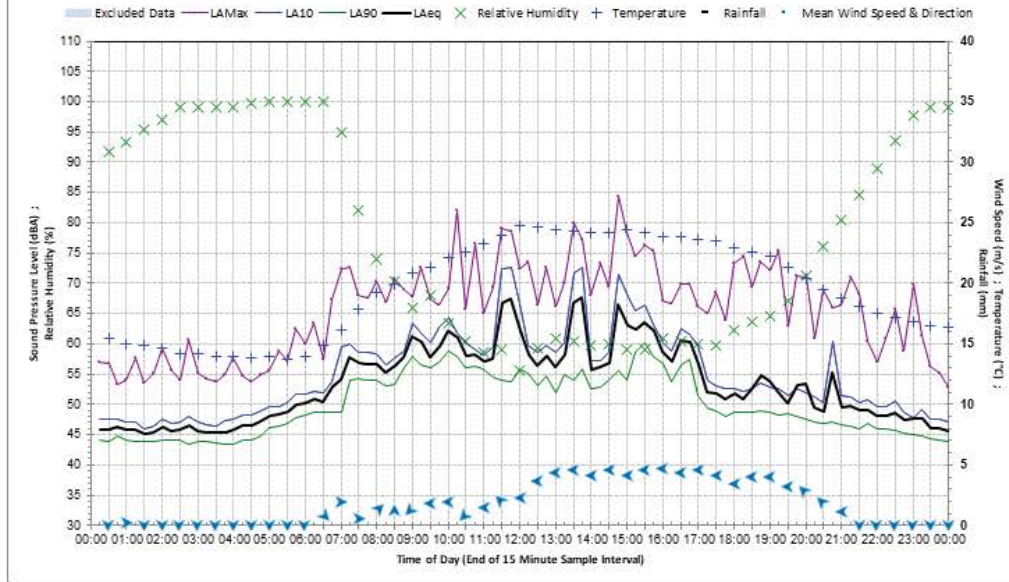


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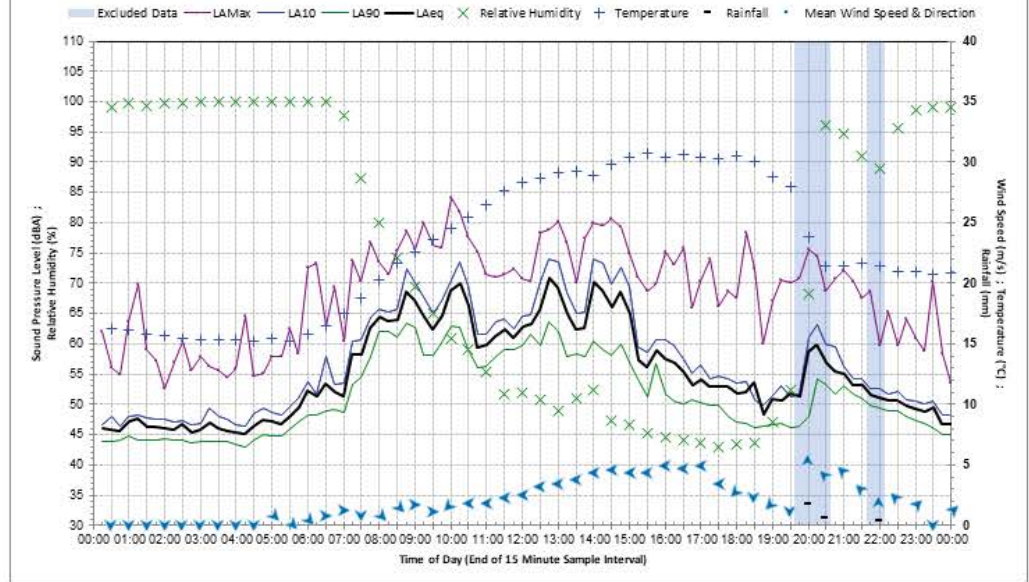




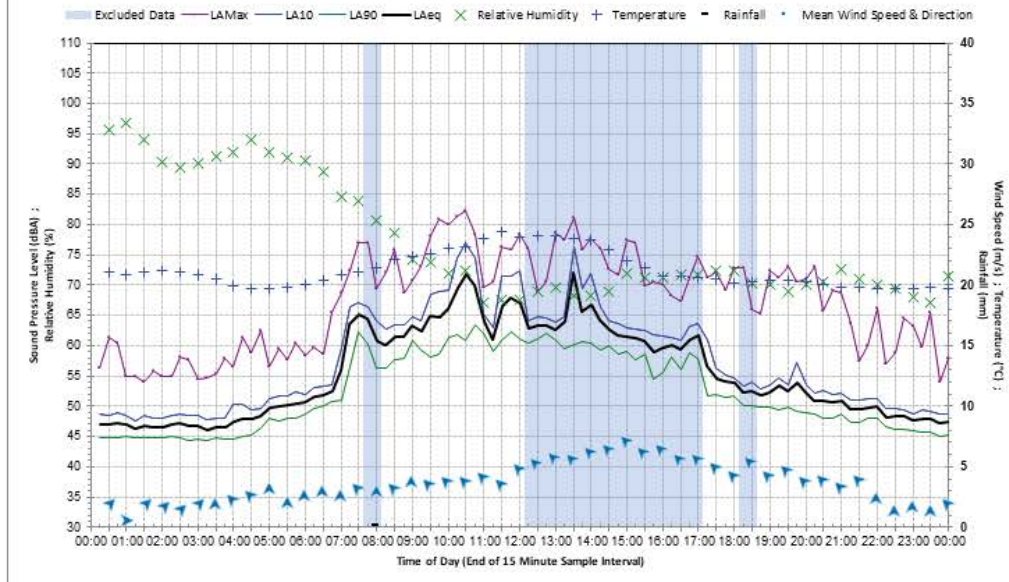
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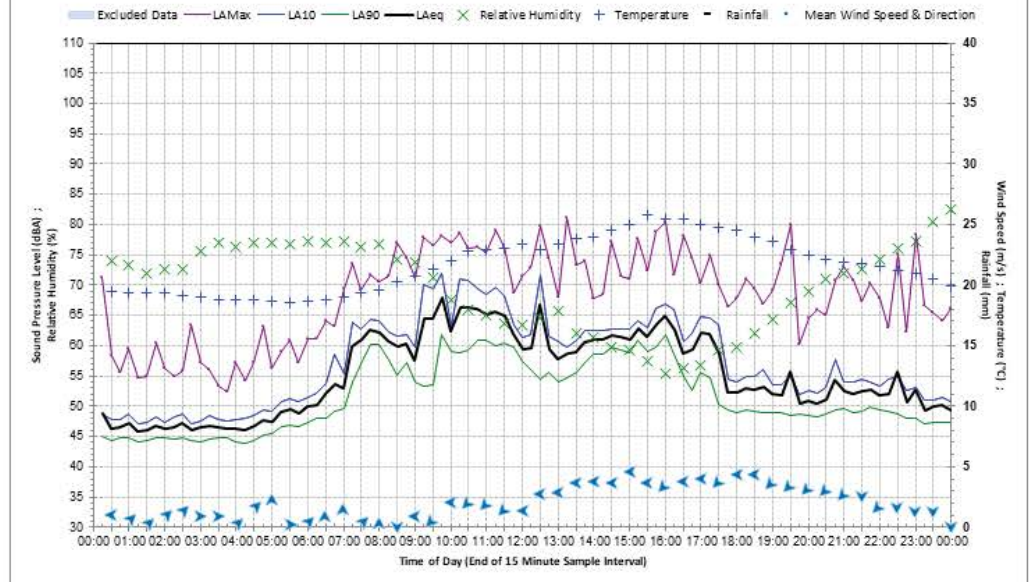
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**Wednesday 15 December 2021**



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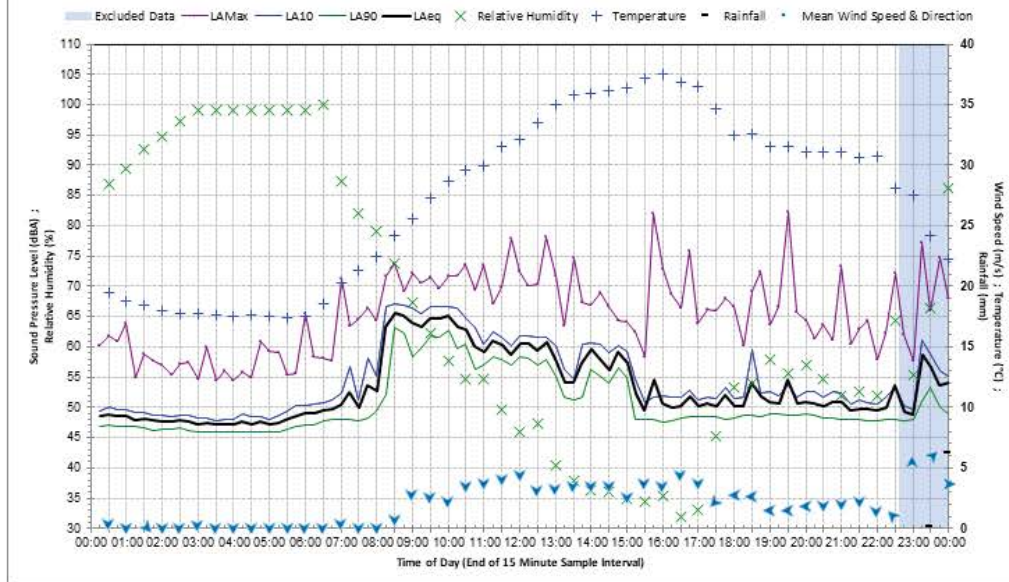


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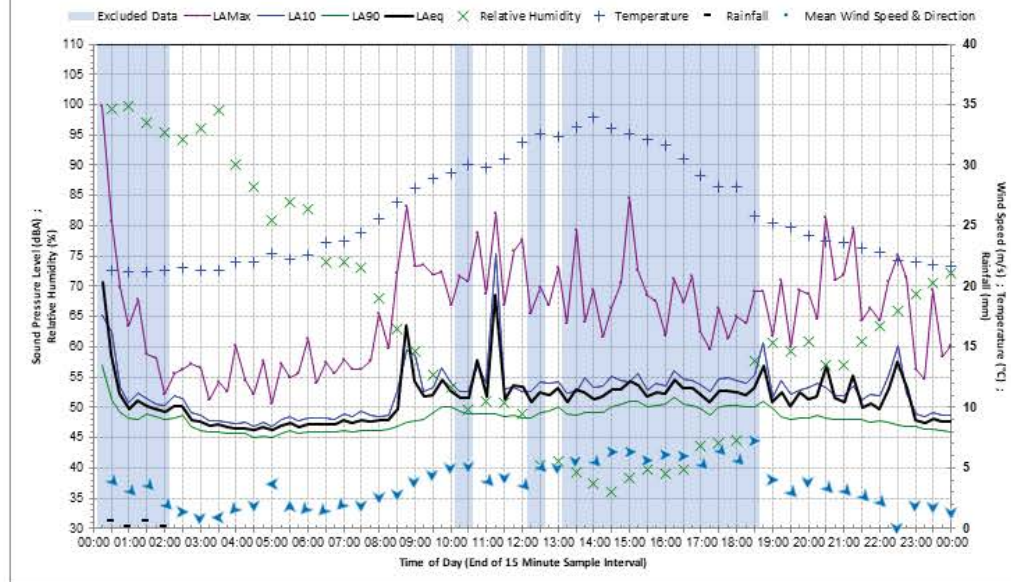




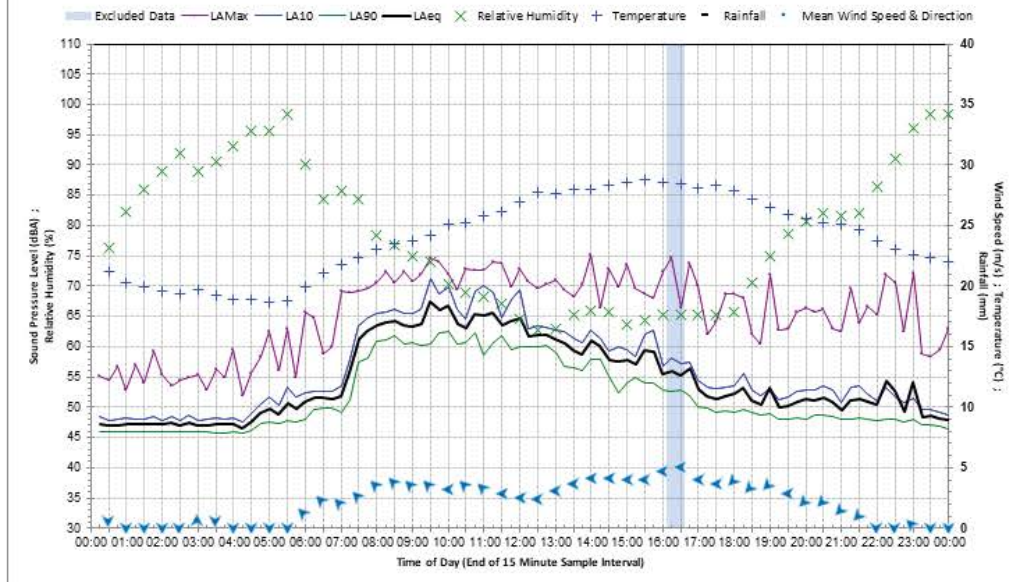
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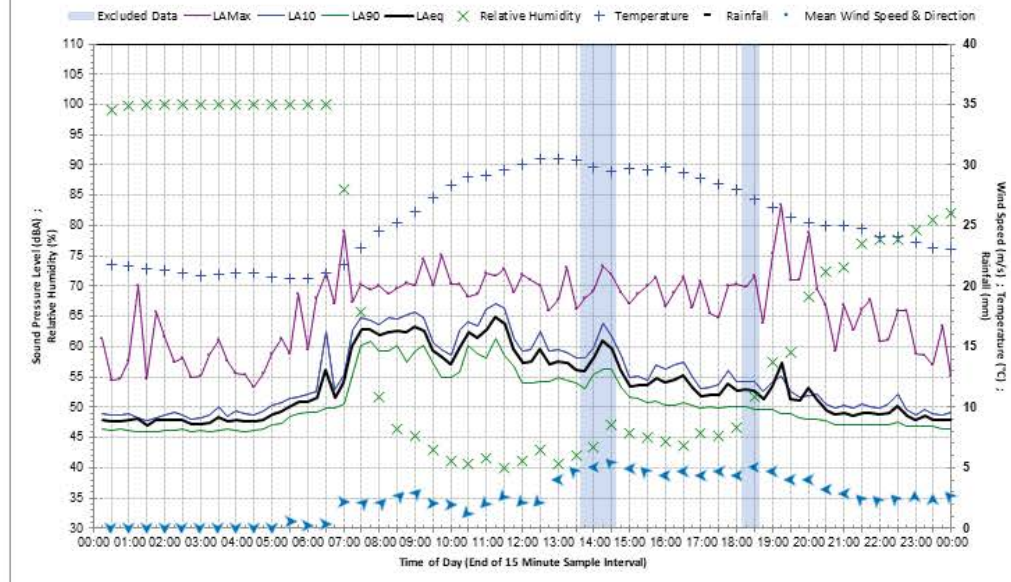
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**Sunday 19 December 2021**



**Statistical Ambient Noise Levels - G59/9 Grazier Street, Lidcombe**  
**Monday 20 December 2021**

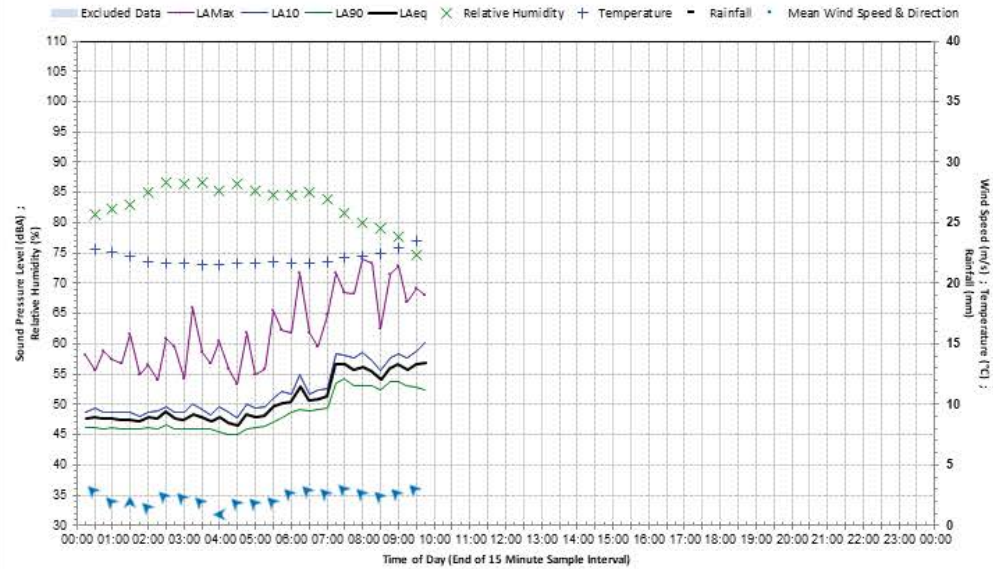


**Statistical Ambient Noise Levels - G59/9 Grazier Street, Lidcombe**  
**Tuesday 21 December 2021**



# Statistical Ambient Noise Levels - G59/9 Grazier Street, Lidcombe

Wednesday 22 December 2021



# **Appendix E**

**Derivation of noise and vibration targets**



## E-1 Construction noise management levels

The EPA has released the Draft Construction Noise Guideline (DCNG) in 2020 for public consultation purposes only and once public consultation is complete, the feedback would be used to provide a final guideline to replace the ICNG. The ICNG would remain applicable for projects, as it is referred to in the SEARs.

However, the DCNG still provides useful guidance and includes the following changes:

- emphasis on the need to engage with the community, to ensure that the community's views are considered when planning how to manage construction noise impacts
- improved guidance for managing noise from construction activities taking place outside the recommended standard hours of work
- alignment of the level of assessment required with risk of noise impact
- a simplified assessment path for routine activities undertaken by public authorities on public infrastructure through industry management procedures
- increased emphasis on the need for proponents to justify the selection of noise mitigation measures to improve transparency.

The intent of the key changes in the DCNG have been considered in this assessment, however construction noise associated with the project has been assessed against the requirements of the ICNG.

### E-1-1 Noise management levels

Table 2 in the ICNG provides recommended NMLs for residences, which are detailed in Table E.1.

**Table E.1** Residential construction noise management levels, dBA (ICNG, 2009)

Time of day	Noise management level, $L_{Aeq}(15 \text{ min})$	Application notes
Recommended standard hours	Noise affected: RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq}(15 \text{ min})$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected: 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: <ul style="list-style-type: none"> <li>– times identified by the community when they are less sensitive to noise (such as before and after school, or mid-morning or mid-afternoon for works near residences)</li> <li>– if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.</li> </ul>
Outside recommended standard hours	Noise affected: RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable measures have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.

Noise management levels are also provided in the ICNG for other sensitive land uses as shown in Table E.2.

**Table E.2** Noise at non-residential sensitive land uses, (ICNG, 2009)

Land use	Management level $L_{Aeq(15min)}$ (applies when properties are being used)
Classrooms at schools and other educational institutions	Internal noise level 45 dBA or external noise level 55 dBA <sup>1</sup>
Hospital wards and operating theatres	Internal noise level 45 dBA or external noise level 55 dBA <sup>1</sup>
Places of worship	Internal noise level 45 dBA or external noise level 55 dBA <sup>1</sup>
Active recreation	External noise level 65 dBA
Passive recreation	External noise level 60 dBA
Commercial premises	External noise level 70 dBA
Industrial premises	External noise level 75 dBA

Note: 1. External noise levels are set at 10 dB above internal noise levels based on assumed attenuation of an open window

## E-1-2 Sleep disturbance

To assess sleep disturbance during construction works during the night period the ICNG requires an assessment of maximum noise events including maximum received noise levels and the number of times the maximum noise level exceeds the RBL for works occurring for more than two consecutive nights. Current guidance in the Noise Policy for Industry (EPA, 2017) recommends a screening criterion for maximum noise levels  $L_{Amax}$  of 15 dB above the night-time RBL and includes a minimum criterion of 52 dBA. The screening criteria is used to identify properties where further analysis of the potential for sleep disturbance is required. This includes assessment of other factors that may affect the potential for sleep disturbance, such as:

- how often high noise events occur at night
- the distribution of likely events across the night-time period and the existing ambient maximum events in the absence of the work
- predicted maximum noise levels at night
- whether there are times when there is a clear change in the noise environment (such as during early morning shoulder periods)
- the degree of maximum noise levels above the background noise level at night.

## E-1-3 Ground-borne noise management levels

The CNVS refers to the construction ground-borne noise objectives in the ICNG. Ground-borne construction noise is usually present on tunnelling projects when equipment such as tunnel boring machines, road headers, rock hammers and drilling rigs are operated underground. As no tunnelling works are proposed as part of the project, ground-borne noise impacts are not anticipated at residential or commercial receivers. For critical spaces such as recording, studios, cinemas and operating theatres, an assessment of ground-borne construction noise for surface construction works (such as rock-breaking) may be required.

Ground-borne noise is usually not a significant disturbance to building occupants during the day period as higher ambient noise levels generally mask the audibility of ground-borne noise emissions. During the evening and night periods, ground-borne noise can be more prominent due the lower ambient noise levels.

The ICNG NMLs for ground-borne noise to assess impacts to amenity and sleep during the evening and night periods are presented below:

- evening (6 pm – 10 pm) internal  $L_{Aeq(15 min)}$ : 40 dBA
- night (10 pm – 7 am) internal  $L_{Aeq(15 min)}$ : 35 dBA.

These impacts only apply if and when the ground-borne noise levels are higher than the airborne noise levels for the same activity.

## E-1-4 Construction road traffic noise

The RNP provides traffic noise target levels for residential receivers in the vicinity of existing roads and are applied to road upgrades. For this assessment these levels are also applied to construction works to identify potential construction traffic impacts and the potential for reasonable and feasible mitigation measures. The RNP road types are based on the functional roles shown in Table E.3.

**Table E.3** Road Categories from RNP

Road category	Functional role	Existing roads used by project
Freeways or motorways/arterial roads	Support major regional and inter-regional traffic movement. Freeways and motorways usual feature strict access controls via grade separated interchanges.	James Ruse Drive, Rosehill Silverwater Road, Ermington M4 Motorway, Lidcombe
Sub-arterial roads	Provide connection between arterial roads and local roads. May support arterial roads during peak period. May have been designed as local streets but can serve major traffic generating developments or support non-local traffic.	South Street, Rydalmere Boronia Street, Ermington Hope Street, Ermington Atkins Road, Ermington Wharf Road, Melrose Park Spurway Street, Ermington Hughes Avenue, Melrose Park Kevin Coombs Avenue, Sydney Olympic Park Old Hill Link, Sydney Olympic Park Macquarie Street, Parramatta
Local roads	Provide vehicular access to abutting property and surrounding streets. Provide a network for the movement of pedestrians and cyclists, and enable social interaction in a neighbourhood. Should connect ,where practicable, only to sub-arterial roads.	Grand Avenue, Camellia Holker Busway, Sydney Olympic Park Australia Avenue, Sydney Olympic Park Dawn Fraser Avenue, Sydney Olympic Park Uhrig Road, Lidcombe John Street, Rydalmere Fallon Street, Rydalmere Primrose Avenue, Rydalmere River Road, Ermington Hilder Road, Ermington

The application notes for the RNP state that *“for existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level as a result of the development should be limited to 2 dB above that of the noise level without the development. This limit applies wherever the noise level without the development is within 2 dB of, or exceeds, the relevant day or night noise assessment criterion.”*

If the road traffic noise increase from the construction work is within 2 dB of current levels then the objectives of the RNP are met and no specific mitigation measures are required. Mitigation should be applied when road traffic noise levels increase by 2 dB and the controlling noise criterion in Table E.4 are exceeded when assessed at the nearest façade of the residential dwelling.

Table E.4 Road traffic noise criteria, dBA

Development type	Day 7 am to 10 pm	Night 10 pm to 7 am
Existing residences affected by noise from <b>new</b> freeway/arterial/sub-arterial road corridors	55 Leq(15hr)	50 Leq(9hr)
Existing residence affected by <b>additional traffic</b> on arterial/sub-arterial/collector roads generated by land use developments	60 Leq(15hr)	55 Leq(9hr)
Existing residences affected by noise from <b>new</b> local road corridors	55 Leq(1hr)	50 Leq(1hr)
Existing residence affected by <b>additional traffic</b> on local roads generated by land use developments		

## E-2 Construction vibration objectives

The effects of vibration in buildings due to vibration intensive equipment associated with construction can be categorised by the following:

- human comfort impacts – occupants or users of a building and inconvenienced or disturbed
- building contents impacts – contents within a building may be affected
- cosmetic damage – the integrity of a building, structure or pipework may be compromised.

### E-2-1 Human comfort objectives

Guidance for acceptable vibration levels for human comfort is based on *Assessing Vibration: A Technical Guideline* (AVTG) (DEC, 2006) which references *BS6472-1: Guide to Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)* (British Standards, 1992).

AVTG provides three assessment methods, depending on whether the vibration source is continuous, impulsive or intermittent. These can be defined as:

- Continuous vibration – normally generated by fixed plant (such as generators and fans) where the vibration emissions could continue uninterrupted throughout the day and night periods.
- Impulsive vibration – normally generated by short duration (i.e. less than two second) events with no more than three occurrences in an assessment period (e.g. ground compaction by dropping a large mass).
- Intermittent vibration – normally generated by continuous vibration sources that may be interrupted (e.g. vibratory rolling, rock breaking and truck pass-bys) or continuous periods of impulsive vibration (e.g. impact piling). For intermittent vibration, human comfort levels are assessed on the basis of Vibration Dose Value (VDV) based on the level and duration of the vibration events.

For construction works related to the project, construction vibration is considered to be intermittent and assessed using VDV. The acceptable VDV values are shown in Table E.5.

Table E.5 Acceptable Vibration Does Values for Human Comfort (BS 6472-2008)

Receiver	Assessment Period	x, y and z axes	
		Preferred values	Maximum values
Critical areas	Day or night	0.10 m/s <sup>1.75</sup>	0.20 m/s <sup>1.75</sup>
Residential	Day	0.20 m/s <sup>1.75</sup>	0.40 m/s <sup>1.75</sup>
	Night	0.13 m/s <sup>1.75</sup>	0.26 m/s <sup>1.75</sup>
Offices, schools, educational institutes and places of worship	When in use	0.40 m/s <sup>1.75</sup>	0.80 m/s <sup>1.75</sup>
Workshops	When in use	0.80 m/s <sup>1.75</sup>	1.60 m/s <sup>1.75</sup>



## E-2-2 Effects on building contents

People can perceive floor vibration at levels well below those likely to cause damage to contents within a building or affect their operation. For most receivers, the controlling vibration criterion is therefore the human comfort criterion and separate objectives are not normally required in relation to the effect of construction vibration on building contents.

For critical spaces such as recording studios, high-technology facility and building with scientific equipment (e.g. electron microscopes and microelectronics manufacturing equipment), vibration criteria can require more stringent objectives than those applicable to human comfort. Where appropriate, objectives for the satisfactory operation of critical instruments or manufacturing processes should be sourced from manufacturer's data and/or other published objectives.

No specific critical spaces have been identified within the study area for the project. Should sensitive and medical equipment be identified within the study area during the design development process, guidance should be sourced from manufacturer's data. Where manufacturer's data is not available, generic vibration curves (VC) curves as published in *Generic Vibration Criteria for Vibration-Sensitive Equipment* (Gordon, 1999) may be adopted as vibration objectives.

## E-2-3 Cosmetic damage objectives

### Reinforced and unreinforced structures

BS 7385-2:1993 *Evaluation and measurement for vibration in buildings Part 2 – Guide to damage* (British Standards, 1993) sets guide values for building vibration bases on the lowest vibration levels above which damage has been credibly demonstrated. The use of BS7385- is the preferred standard in NSW to assess potential vibration impacts to standard structures and is consistent with the Transport for NSW noise and vibration guidelines.

The guide values from BS7385 for transient vibration to ensure minimal risk of cosmetic damage to residential and industrial buildings are presented in Table E.6.

Table E.6 Transient vibration guide values – minimal risk of cosmetic damage

Type of building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse <sup>1</sup>	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures industrial and heavy commercial building	50 mm/s at 4 Hz and above	
Unreinforced or light framed structures residential or light commercial type buildings <sup>2</sup>	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Notes: 1. Values referred to are at the base of the building.

2. At frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) should not be exceeded.

BS7385 also states that the guide values relate predominantly to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings. The standard states that '*where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values in Table 16 may need to be reduced by up to 50%*'. Construction activities such as rock-breaking, hammering and piling have the potential to cause dynamic loading in some structures. As such, a conservative vibration damage screening level is given below:

- reinforced or framed structures: 25 mm/s
- unreinforced or light framed structures: 7.5 mm/s.

Where the predicted/measured vibration level exceeds the screening level above, further investigation should be undertaken on the building structure, vibration source, dominant frequencies and dynamic characteristics of the structures to determine an appropriate safe vibration management level.

## Heritage items and structures

Heritage buildings and structures are assessed as per the screening vibration levels for reinforced and unreinforced buildings as heritage items should not be assumed to be more sensitive to vibration unless they are found to be structurally unsound. Subsequent to an inspection, if a heritage building or structure is found to be structurally unsound a conservative cosmetic damage objective of 2.5 mm/s peak particle velocity level would be considered (based on German Standard *DIN 4150-3 Structural Vibration – Part 3: Effects of vibration on structure* (German Standards, 1999)).

## Buried pipework

BS7385 notes that structures below ground are known to sustain higher levels of vibration and are very resistant to damage unless in very poor condition. Guidance can also be taken from DIN 4150-3 which sets out guideline values for vibration in terms of PPV to be used when assessing the effects of vibration on buried pipework as shown in Table E.7.

**Table E.7** Guideline values for short-term vibration on buried pipework

Pipe material	Guideline values for velocity measured on pipe in mm/s, PPV
Steel (including welded pipes)	100
Clay, concrete, reinforced concrete, pre-stressed concrete, metal (with or without flange)	80
Masonry, plastic	50

## E-3 Operational noise and vibration

### E-3-1 Airborne noise from the light rail track

A summary of the operational noise trigger levels for the assessment of the light rail vehicles and applicable to the Parramatta Light Rail Stage 2 study area are presented in the Table E.8 and are based on the RING.

**Table E.8** Airborne light rail vehicle noise trigger levels

Sensitive land use	Day	Night
Residential, mixed-use developments and hotels <sup>1</sup>	60 L <sub>Aeq</sub> (15 hour) <b>and</b> 80 L <sub>Amax</sub>	50 L <sub>Aeq</sub> (9 hour) <b>and</b> 80 L <sub>Amax</sub>
Schools, educational institutions and child care centres	40 L <sub>Aeq</sub> (1hour) internal or 50 L <sub>Aeq</sub> (1hour) external (when in use)	
Places of worship	40 L <sub>Aeq</sub> (1hour) internal or 50 L <sub>Aeq</sub> (1hour) external (when in use)	
Open space – passive use	60 L <sub>Aeq</sub> (1hour) external (when in use)	
Open space – active use	65 L <sub>Aeq</sub> (1hour) external (when in use)	
Other commercial (public buildings, exhibition areas, café, bar, retail, offices and restaurant) <sup>2</sup>	40 L <sub>Aeq</sub> (1hour) internal or 60 L <sub>Aeq</sub> (1hour) external (when in use) (Adopted noise goal only – not considered noise sensitive in the RING)	

- Notes:
1. The residential noise trigger levels have been assumed for mixed-use developments and hotels. It is assumed that there may be habitable areas on the ground floor of mixed-use developments and hotels as a worst-case. Where this level is exceeded, further investigation has been undertaken to determine which floor and façade may include habitable areas.
  2. A 10 dB inside to outside transfer function has been assumed to account for noise through an open window.
  3. Internal noise trigger level is based on the minimum design sound level range for general office areas, coffee shops, restaurants and exhibition areas in AS2107 Acoustics – Recommended design sound levels and reverberations times for building interiors as screening assessment. A 20 dB inside to outside transfer function has been assumed to account for a closed window with gaps using standard construction. Where this level is exceeded, further investigation has been undertaken to determine the type of occupancy and the likely construction of the building facade.

The following additional notes are provided based on guidance from the RING:

- Specified noise trigger levels refer to noise from rail transportation only and do not include ambient noise from other sources.
- Noise levels at residences are assessed one metre in front of the most-affected building façade and should include a +2.5 dB correction in the modelling to account for reflection from the building façade.
- $L_{Amax}$  refers to the maximum noise level not exceeded for 95 per cent of rail pass-by events and is measured using the 'fast' response setting on a sound-level meter. The purpose of the  $L_{Amax}$  trigger levels is to cap the potential noise impacts associated with individual pass-by events. For projects where different types of rolling stock would be used (e.g. freight and passenger operations), the  $L_{Amax}$  noise level should be reported separately for each type of rolling stock and compared with the  $L_{Amax}$  (95 per cent) trigger levels.
- The  $L_{Amax}$  noise triggers in the RING apply to noise and safety devices such as horns and bells at level crossings where there is a normal part of operational noise. For Parramatta Light Rail Stage 2, warning bells would only be used in case of an emergency and are not considered part of normal operations. As such, have not been considered in the operational noise modelling and assessment.

## E-3-2 Airborne noise from substations, stabling and maintenance facility and light rail stops

Noise trigger levels have been established based on the *Noise Policy for Industry* (EPA, 2017) to assess potential impacts from fixed facilities associated with Parramatta Light Rail Stage 2. For residential receivers, the project noise trigger level is based on the lower of the 'intrusiveness' noise levels and the 'project amenity' noise levels. For other sensitive receivers, the project noise trigger level is based on the project amenity noise level only.

Where there is a risk of sleep disturbance impacts due to maximum noise level events, sleep disturbance is assessed against the screening criterion in the NPfI.

### Intrusiveness noise level

The intrusiveness noise level is determined by a 5 dB addition to the RBL with a minimum intrusiveness noise level of 35 dBA for the evening and night period and 40 dBA for the day period. The NPfI recommends that the intrusiveness noise level for the evening and day period should not exceed the daytime period. The intrusiveness noise levels are only applicable to residential receivers.

### Recommended amenity noise level

The recommended amenity noise level applies to all industrial noise in the area which when combined should remain below the recommended amenity noise level. The recommended amenity noise level represents the total industrial noise at a receiver location and a Project Amenity Noise Level is set at 5 dB below the recommended amenity noise level.

Residential receiver areas are characterised into 'urban', 'suburban', 'rural' or other categories based on land uses and the existing level of noise from industry and road traffic.

### Sleep disturbance screening criterion

To assess sleep disturbance the NPfI recommends the following screening criteria, assessed externally at the nearest residential location.

- $L_{Aeq(15min)}$  40 dBA or the prevailing RBL + 5 dB (whichever is greater); and/or
- $L_{AFmax}$  52 dBA or the prevailing RBL + 15 dB (whichever is greater).

As the intrusiveness noise levels are at or above  $L_{Aeq(15min)}$  40 dBA at all residences, sleep disturbance has been assessed against the  $L_{AFmax}$  screening criteria. Should maximum noise level events during operation exceed the screening criteria, a detailed maximum noise assessment should be undertaken.

It is not expected that maximum noise events would occur at traction power substations, as such no further assessment of sleep disturbance impacts due to noise from substations has been provided.

## Effects of changing land use

When land uses in an area are undergoing significant change, for example, the industrial area in Camellia changing to a mixed-used town centre including residential area, the background noise levels would be expected to change, sometimes significantly. The impact of noise from an existing industry, such as the stabling and maintenance facility, on a proposed new residential area should be made using the recommended amenity noise level for the residential land use, not the project intrusiveness noise level.

Where impacts exceed the amenity noise level, consideration should be given to how these impacts can be avoided or mitigated, such as modifying the location of the proposed residential development, placing screening land uses in-between the proposed residences and existing industry, or ensuring residences are built in a manner that provides acceptable indoor noise amenity.

## Project noise trigger levels

A summary of the project noise trigger levels for sensitive receivers are presented in the Table E.9 (substations), Table E.10 (light rail stops), Table E.11 (stabling and maintenance facility).

For a residence, the project noise trigger level and maximum noise levels are to be assessed at the reasonably most-affected point on or within the residential property boundary or, if that is more than 30 metres from the residence, at the reasonably most affected point within 30 metres of the residence, but not closer than three metres to a reflective surface and at a height of between 1.2 -1.5 metres above ground level.

In assessing amenity noise levels at commercial or industrial premises, the noise level is to be assessed at the reasonably most-affected point on or within the property boundary.

For the purposes of assessment to standardise the approach the NPfI recommends that the  $L_{Aeq(15min)} = L_{Aeq(period)} + 3$  dB unless an alternative approach can be justified.

The applicability of the NPfI project noise trigger levels are summarised below:

- traction power substations (TPS) – lower of the intrusiveness and amenity noise level
- light rail stops – intrusiveness noise level only (PA noise would by intermittent not cause background noise creep)
- stabling and maintenance facility – project noise trigger levels derived from the Stage 1 noise goals.

**Table E.9** NPfI project noise trigger levels – residences near traction power substations, dBA

TPS ref.	Suburb	NCA	Receiver type	RBL (night)	$L_{Aeq(15min)}$ Intrusiveness noise level (RBL + 5 dB)	$L_{Aeq(night)}$ amenity noise level	$L_{Aeq(15min)}$ Project amenity noise level	$L_{Aeq(15min)}$ Project noise trigger level
TPS-A	Camellia	C	Urban	-	-	45	40	43
TPS-B	Rydalmere	E	Suburban	33	38	40	38	38
TPS-C	Ermington	J	Suburban	36	41	40	38	38
TPS-D	Sydney Olympic Park	M	Suburban	36	41	40	38	38
TPS-E	Lidcombe (Carter Street)	R	Urban	45	50	45	43	43



**Table E.10** NPfI project noise trigger levels – residences near light rail stops, dBA

Light rail stop	Suburb	NCA	RBL (night)	L <sub>Aeq</sub> (15min) Intrusiveness noise level (RBL + 5 dB)	L <sub>AFmax</sub> sleep disturbance screening criterion
Sandown Boulevard	Camellia	C	47	52	62
John Street	Rydalmere	E	33	38	52
Nowill Street	Rydalmere	F	36	41	52
River Road	Ermington	H	36	41	52
Murdoch Street	Ermington	I	35	40	52
Atkins Road and Melrose Park	Ermington	J	36	41	52
Waratah Street	Melrose Park	K	32	37	52
Footbridge Boulevard and Hill Road	Wentworth Point	M	36	41	52
Holker Street	Sydney Olympic Park	P	39	44	54
Jacaranda Square and Olympic Boulevard	Sydney Olympic Park	Q	41	46	56
Carter Street	Lidcombe	R	45	50	60

**Table E.11** NPfI project noise trigger levels – sensitive receivers near stabling and maintenance facility, dBA

Suburb/NCA	Receiver type	Project noise trigger level	L <sub>AFmax</sub> sleep disturbance
Rosehill – Camellia (NCA-A)	Urban residential	52 L <sub>Aeq</sub> (15min) Day	
		48 L <sub>Aeq</sub> (15min) Evening	
		46 L <sub>Aeq</sub> (15min) Night	56
Camellia town centre (NCA-C)	Urban residential	58 L <sub>Aeq</sub> (15min) Day	-
		48 L <sub>Aeq</sub> (15min) Evening	-
		43 L <sub>Aeq</sub> (15min) Night	53
Camellia (NCA-C)	Commercial receivers	65 L <sub>Aeq</sub> (15min)	-
	Industrial receivers	68 L <sub>Aeq</sub> (15min)	-
	Educational receivers	38 (internal) L <sub>Aeq</sub> (1hr)	-

## E-3-3 Ground-borne noise and vibration

### Human comfort

The RING refers to *Assessing vibration: A technical guideline* (AVTG) (DEC, 2006) for applicable vibration criteria relevant to train operations. The AVTG provides vibration criteria that, if exceeded, have the potential to adversely affect the amenity of occupants inside buildings as it may affect their quality of life or working efficiency.

Human comfort impacts are experienced at levels well below those that can damage or affect a structure and its contents. The preferred and maximum values recommended by the AVTG are expressed in terms of the cumulative vibration dose value (VDV) and provided in the table below. The estimated VDV (eVDV) calculation methodology outlined in AVTG is considered appropriate for vibration sources with crest factors less than six (such as light rail vehicles) and has been used for comparison against the criteria.

The 'preferred values' for intermittent vibration from AVTG are recommended as trigger levels by the RING for the purposes of initiating an assessment of feasible and reasonable mitigation measures. These values are shown in Table E.12.

**Table E.12** Human comfort intermittent vibration limits

Receiver type	Period	Intermittent vibration dose value (m/s <sup>1.75</sup> )	
		Preferred value	Maximum value
Residential	Day (7.00 am and 10.00 pm)	0.2	0.4
	Night (10.00 pm and 7.00 am)	0.13	0.26
Offices, schools, educational institutes, and places of worship	When in use	0.4	0.8
Workshops	When in use	0.8	1.6

## Structural damage

Vibration transmission through the ground can cause a structure or structure coupled elements (walls, windows) to radiate. The transmitted vibration energy has the potential to damage and compromise the integrity of a structure as well as increase the risk of damage to building contents.

Structural damage criteria are significantly higher than those typically felt by humans. While there are no current Australian Standards that set criteria for the assessment of building damage caused by vibration, guidance on limiting values can be found in international standards such as:

- British Standard BS 7385-Part 2:1993 Evaluation and measurement for vibration in buildings; and
- German Standard DIN 4150-3:1999 Structural Vibration Part 3: Effects of vibration on structures.

These standards have been referenced in other large infrastructure projects in Australia.

The British Standard provides peak vibration velocities of 15-50 mm/s for cosmetic damage to typical residential structures while the German standard provides a range from 3 mm/s to 10 mm/s for sensitive structures such as heritage listed buildings.

The light rail vehicle source vibration levels (refer to Section 4.2.4 and Appendix C-4) are significantly lower than the structural damage criteria. Therefore, structural damage impacts from light rail vehicle operations are not expected and are not discussed further.

## Vibration sensitive equipment

For particularly vibration sensitive equipment such as research and computer equipment, the criteria outlined in the table below are likely to be non-conservative. *ASHRAE Handbook Chapter 48 Sound and Vibration Control* provides criteria for sensitive equipment, noting that specific values from equipment manufacturers should be sought where possible. The ASHRAE criteria for vibration sensitive equipment over the frequency range of 8 to 80 Hz can be summarised in Table E.13.

**Table E.13** Adopted vibration criteria for sensitive equipment (Source: ASHRAE)

Equipment type	Adopted criteria
Computer equipment, probe test equipment and microscopes less than 40x.	200 µm/s
Bench microscopes up to 100x magnification, laboratory robots.	100 µm/s
Bench microscopes up to 400x magnification; optical and other precision balances; coordinate measuring machines; metrology laboratories; optical comparators; microelectronics manufacturing equipment; proximity and projection aligners, etc.	50 µm/s
Microsurgery, eye surgery, neurosurgery; bench microscopes at magnification greater than 400x; optical equipment on isolation tables; microelectronic manufacturing equipment, such as inspection and lithography equipment (including steppers) to 3 mm line widths.	25 µm/s
Electron microscopes up to 30,000x magnification; microtomes; magnetic resonance imagers; microelectronics manufacturing equipment, such as lithography and inspection equipment to 1 mm detail size.	12.5 µm/s

Equipment type	Adopted criteria
Electron microscopes at magnification greater than 30,000x; mass spectrometers; cell implant equipment; microelectronics manufacturing equipment, such as aligners, steppers, and other critical equipment for photolithography with line widths of 1/2 µm; includes electron beam systems.	6 µm/s
Unisolated laser and optical research systems; microelectronics manufacturing equipment, such as aligners, steppers, and other critical equipment for photolithography with line widths of 1/4 µm; includes electron beam systems.	3 µm/s

Details regarding the presence of sensitive equipment at individual sensitive receivers is unknown at this stage of the design development process. Predicted maximum peak vibration velocities (and eVDV values) in each NCA are provided in Section 4.2.5.

## Ground-borne noise targets

Operational ground-borne noise is assessed in accordance with the RING. The ground-borne noise trigger levels are provided in Table E.14. As the proposed development in a new rail line, the absolute levels in Table E.14 are applicable to the project.

The RING notes that the above trigger levels are “*relevant only where ground-borne noise levels are audible and are of a higher level than airborne noise levels from rail operations*”. Other receivers sensitive to ground-borne noise such as theatres or medical facilities have not been identified in the study area.

Table E.14 Ground-borne noise trigger levels

Sensitive land use	Time of day	Internal noise trigger levels, dBA
	Development increases existing rail noise by 3 dB or more <b>and</b> resulting rail noise level exceeds:	
Residential	Day (7am-10pm)	40 L <sub>ASmax</sub>
	Night (10pm-7am)	35 L <sub>ASmax</sub>
Schools, educational institutes, places of worship	When in use	40–45 L <sub>ASmax</sub>

## E-4 Road traffic noise

### E-4-1 During operation

In locations where a development has the potential to result in an increase in road traffic noise levels, the impacts on sensitive receivers are required to be assessed under the NSW EPA ‘Road Noise Policy’ (RNP).

The application notes for the RNP state that “*for existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level as a result of the development should be limited to 2 dB above that of the noise level without the development. This limit applies wherever the noise level without the development is within 2 dB of, or exceeds, the relevant day or night noise assessment criterion.*”

The RNP notes that an increase of 2 dB (build scenario compared to the no-build scenario) represents a minor impact that is considered barely perceptible to the average person. Should an increase in road traffic noise levels be predicted to be greater than 2 dB, traffic noise levels should be assessed against the road traffic noise criteria presented in Table E.15 and mitigation strategies should be investigated to reduce potential noise impacts.

Table E.15 Road traffic noise criteria, dBA

Development type	Day 7 am to 10 pm	Night 10 pm to 7 am
Existing residence affected by <b>additional traffic</b> on existing freeways/arterial/sub-arterial roads generated by land use developments	60 Leq(15hr)	55 Leq(9hr)
Existing residence affected by <b>additional traffic</b> on existing local roads generated by land use developments	55 Leq(1hr)	50 Leq(1hr)

## E-4-2 Sleep disturbance screening assessment

The *Road Noise Policy* provides a literature review for the assessment of sleep arousal due to traffic noise however does not set a sleep disturbance assessment criterion. Sleep disturbance impacts are likely to be dependent on the following:

- maximum noise level of an event
- number of occurrences
- duration of the event
- level above background or ambient noise levels.

The *Environmental Noise Management Manual* (ENMM) (RTA, 2001) recommends that an assessment of maximum noise levels should include a calculation of the maximum noise levels, the extent to which the maximum noise levels for individual vehicle pass-bys exceed the  $L_{Aeq}$  for each hour of the night, and the number of maximum noise events. Additionally, the ENMM advises that the maximum noise level can be used as a tool to prioritise and rank mitigation strategies, however, should not be applied as a decisive noise criterion for selection of mitigation treatments.

At locations where road traffic is continuous rather than intermittent, the  $L_{Aeq(9hr) (night)}$  target noise levels should sufficiently account for sleep disturbance impacts. However, where the emergence of  $L_{Amax}$  over the ambient  $L_{Aeq}$  is equal to or greater than 15 dB, the  $L_{Aeq(9hr)}$  criteria may not sufficiently account for sleep disturbance impacts. In this case a maximum noise event is defined as any pass-by for which the  $L_{Amax}$  noise level exceeds  $L_{Aeq (1hr)}$  noise level by more than 15 dB and where the  $L_{Amax}$  noise level is greater than 65 dBA.

## E-4-3 During construction

During the construction phase of the project, additional traffic on public roads should be also assessed against the requirements of the RNP. Road traffic noise levels during construction should be compared against road traffic noise levels prior to the construction phase and where a 2 dB increase is predicted, traffic noise levels should be assessed against the controlling road traffic noise criteria in the table above.

Mitigation options for construction vehicle related traffic is limited because the proponent generally has no control over public roads. As such, where impacts are anticipated to occur for less than one year, standard noise mitigation options should be considered and where impacts are anticipated to occur for more than a year, there should be further investigation into potential noise mitigation strategies.

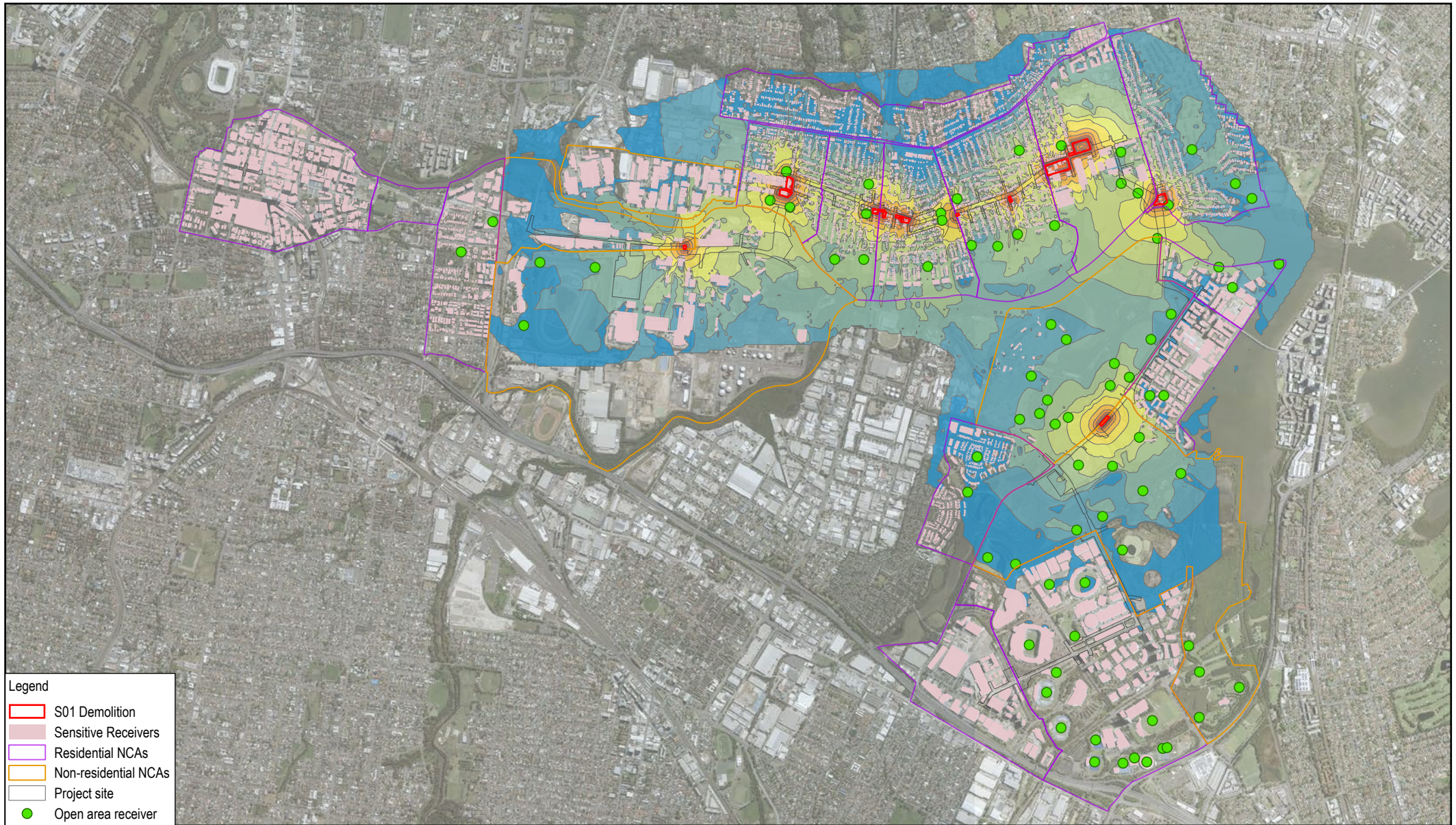


# **Appendix F**

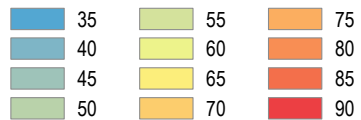
**Construction noise and vibration results**

## **F-1 Construction noise contours, $L_{Aeq}$ (15 min) dBA**



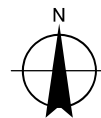


Noise contours, LAeq (15min) dBA



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Transport for NSW  
Parramatta Light Rail Stage 2 EIS  
Noise and vibration impact assessment

Construction noise contour,  
LAeq(15 min) dBA  
[S01 - Demolition works]

Project No. 12557728  
Revision No. -  
Date 28/06/2022

**FIGURE F-1**





- Legend**
- S01 Demolition
  - Sensitive Receivers
  - Residential NCAs
  - Non-residential NCAs
  - Project site
  - Open area receiver

Noise contours, LAeq (15min) dBA

	35		55		75
	40		60		80
	45		65		85
	50		70		90

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Meters

Map Projection: Transverse Mercator  
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Grid: GDA 1994 MGA Zone 56



Transport for NSW  
Parramatta Light Rail Stage 2 EIS  
Noise and vibration impact assessment

Construction noise contour,  
LAeq(15 min) dBA  
[S01 - Demolition of the Sandown Line]

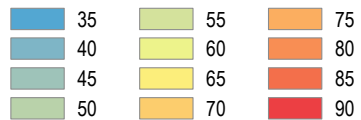
Project No. 12557728  
Revision No. -  
Date 28/06/2022

**FIGURE F-2**





Noise contours, LAeq (15min) dBA



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Meters

Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 56



Transport for NSW  
Parramatta Light Rail Stage 2 EIS  
Noise and vibration impact assessment

Construction noise contour,  
LAeq(15 min) dBA  
[S02 - Construction compounds]

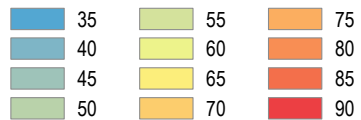
Project No. 12557728  
Revision No. -  
Date 28/06/2022

**FIGURE F-3**





Noise contours, LAeq (15min) dBA



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Map Projection: Transverse Mercator  
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Grid: GDA 1994 MGA Zone 56



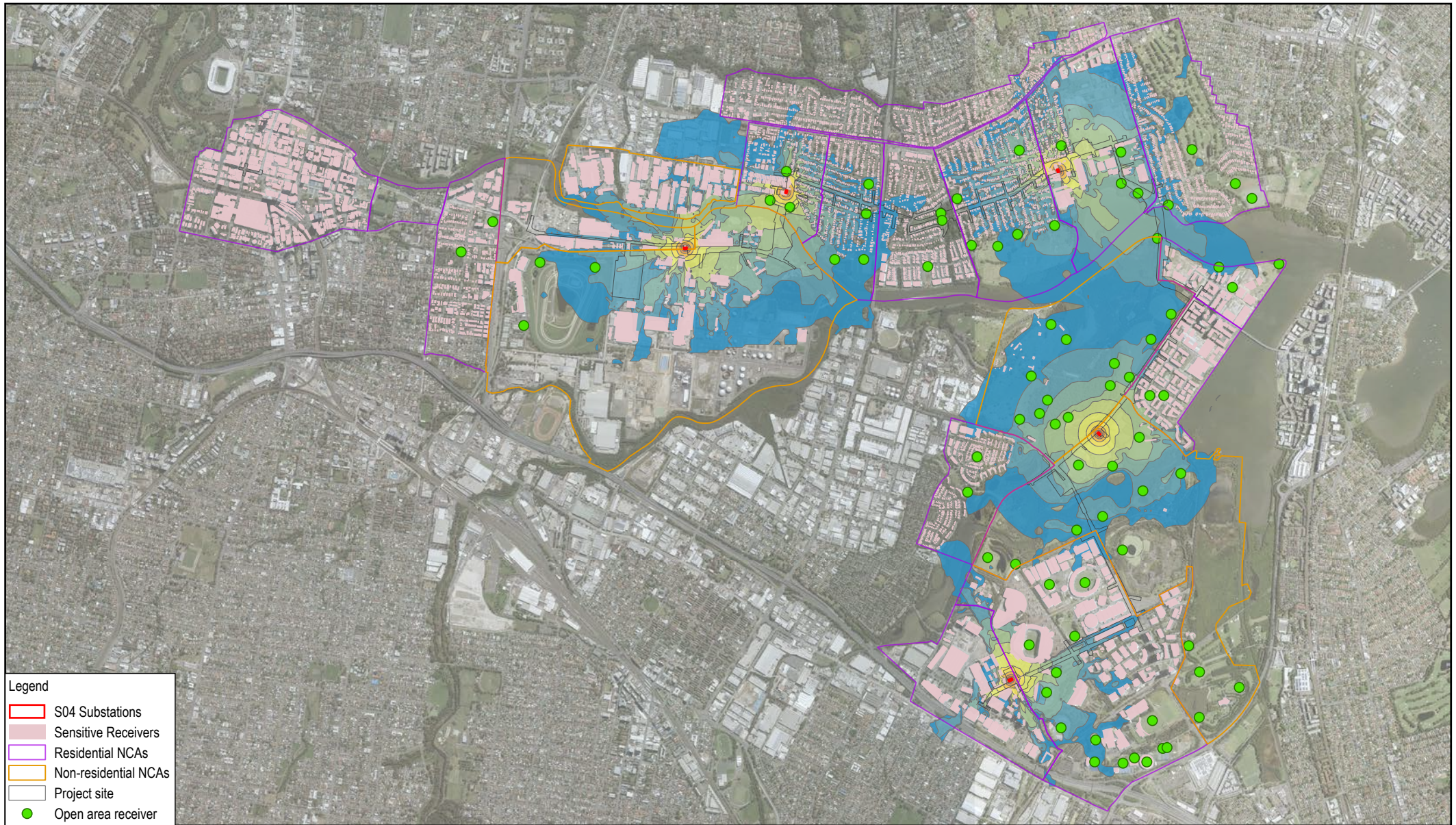
Transport for NSW  
Parramatta Light Rail Stage 2 EIS  
Noise and vibration impact assessment

Construction noise contour,  
LAeq(15 min) dBA  
[S03 -Recycling of spoil and ballast]

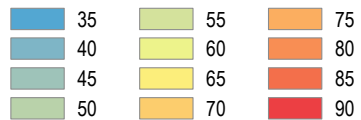
Project No. 12557728  
Revision No. -  
Date 28/06/2022

**FIGURE F-4**



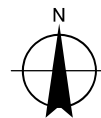


Noise contours, LAeq (15min) dBA



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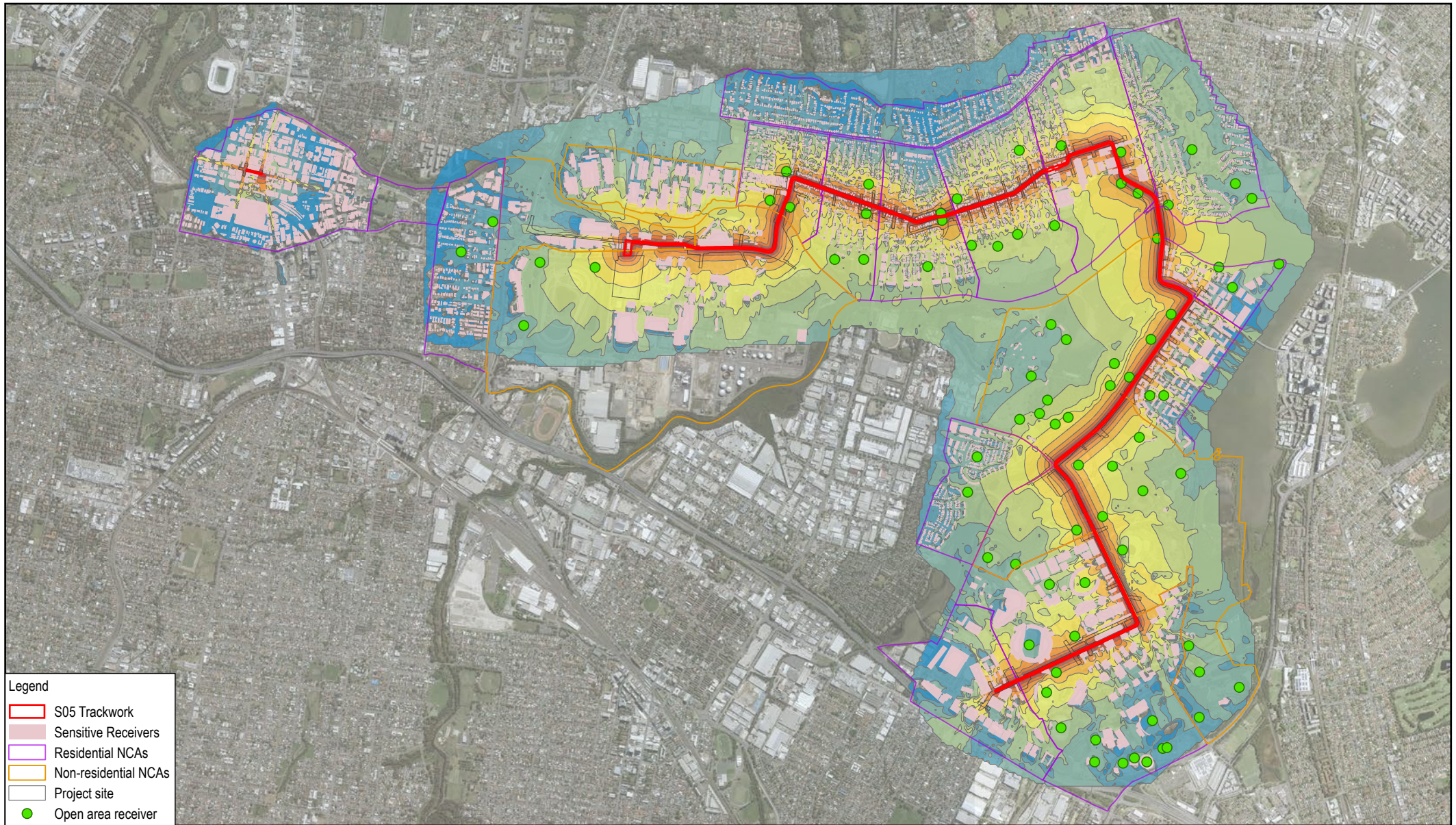
Transport for NSW  
Parramatta Light Rail Stage 2 EIS  
Noise and vibration impact assessment

Construction noise contour,  
LAeq(15 min) dBA  
[S04 - Construction substations]

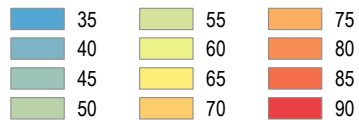
Project No. 12557728  
Revision No. -  
Date 28/06/2022

**FIGURE F-5**



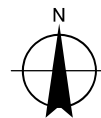


Noise contours, LAeq (15min) dBA



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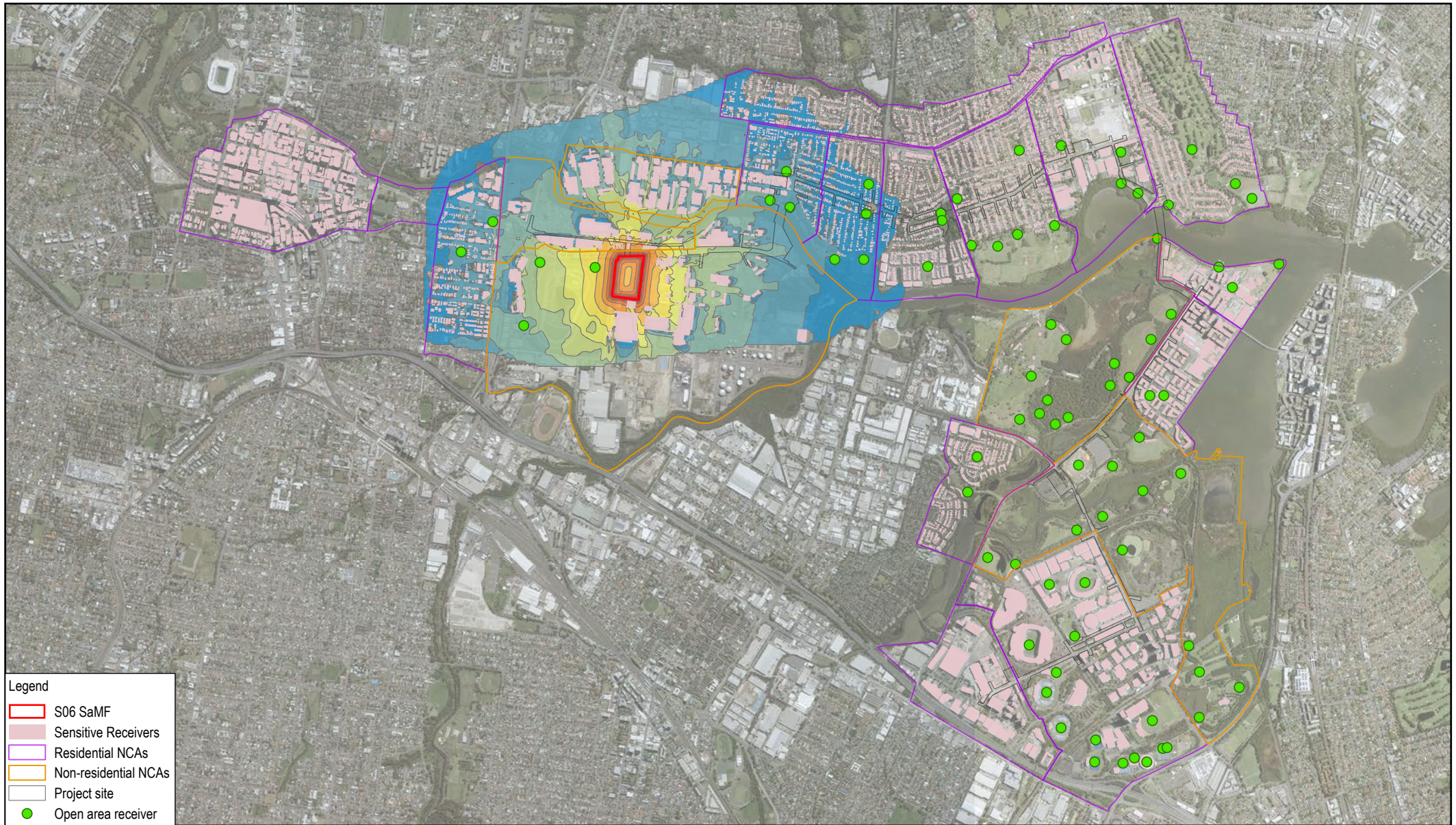
Transport for NSW  
Parramatta Light Rail Stage 2 EIS  
Noise and vibration impact assessment

Construction noise contour,  
LAeq(15 min) dBA  
[S05 -Trackworks]

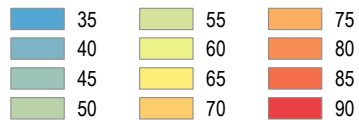
Project No. 12557728  
Revision No. -  
Date 28/06/2022

**FIGURE F-6**



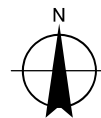


Noise contours, LAeq (15min) dBA



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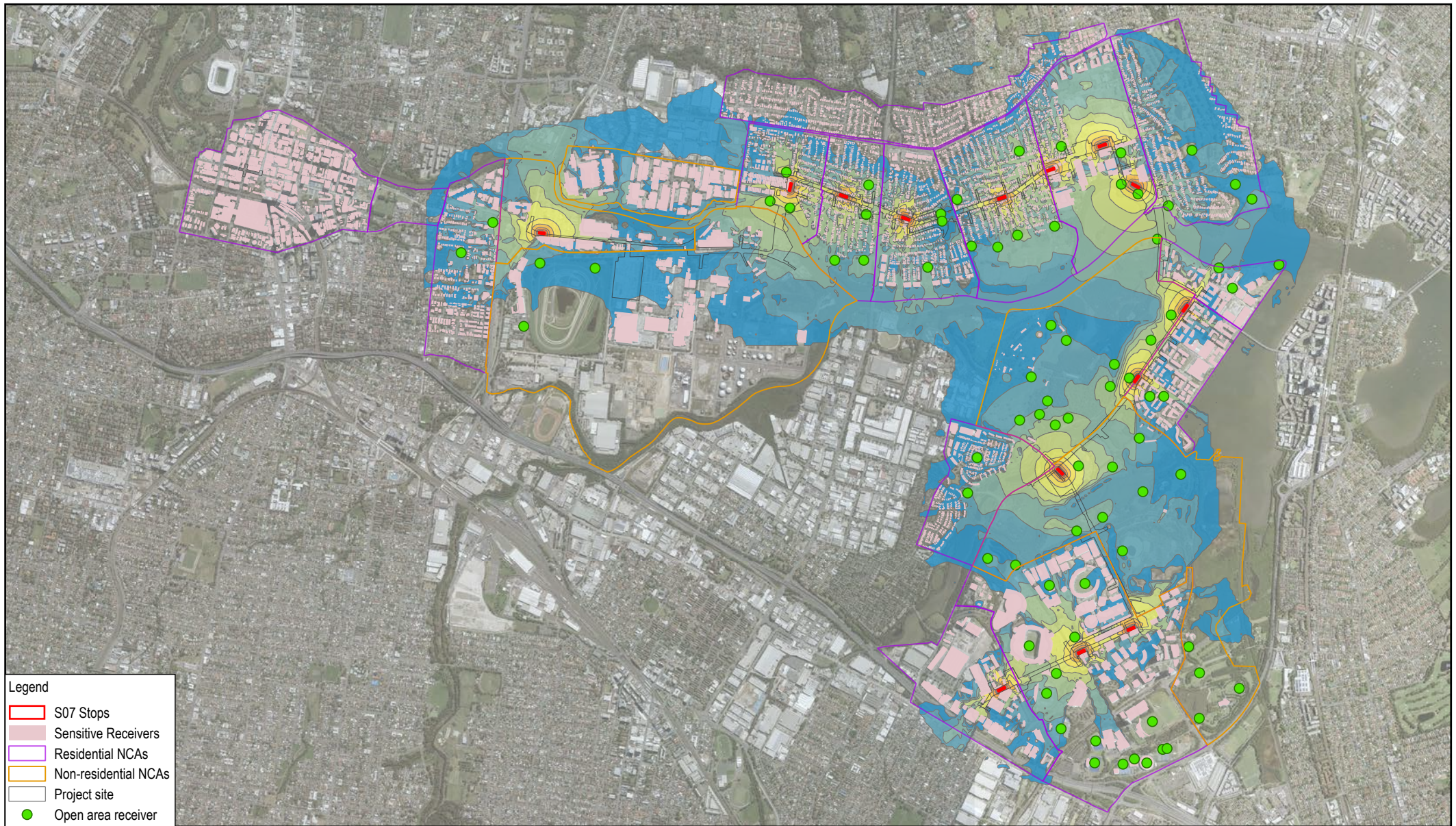
Transport for NSW  
Parramatta Light Rail Stage 2 EIS  
Noise and vibration impact assessment

Construction noise contour,  
LAeq(15 min) dBA  
[S06 - Modifications to the Camellia SaMF]

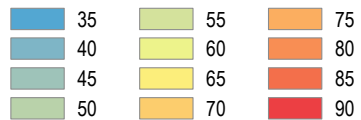
Project No. 12557728  
Revision No. -  
Date 28/06/2022

**FIGURE F-7**



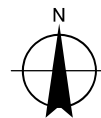


Noise contours, LAeq (15min) dBA



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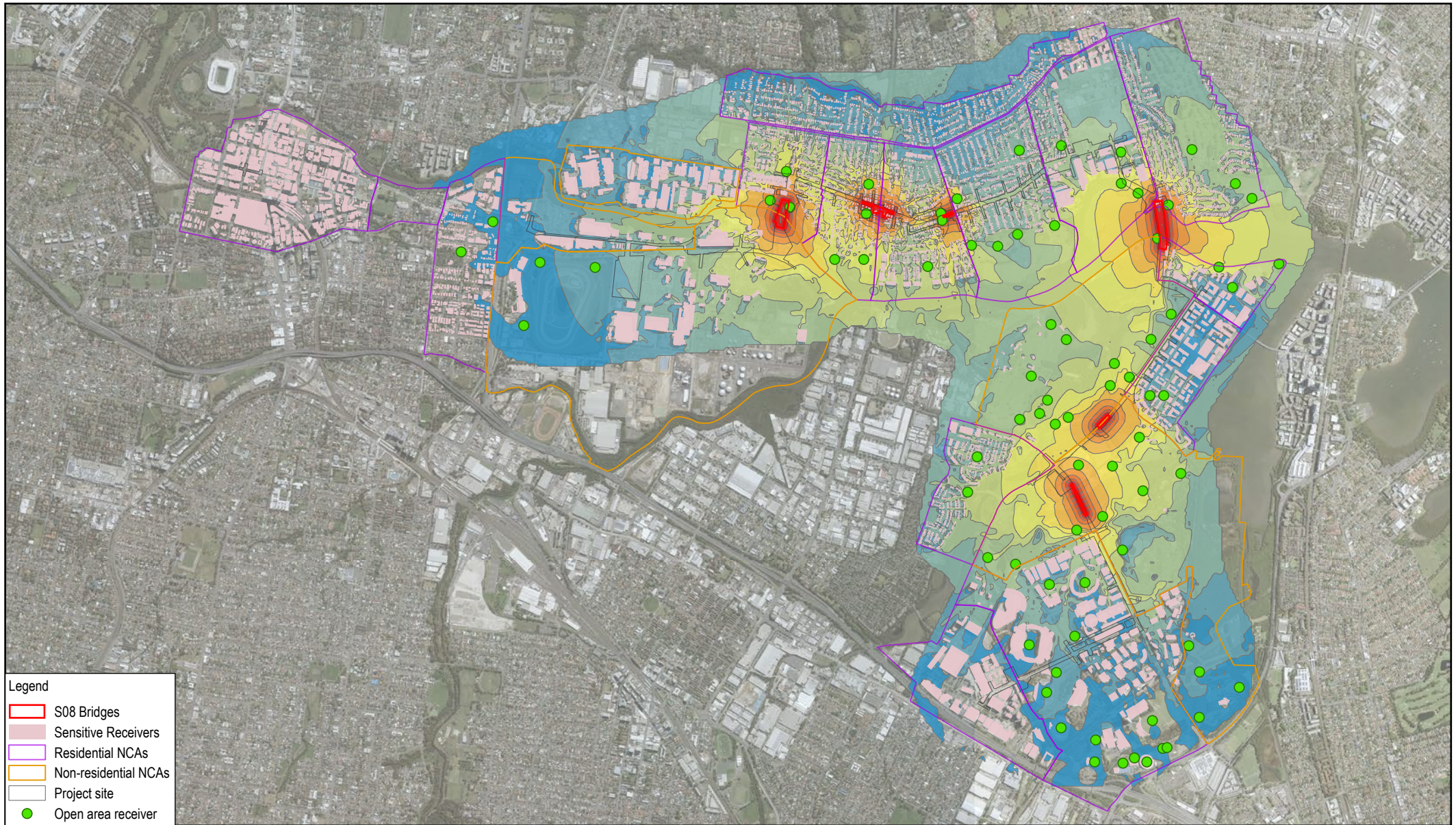
Transport for NSW  
Parramatta Light Rail Stage 2 EIS  
Noise and vibration impact assessment

Construction noise contour,  
LAeq(15 min) dBA  
[S07 - Construction of stops]

Project No. 12557728  
Revision No. -  
Date 28/06/2022

**FIGURE F-8**





- Legend**
- S08 Bridges
  - Sensitive Receivers
  - Residential NCAs
  - Non-residential NCAs
  - Project site
  - Open area receiver

Noise contours, LAeq (15min) dBA

	35		55		75
	40		60		80
	45		65		85
	50		70		90

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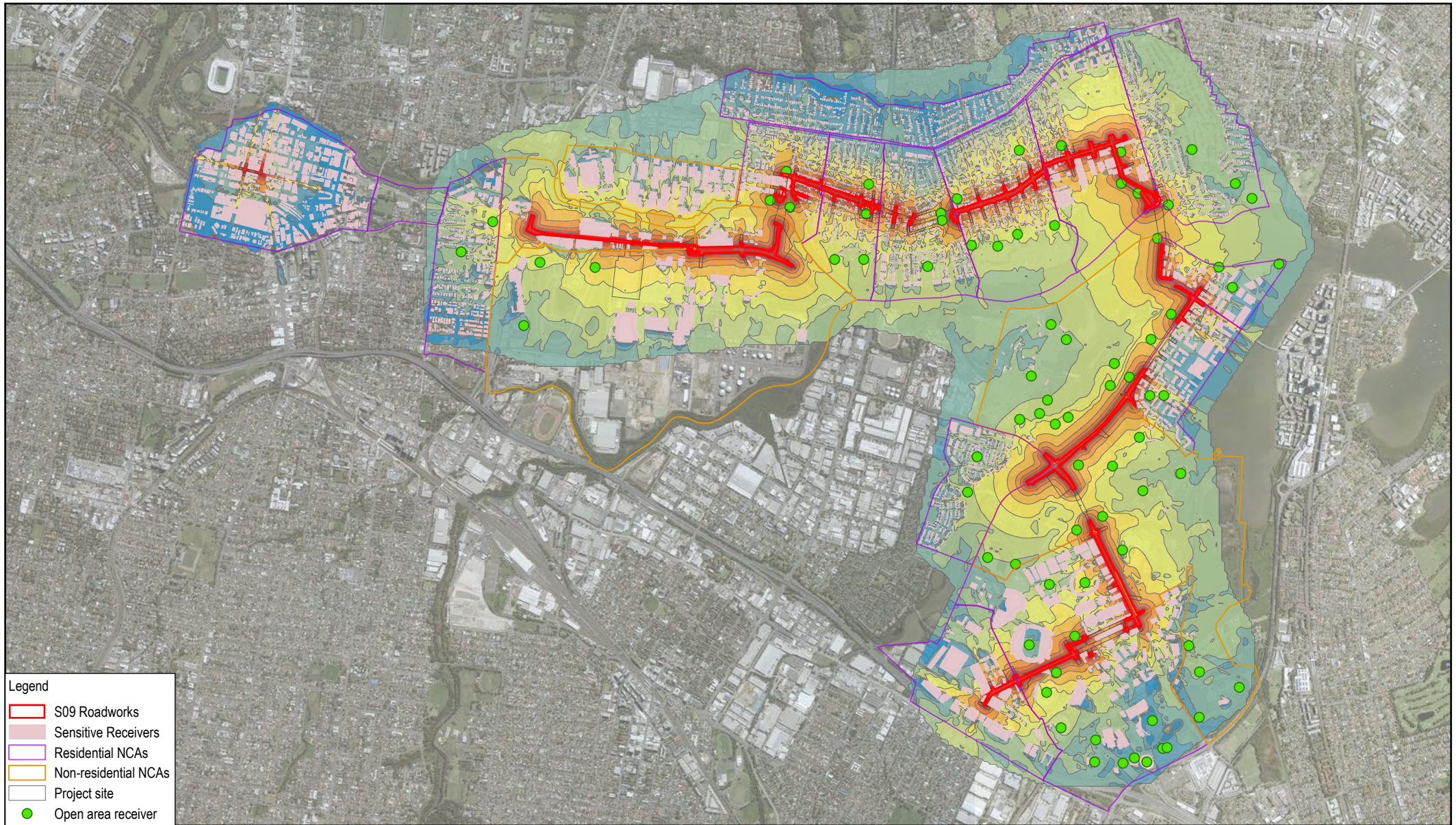
Transport for NSW  
Parramatta Light Rail Stage 2 EIS  
Noise and vibration impact assessment

Construction noise contour,  
LAeq(15 min) dBA  
[S08 - Construction of bridges]

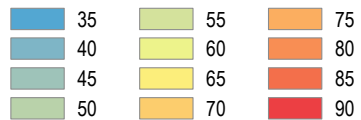
Project No. 12557728  
Revision No. -  
Date 28/06/2022

**FIGURE F-9**



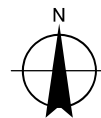


Noise contours, LAeq (15min) dBA



Paper Size ISO A4  
0 550 1,100  
Meters

Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 56



Transport for NSW  
Parramatta Light Rail Stage 2 EIS  
Noise and vibration impact assessment

Construction noise contour,  
LAeq(15 min) dBA  
[S09 - Off corridor roadworks]

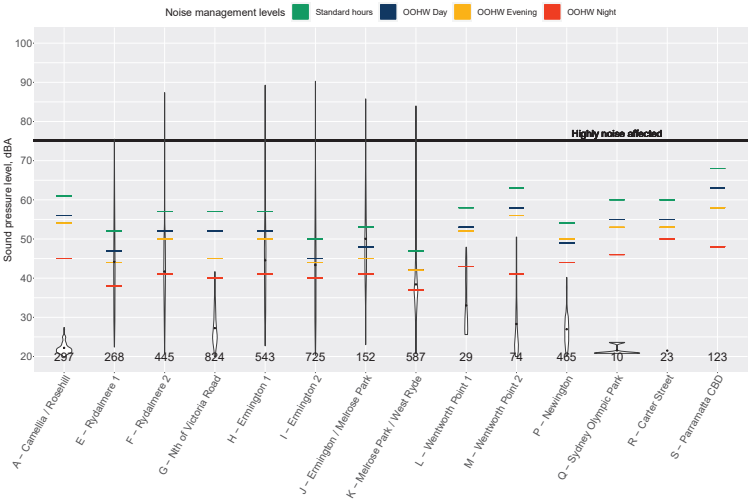
Project No. 12557728  
Revision No. -  
Date 28/06/2022

**FIGURE F-10**

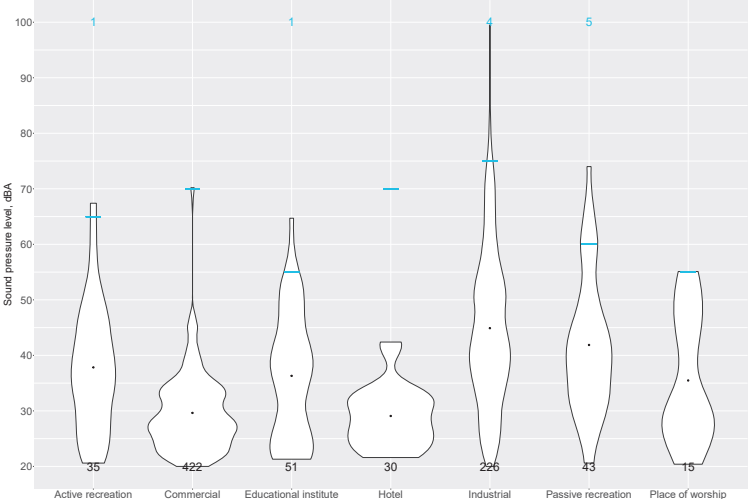


## **F-2      Construction noise result charts**

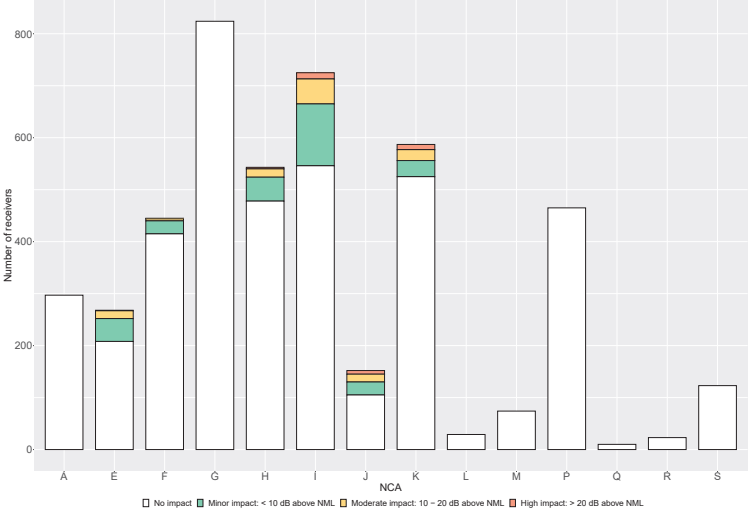
S01.01 – Range of noise levels per residential NCA



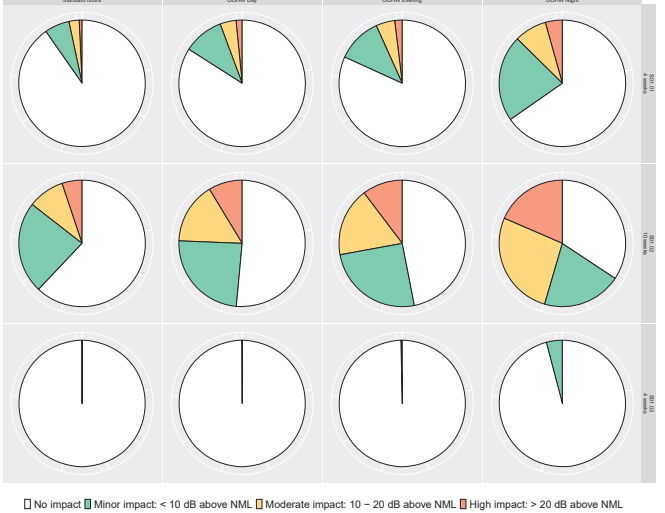
S01.01 – Range of noise levels per non-residential receiver type



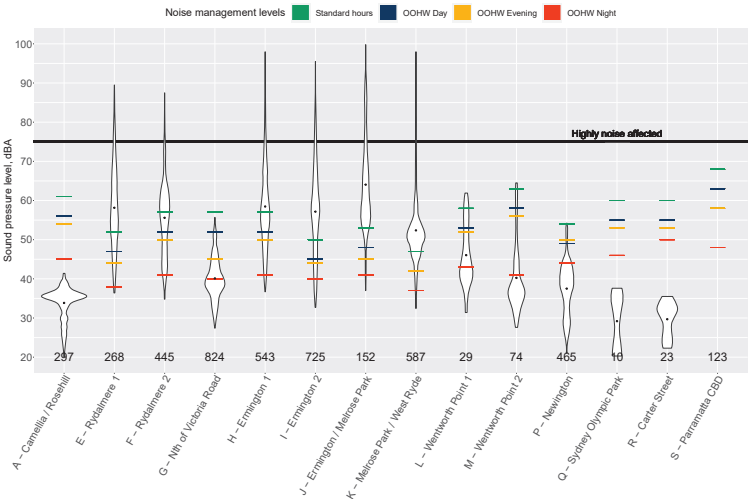
S01.01 – Impacts to residential receivers



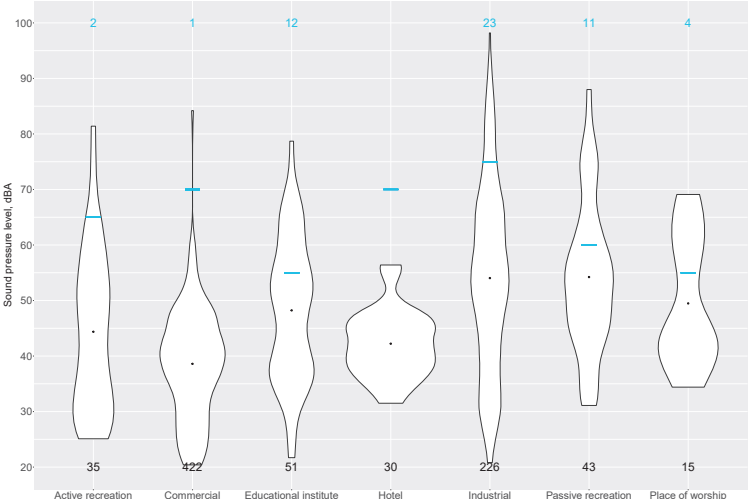
S01 – Impacts and duration of all sub-scenarios

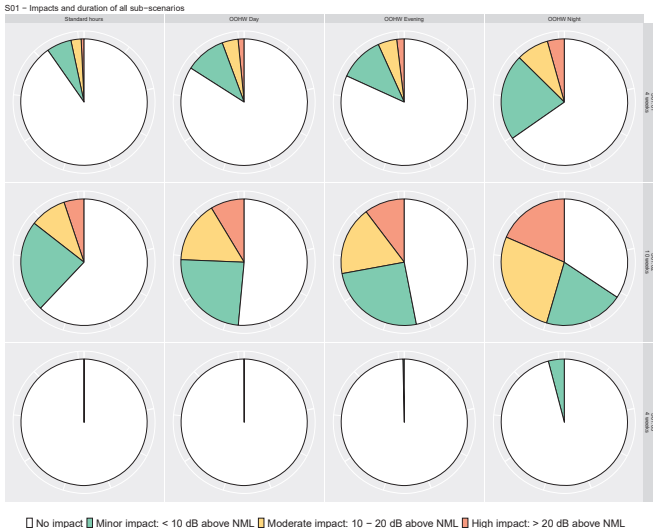
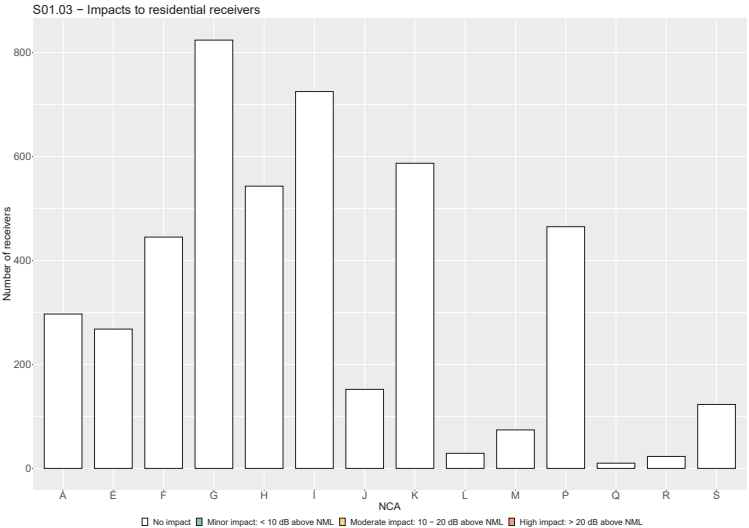
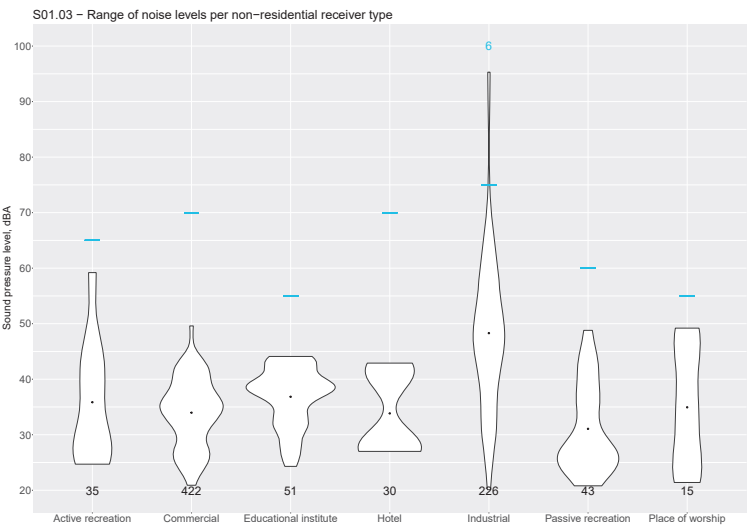
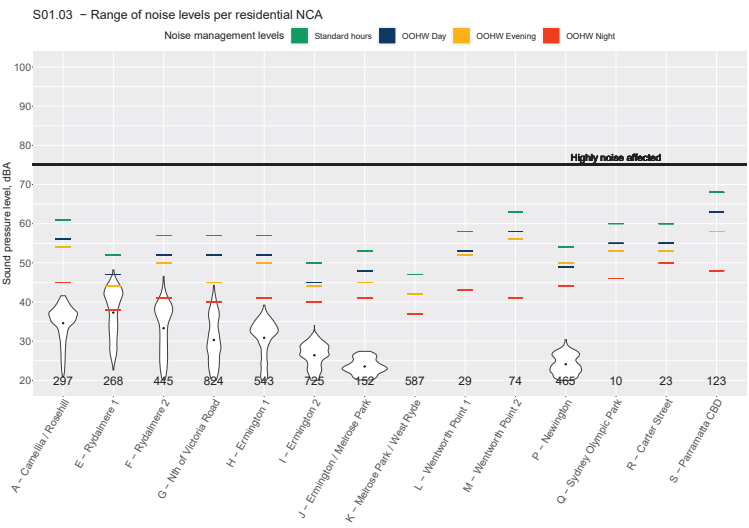
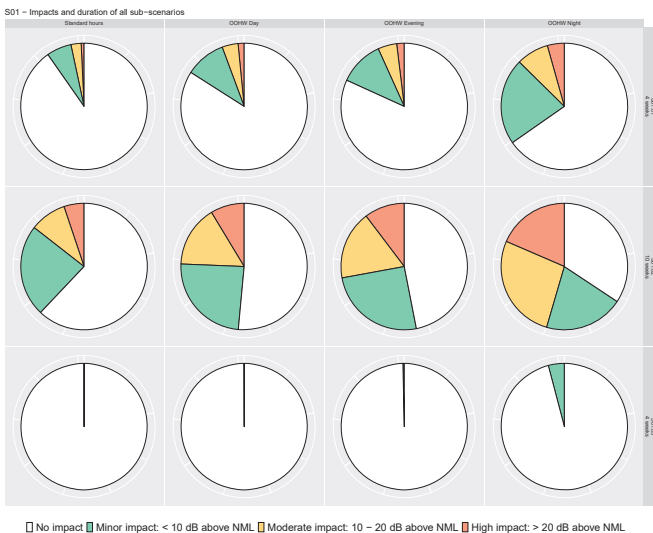
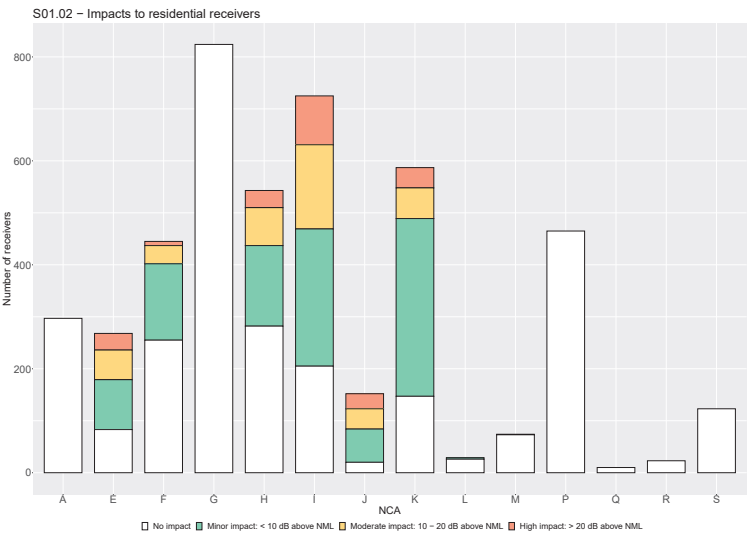


S01.02 – Range of noise levels per residential NCA

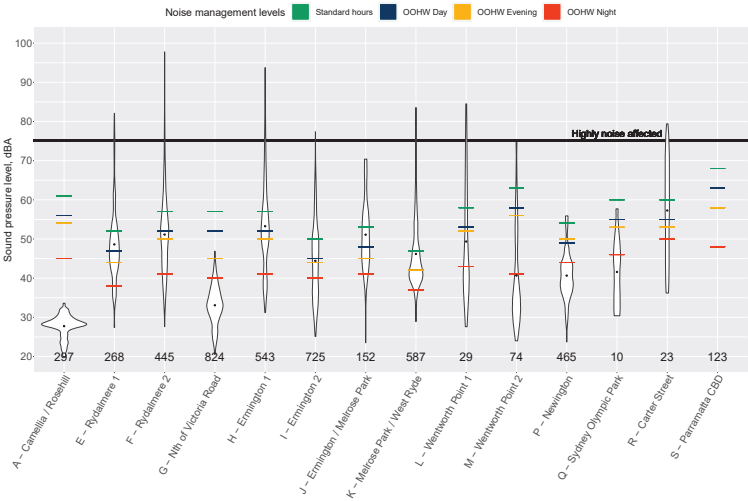


S01.02 – Range of noise levels per non-residential receiver type

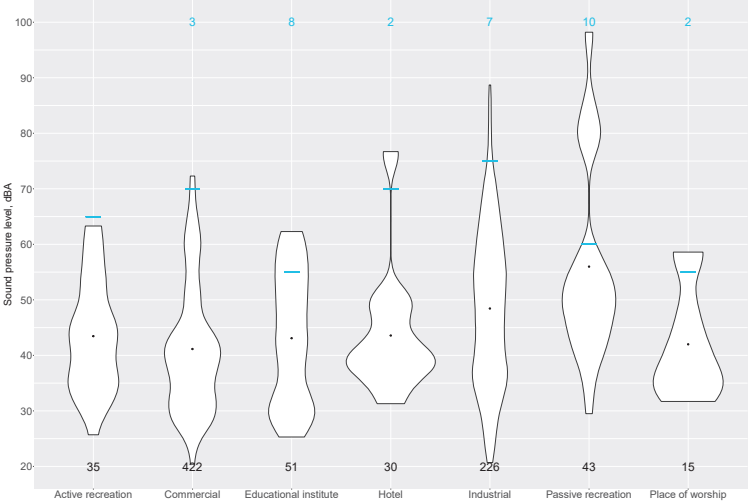




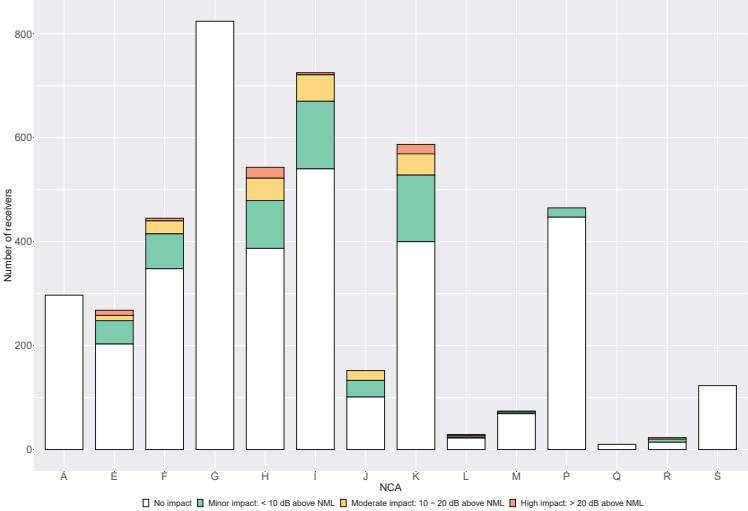
S02.01 – Range of noise levels per residential NCA



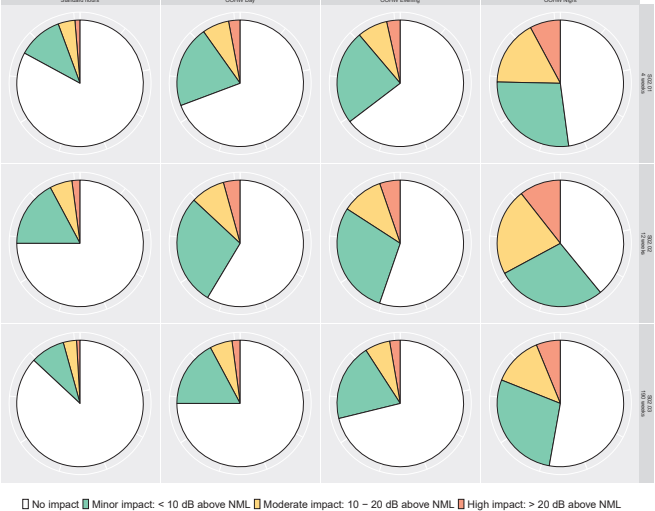
S02.01 – Range of noise levels per non-residential receiver type



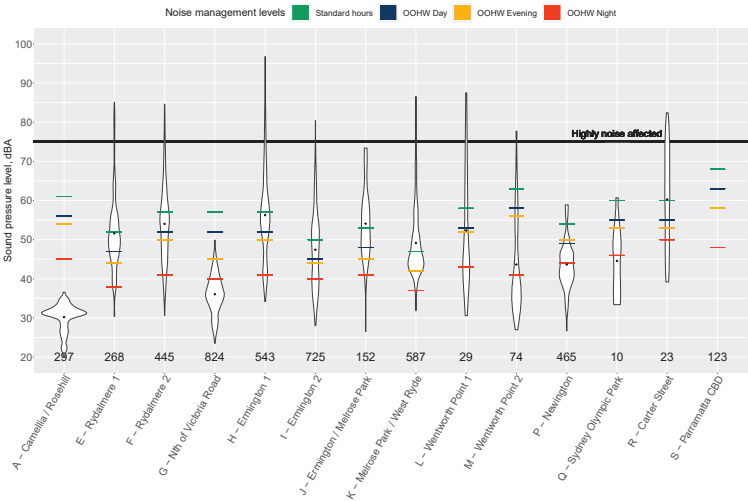
S02.01 – Impacts to residential receivers



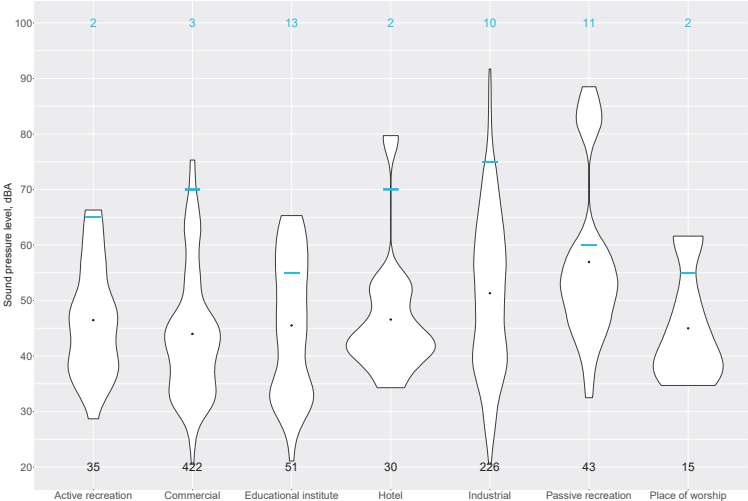
S02 – Impacts and duration of all sub-scenarios



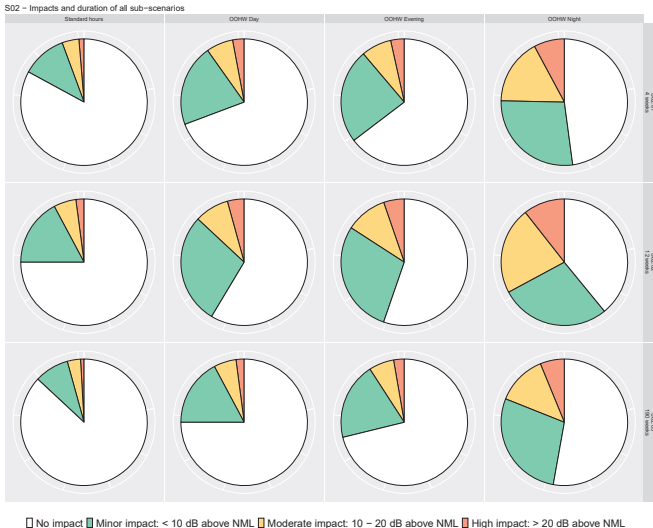
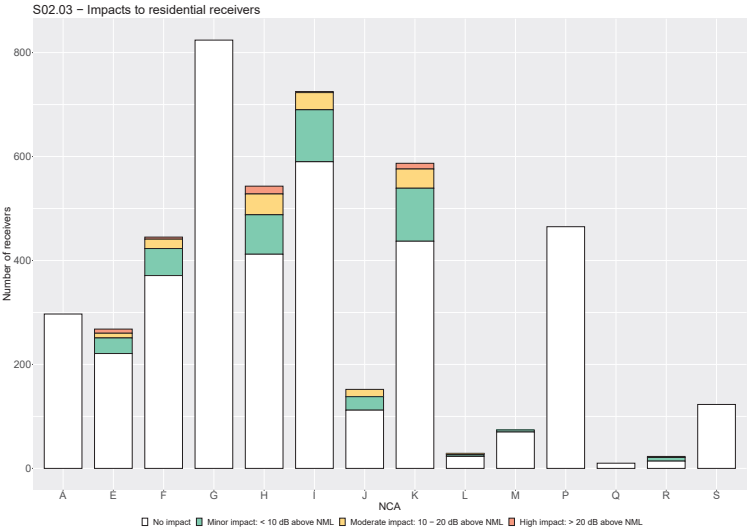
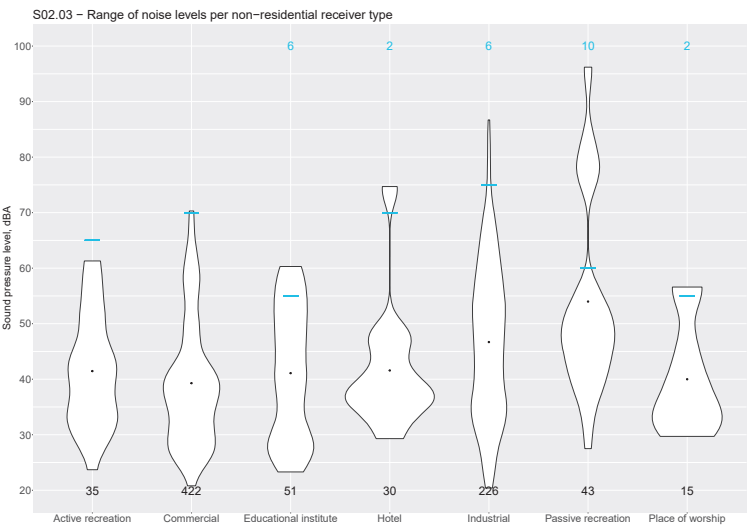
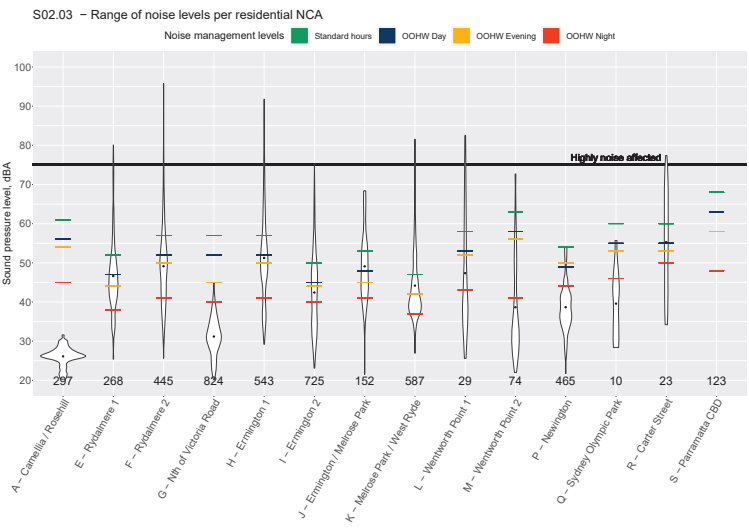
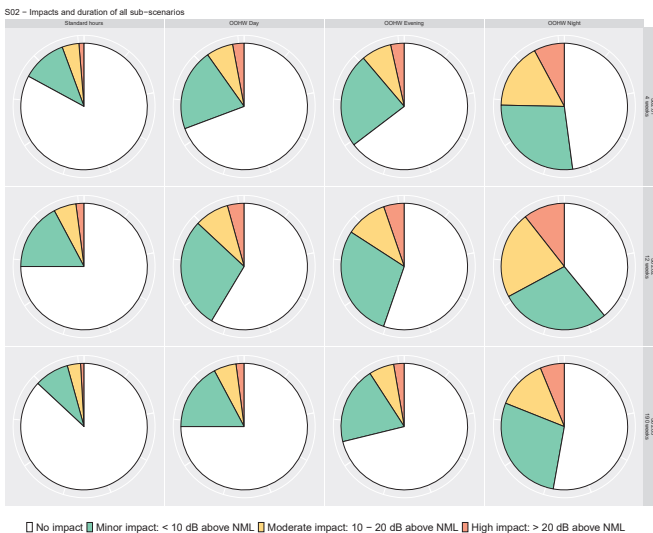
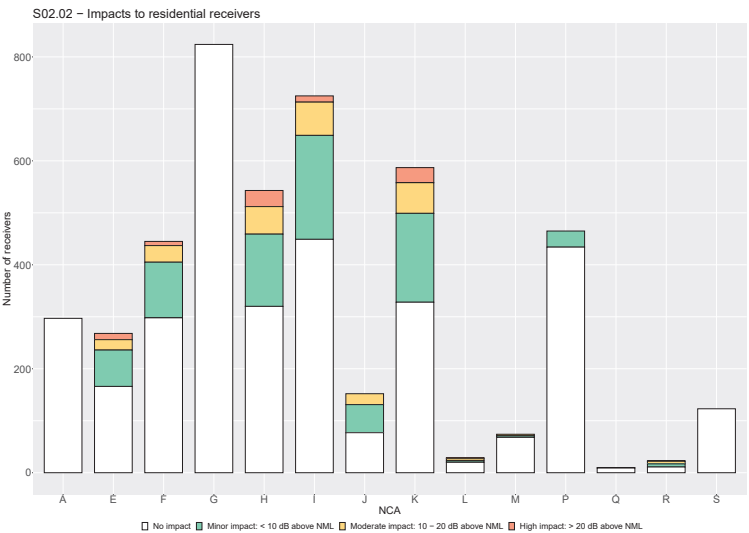
S02.02 – Range of noise levels per residential NCA

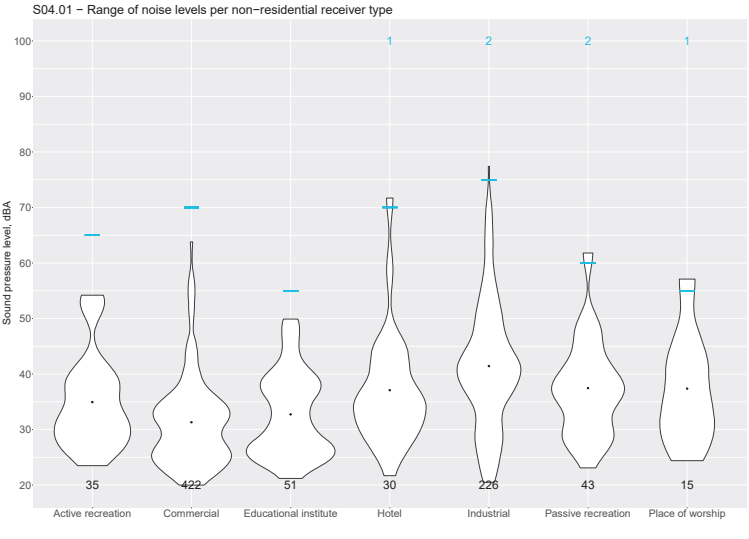
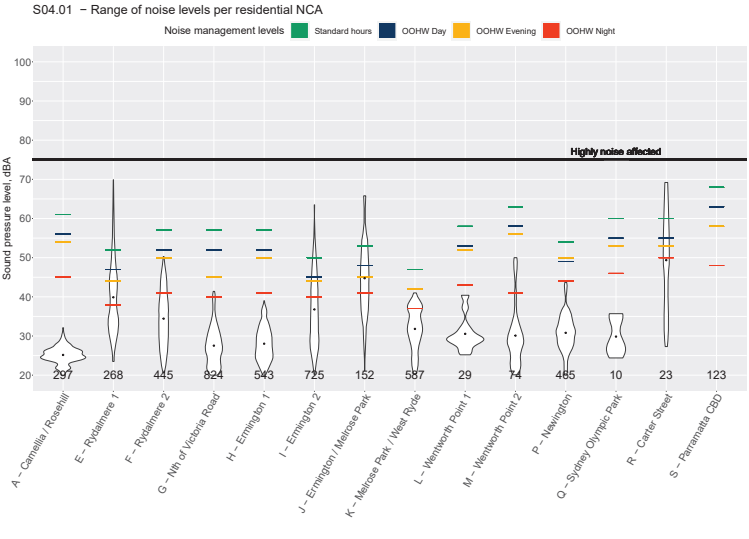
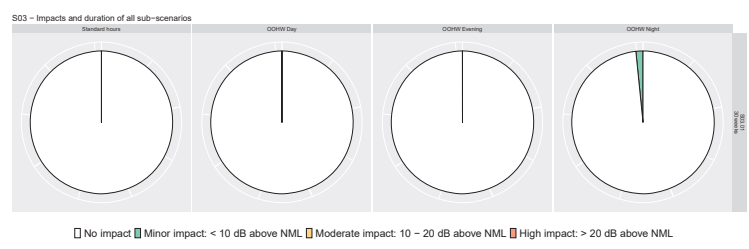
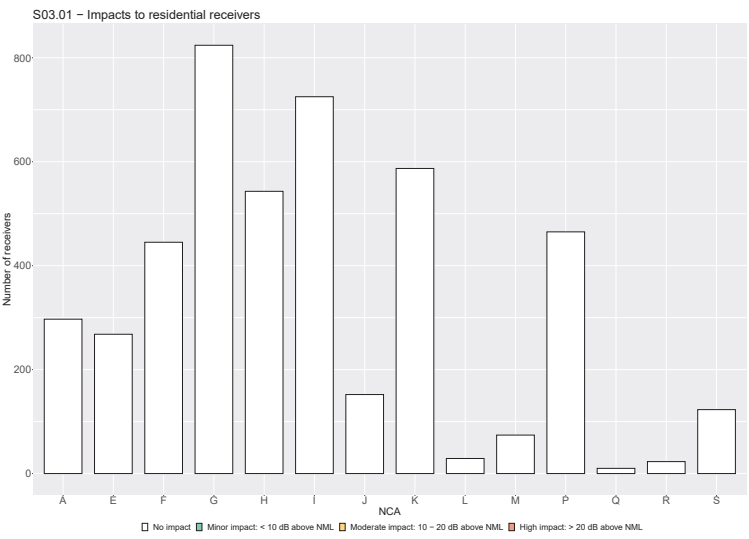
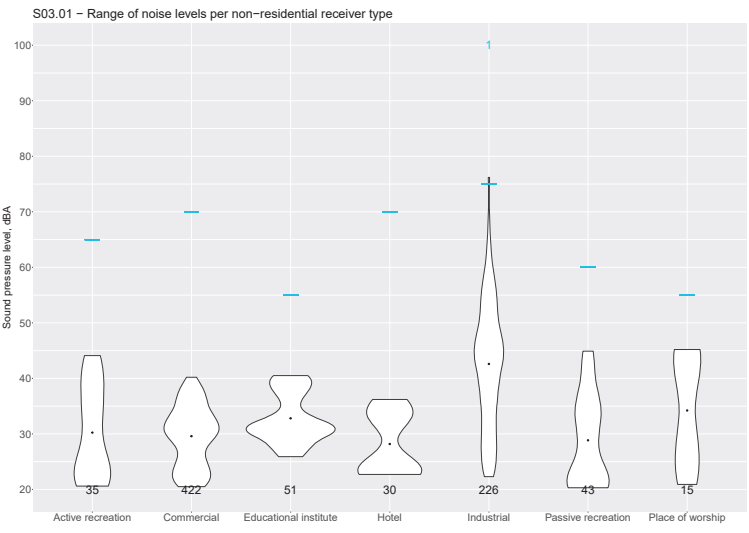
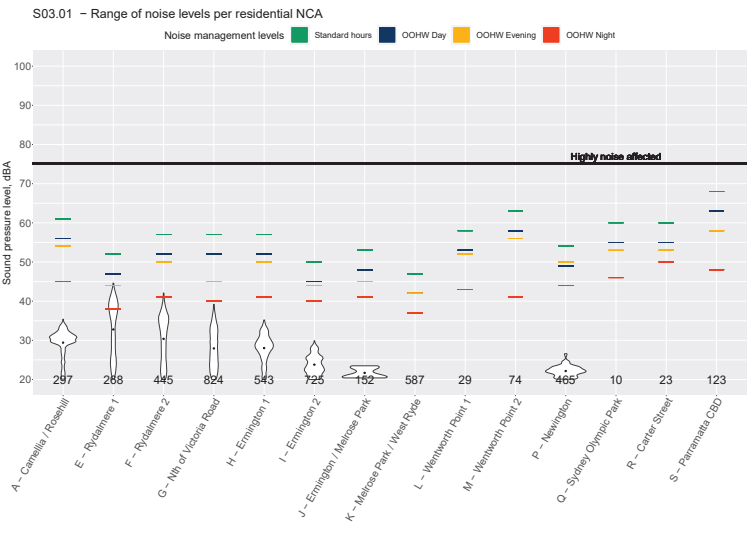


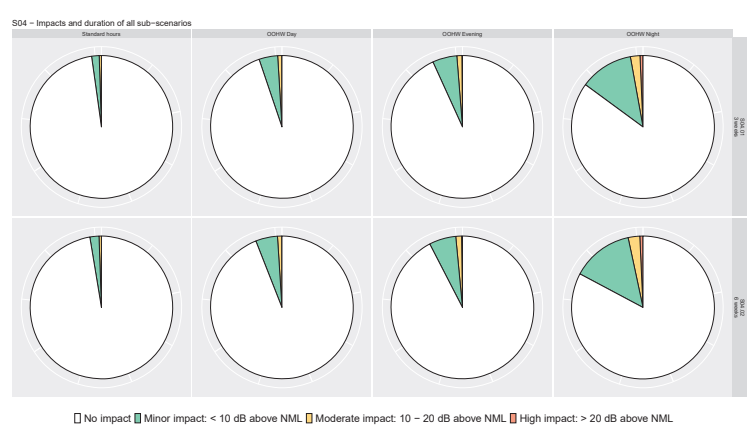
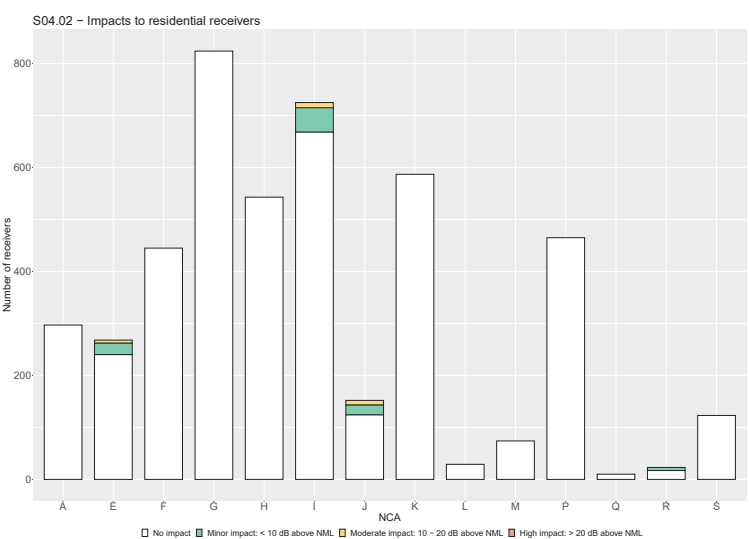
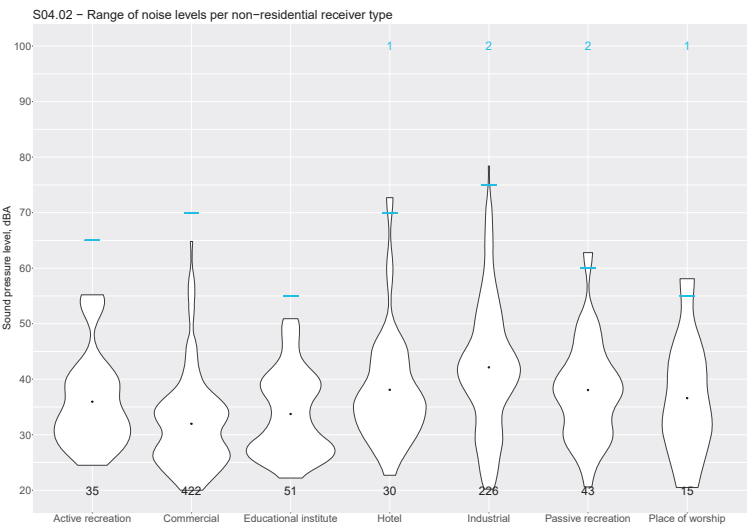
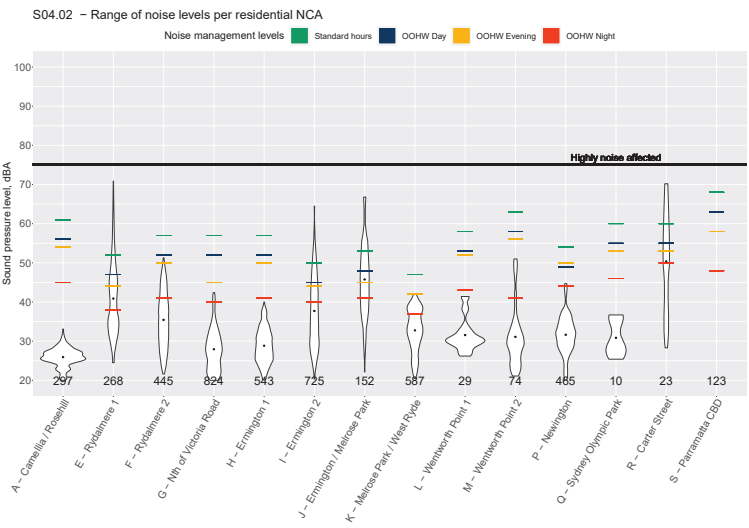
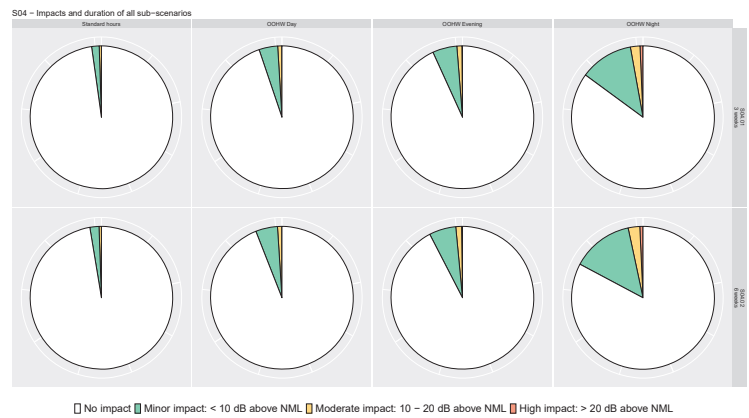
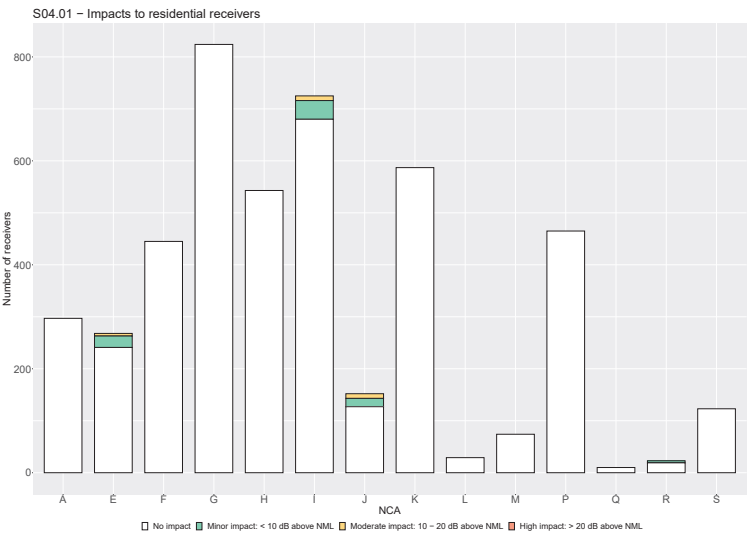
S02.02 – Range of noise levels per non-residential receiver type



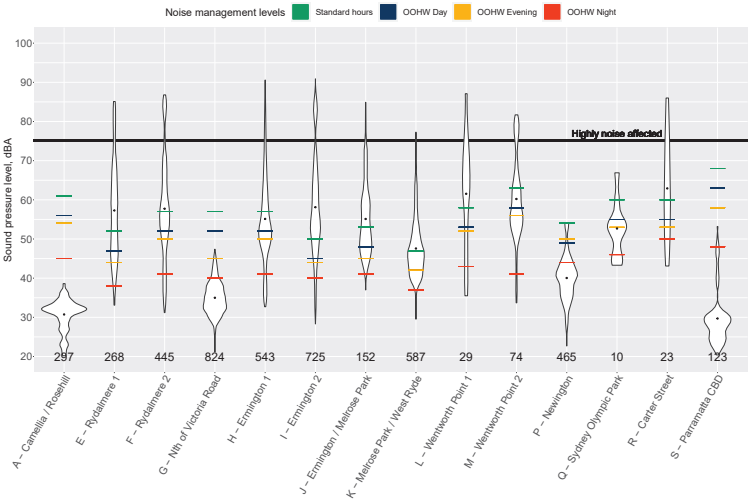




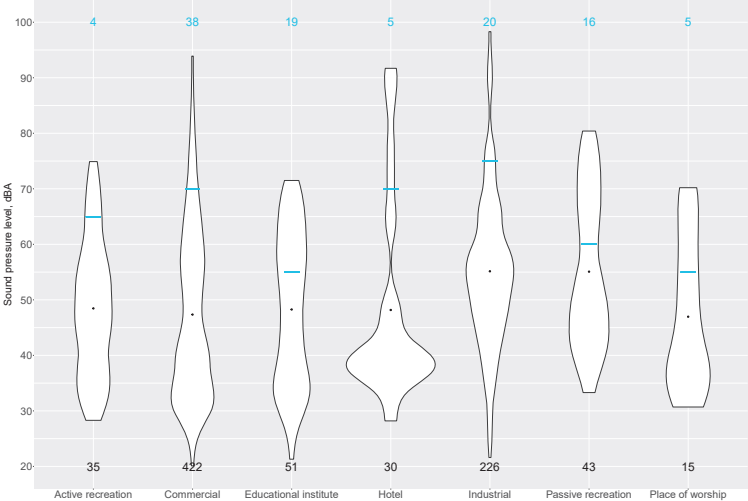




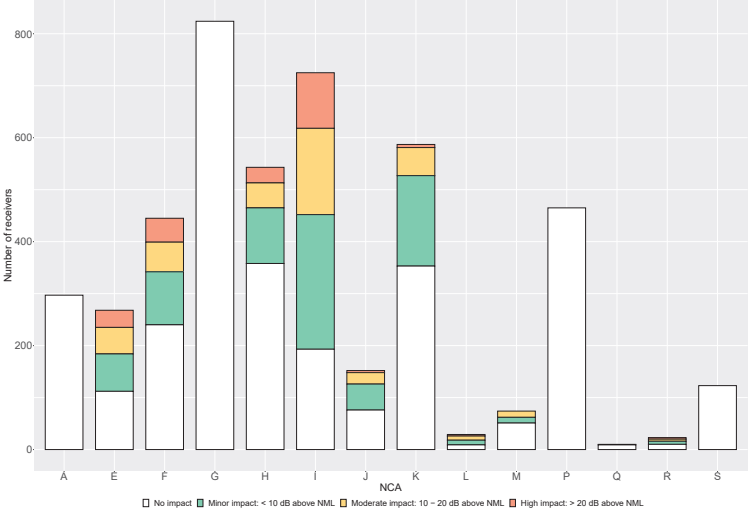
S05.01 – Range of noise levels per residential NCA



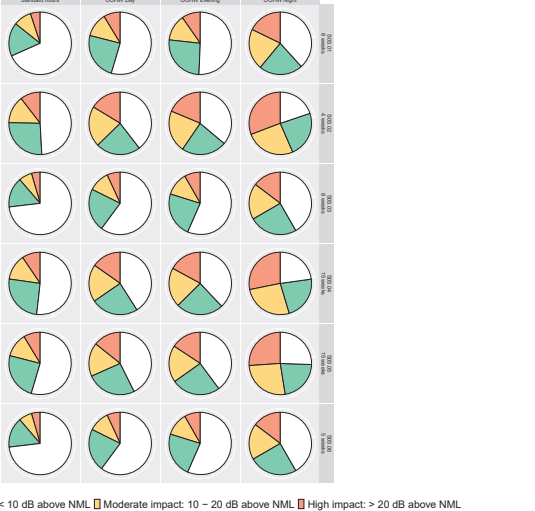
S05.01 – Range of noise levels per non-residential receiver type



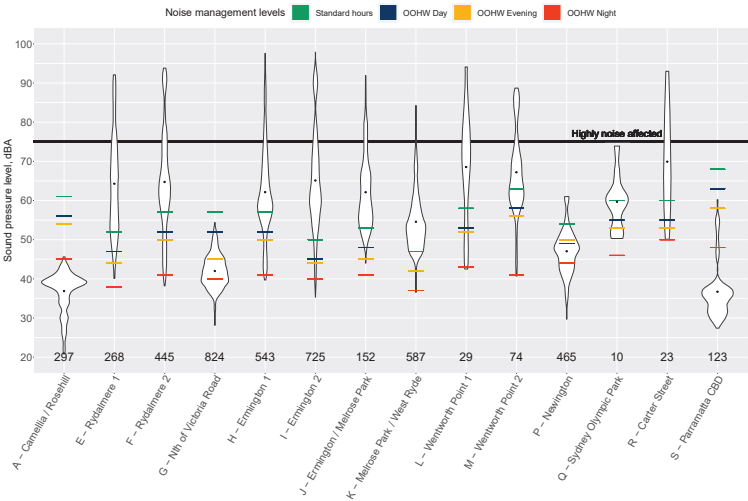
S05.01 – Impacts to residential receivers



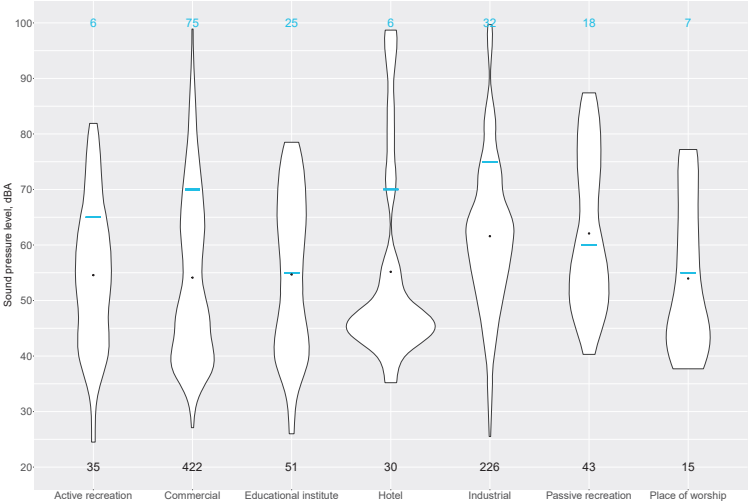
S05 – Impacts and duration of all sub-scenarios



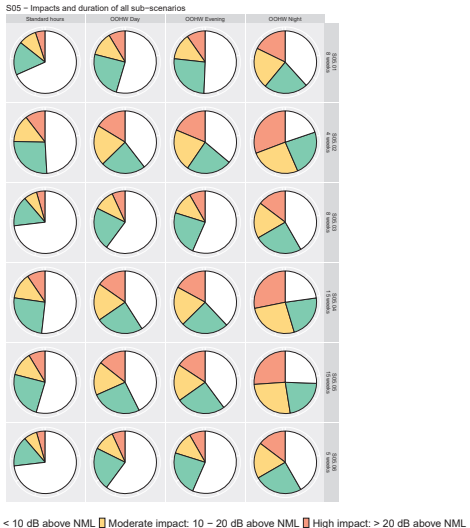
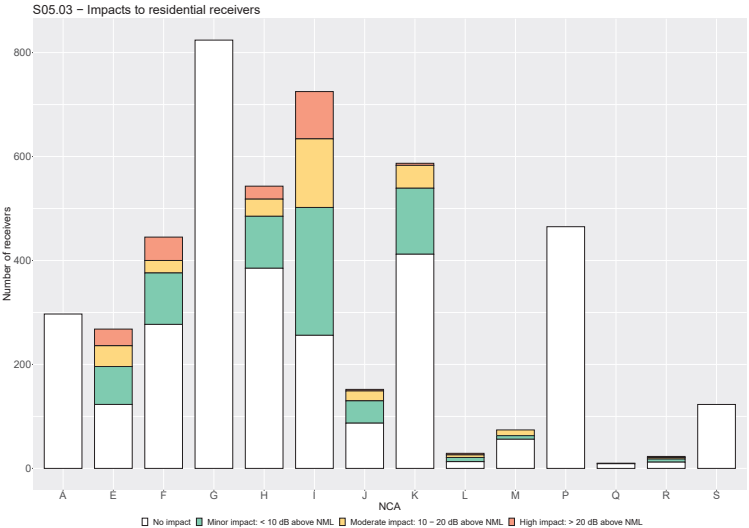
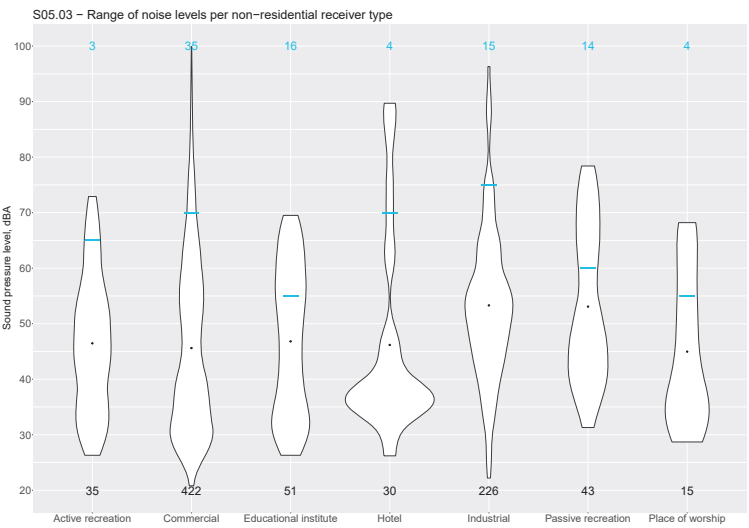
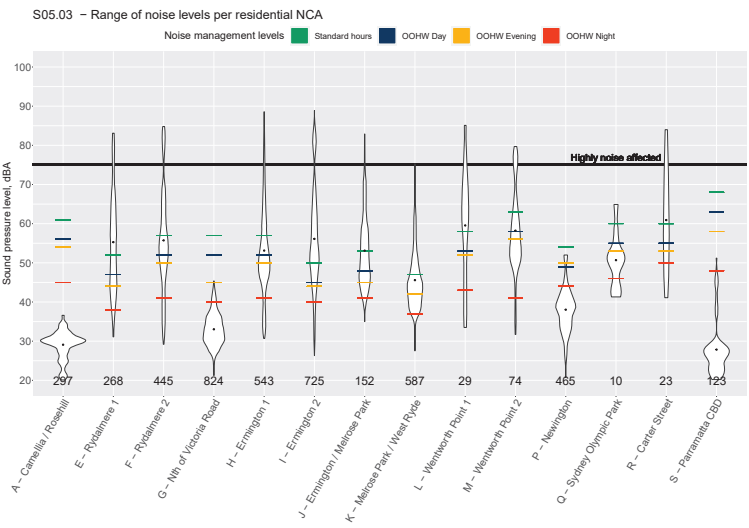
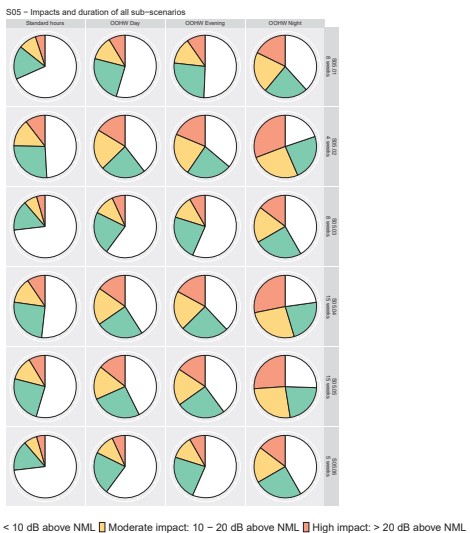
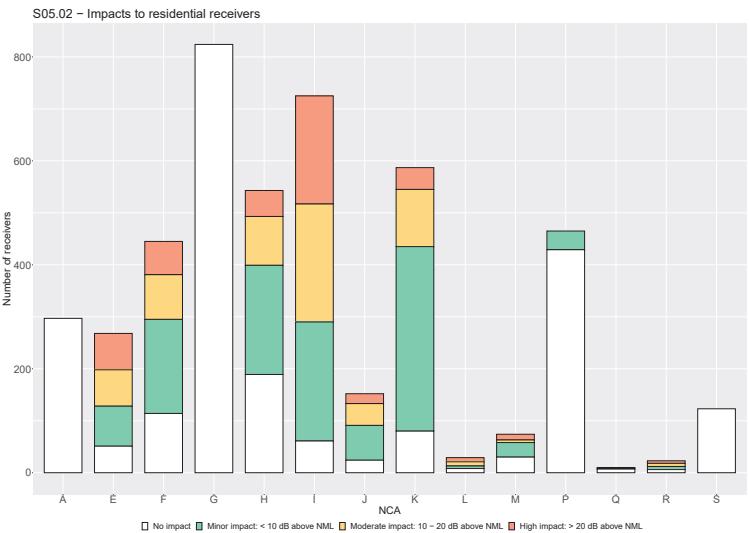
S05.02 – Range of noise levels per residential NCA



S05.02 – Range of noise levels per non-residential receiver type

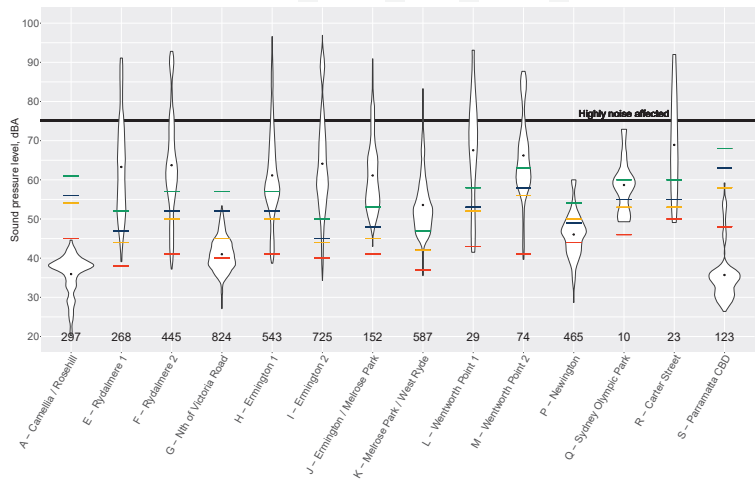




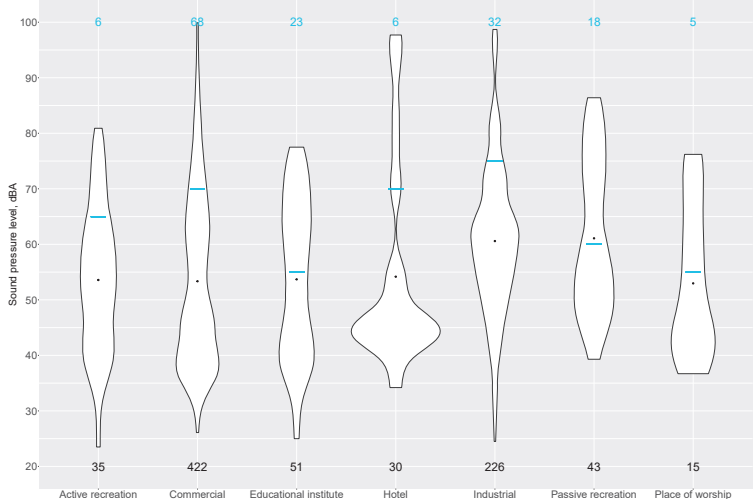


S05.04 – Range of noise levels per residential NCA

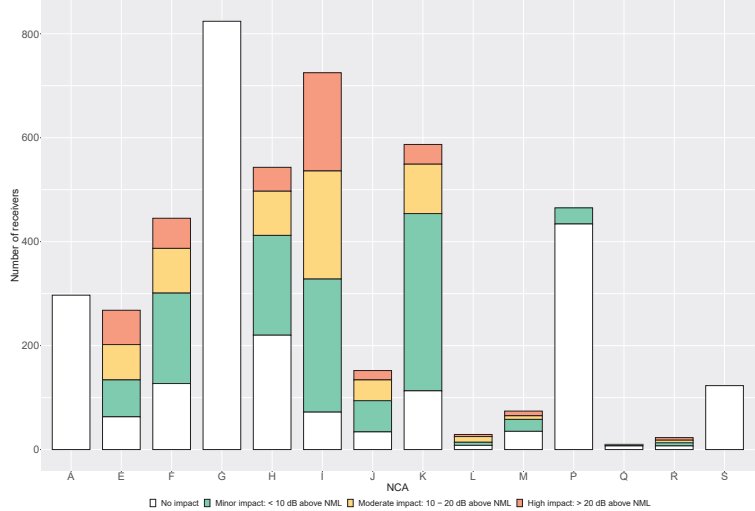
Noise management levels



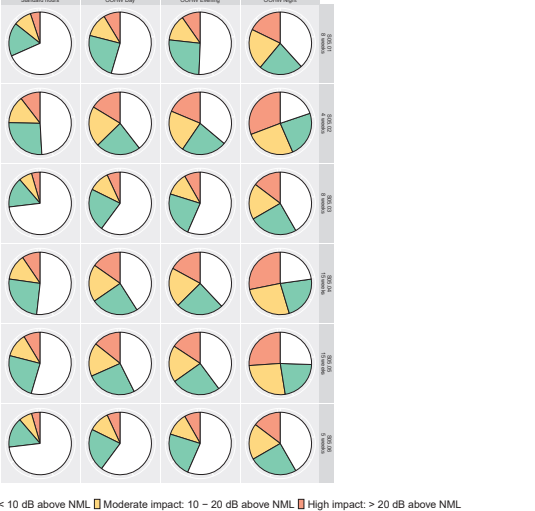
S05.04 – Range of noise levels per non-residential receiver type



S05.04 – Impacts to residential receivers

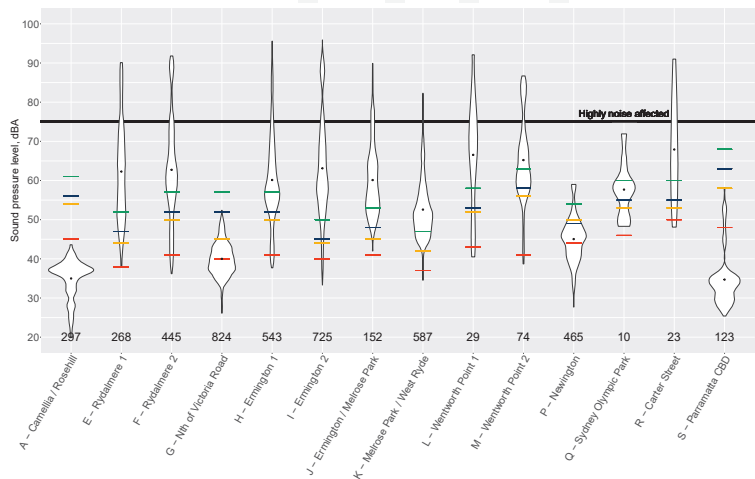


S05 – Impacts and duration of all sub-scenarios

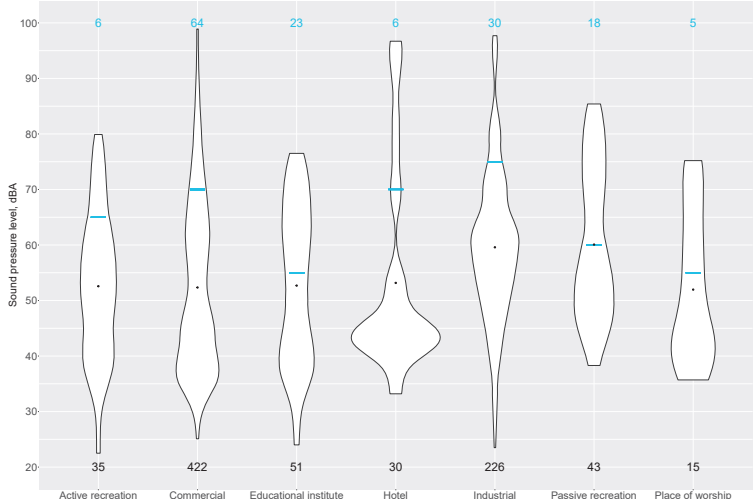


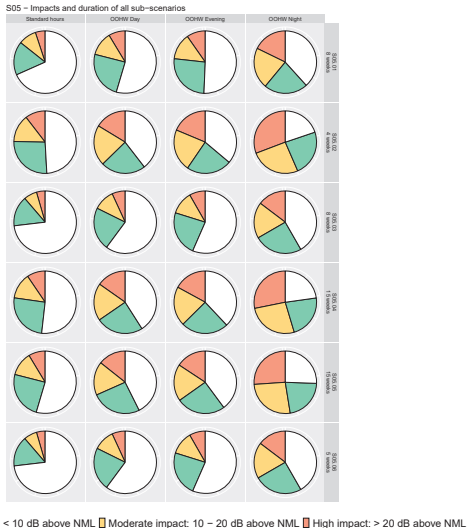
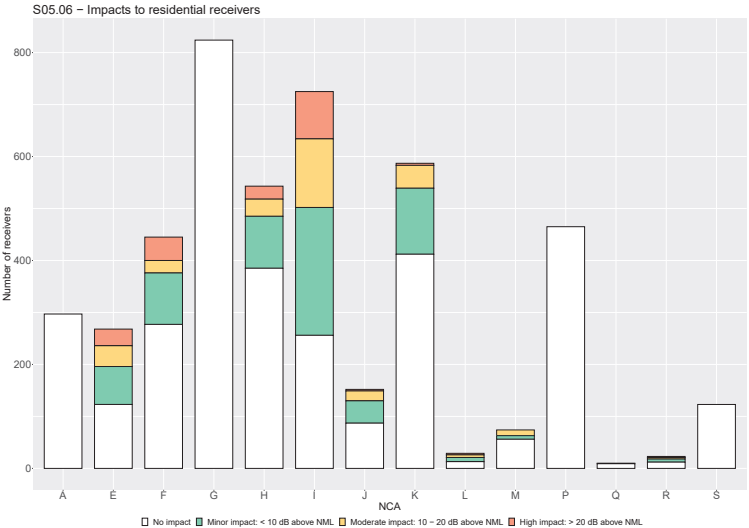
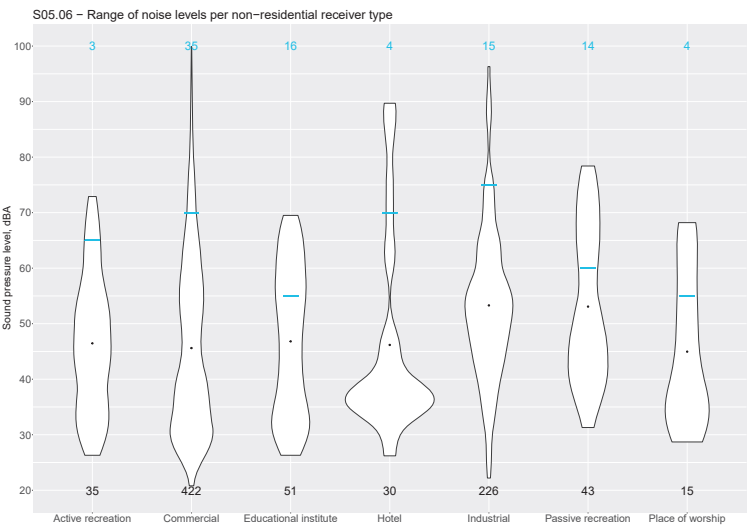
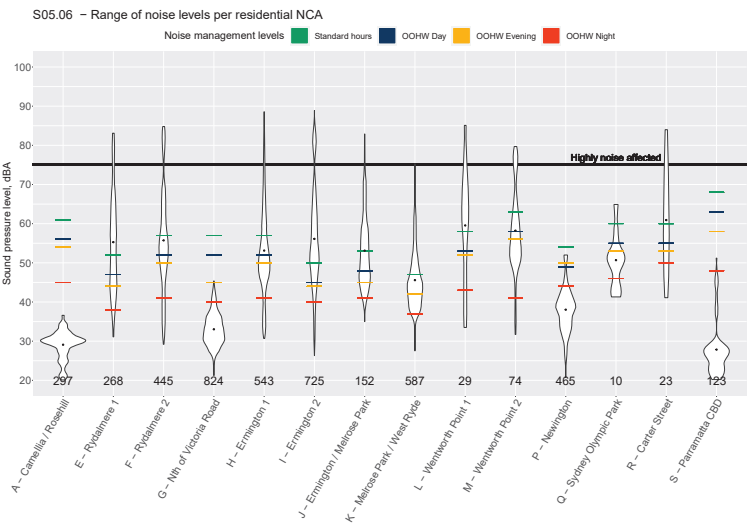
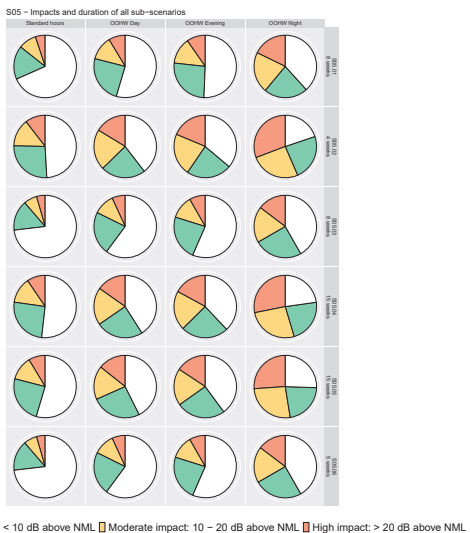
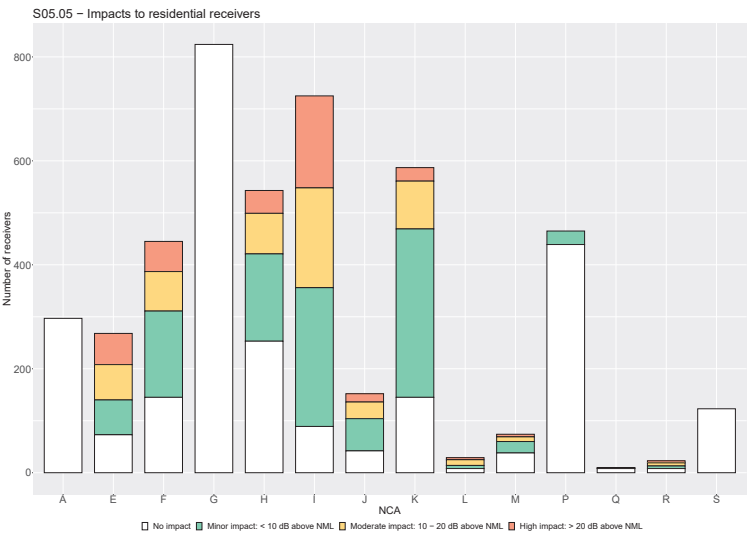
S05.05 – Range of noise levels per residential NCA

Noise management levels



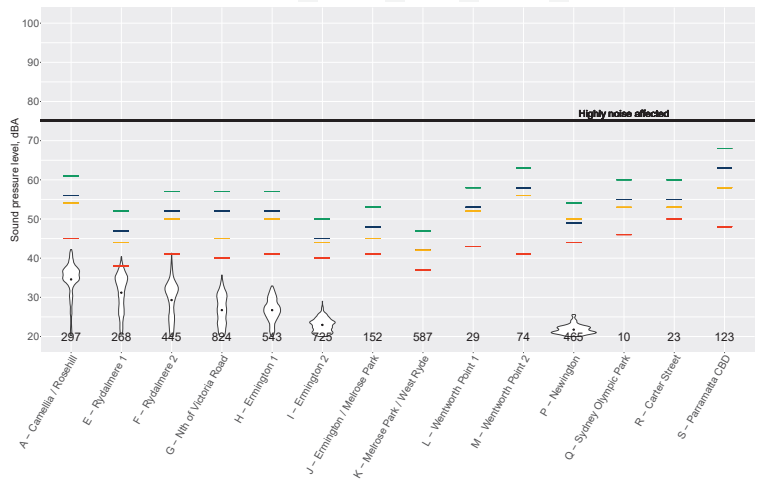
S05.05 – Range of noise levels per non-residential receiver type



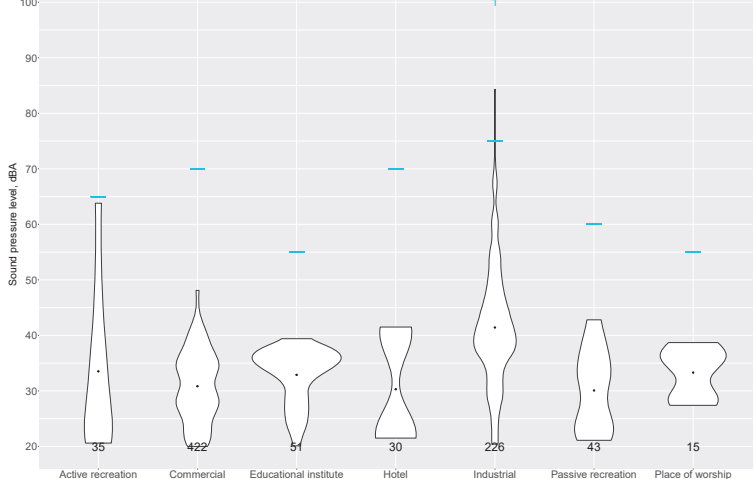


S06.01 – Range of noise levels per residential NCA

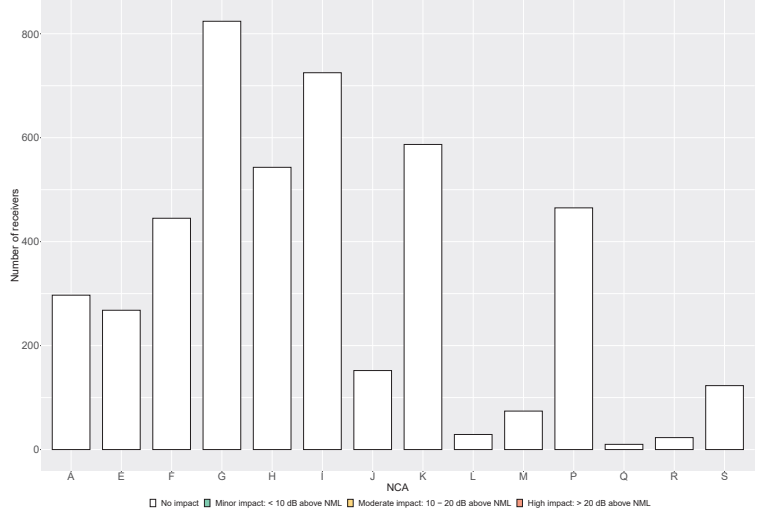
Noise management levels Standard hours OOHW Day OOHW Evening OOHW Night



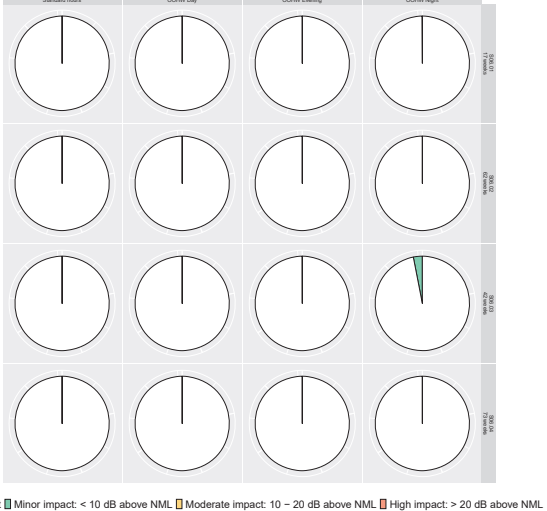
S06.01 – Range of noise levels per non-residential receiver type



S06.01 – Impacts to residential receivers

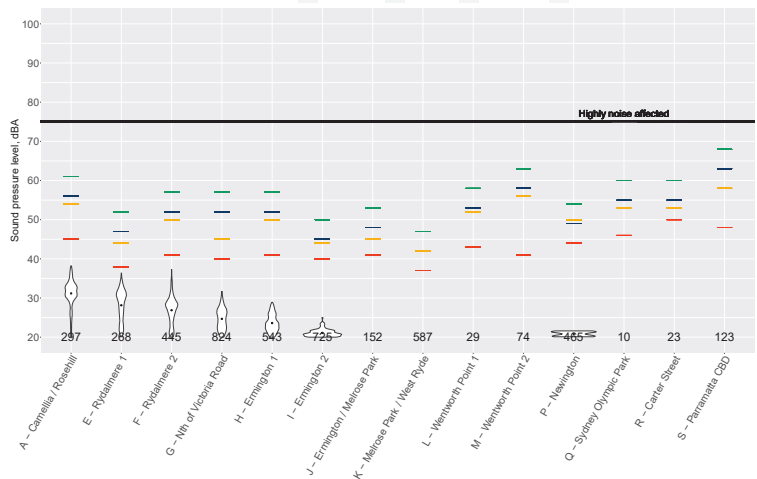


S06 – Impacts and duration of all sub-scenarios

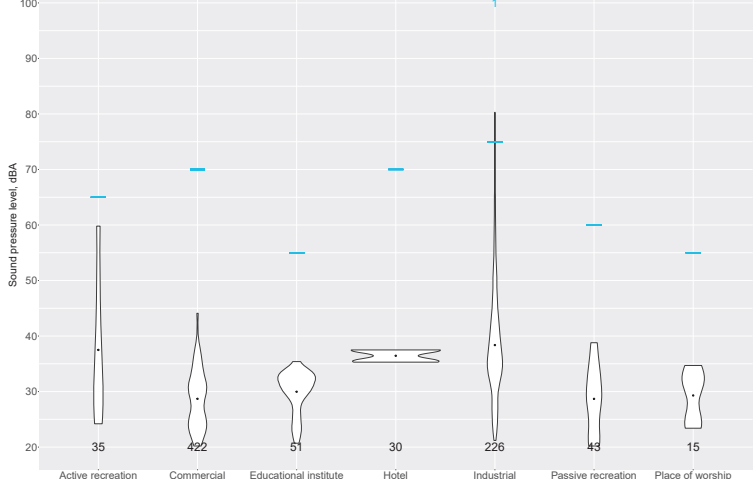


S06.02 – Range of noise levels per residential NCA

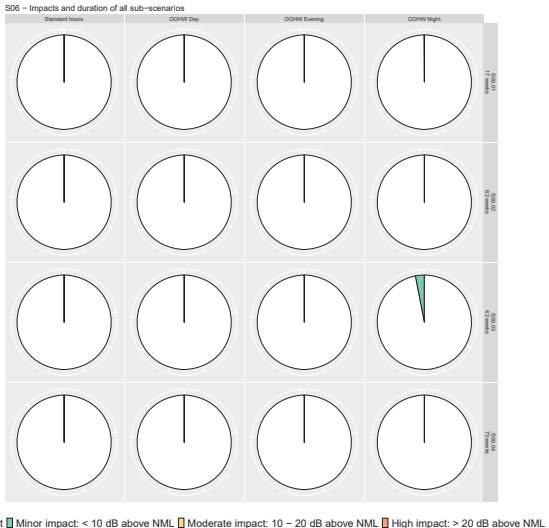
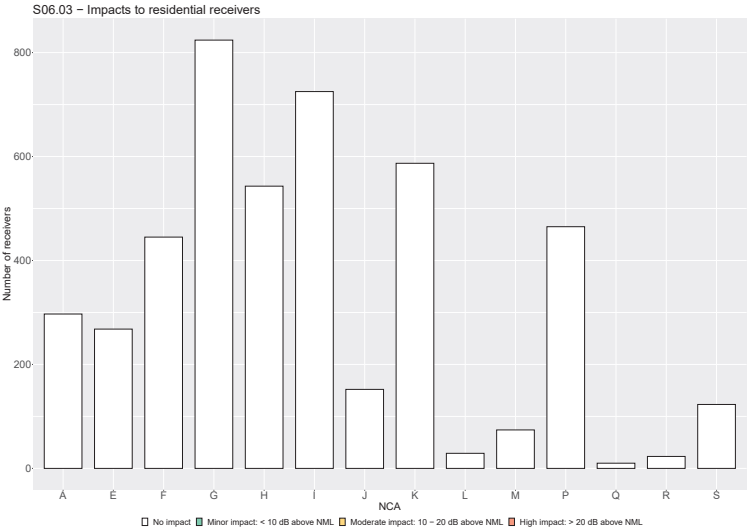
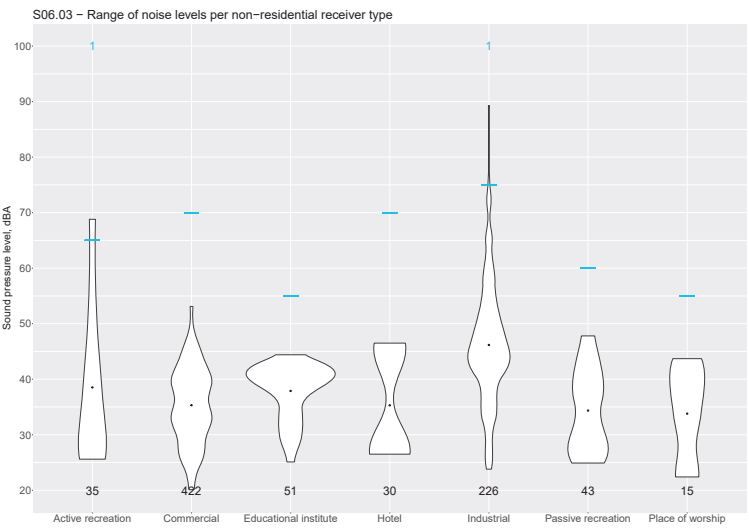
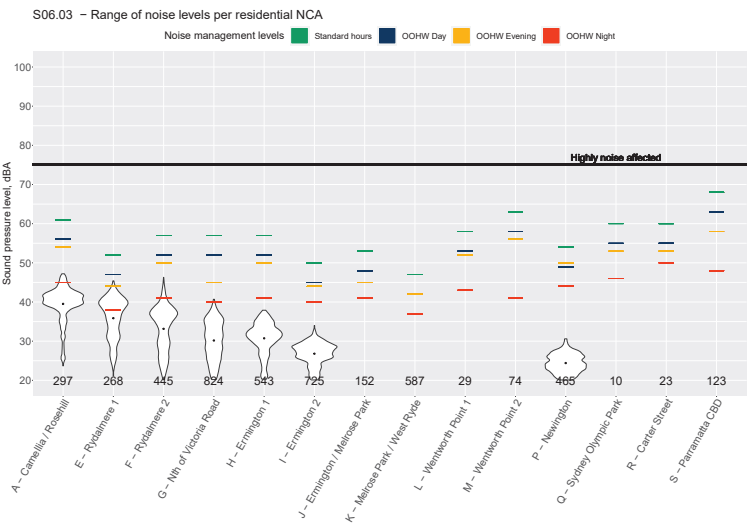
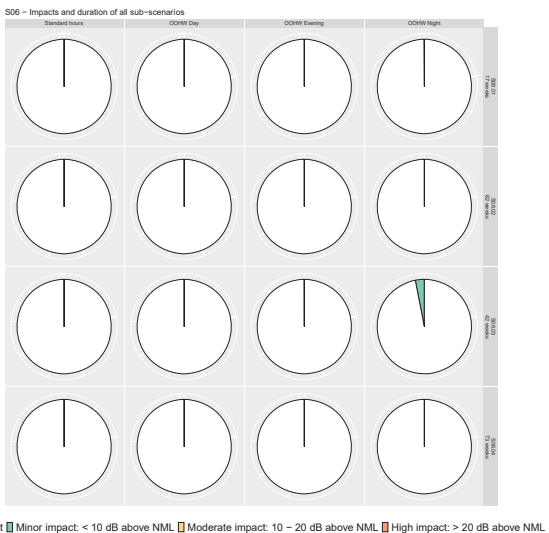
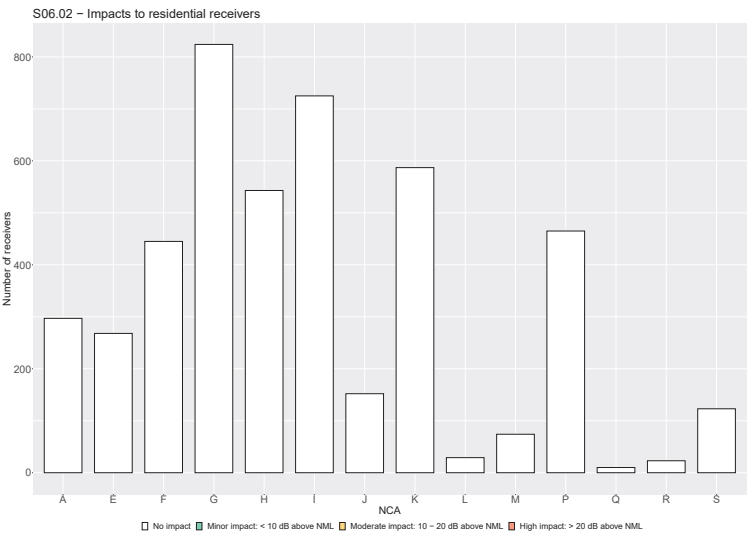
Noise management levels Standard hours OOHW Day OOHW Evening OOHW Night



S06.02 – Range of noise levels per non-residential receiver type

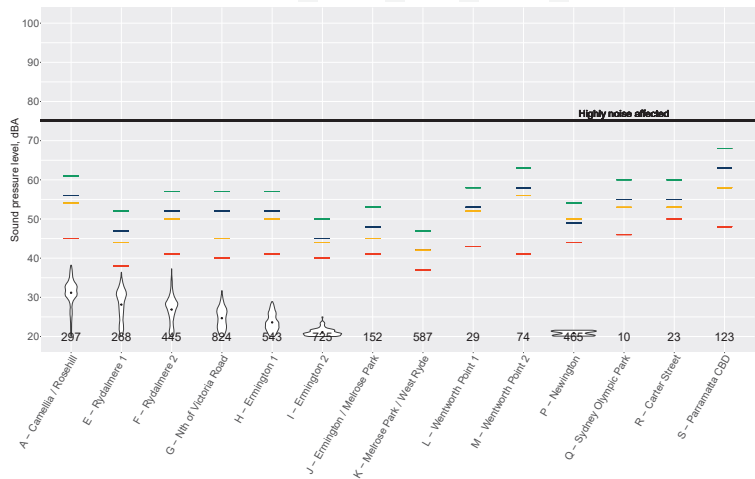




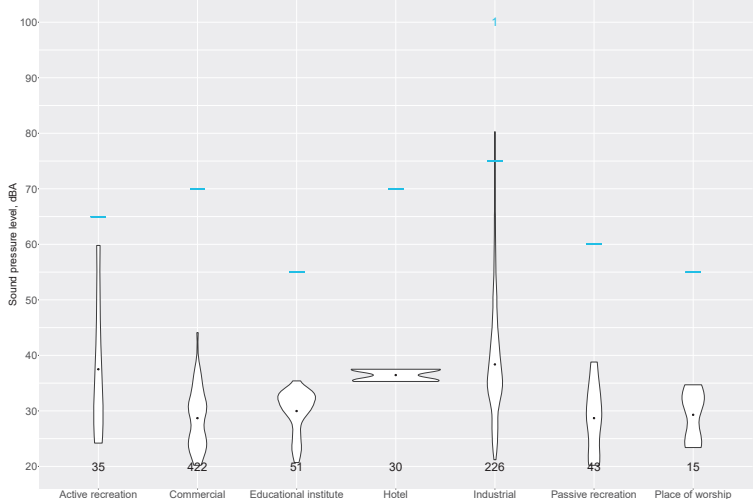


S06.04 – Range of noise levels per residential NCA

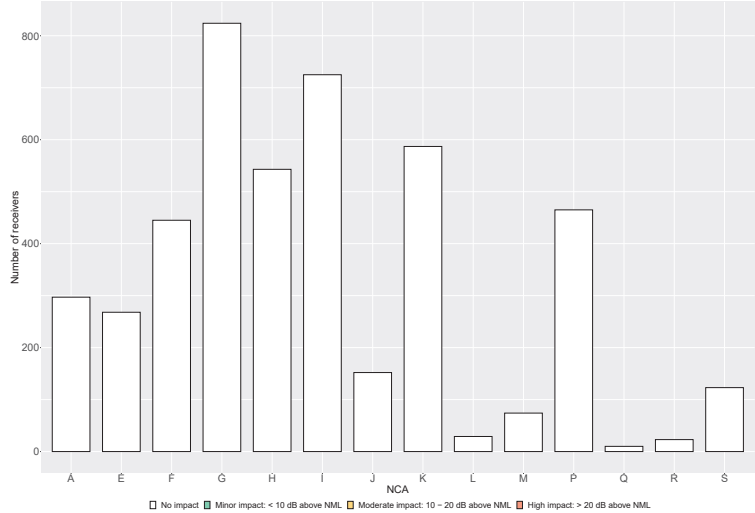
Noise management levels Standard hours OOHW Day OOHW Evening OOHW Night



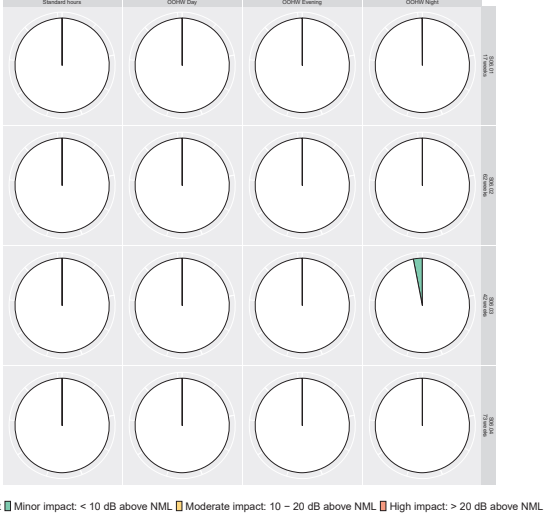
S06.04 – Range of noise levels per non-residential receiver type



S06.04 – Impacts to residential receivers

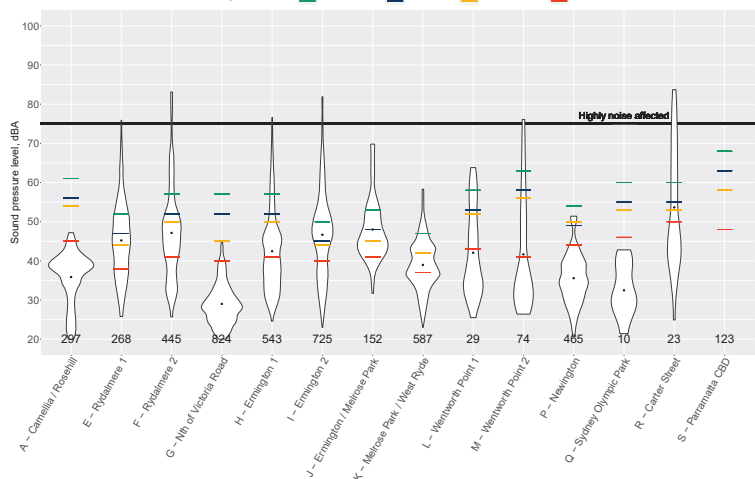


S06 – Impacts and duration of all sub-scenarios

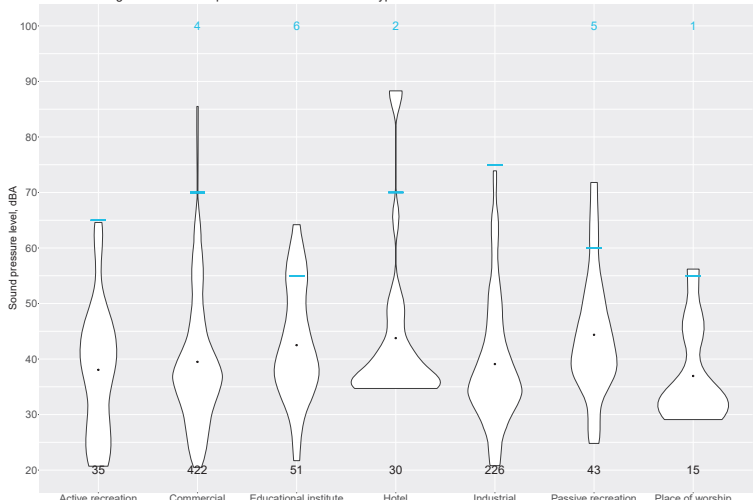


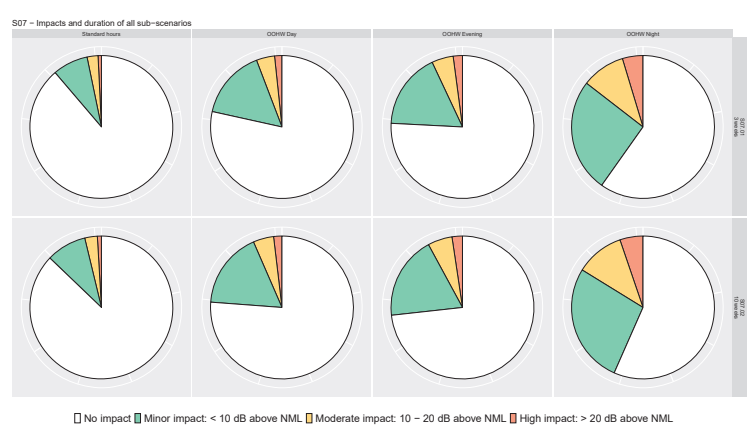
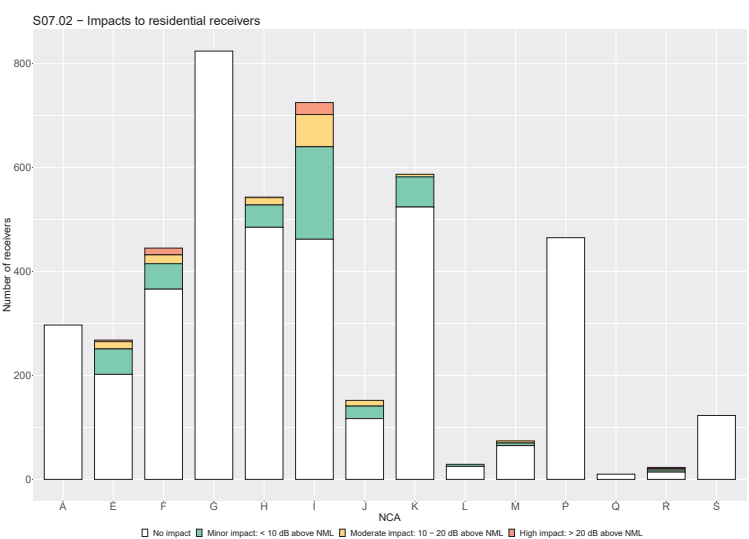
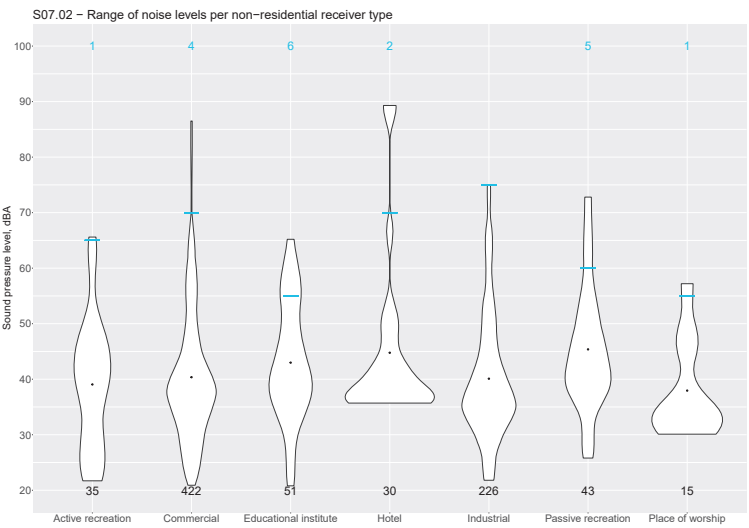
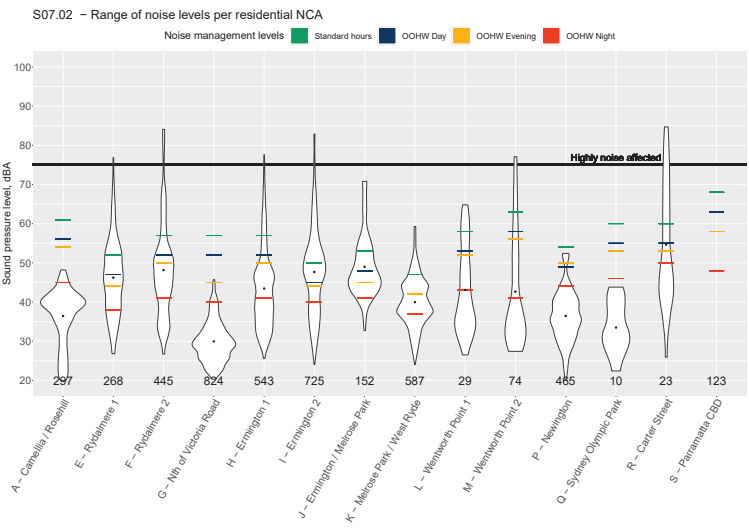
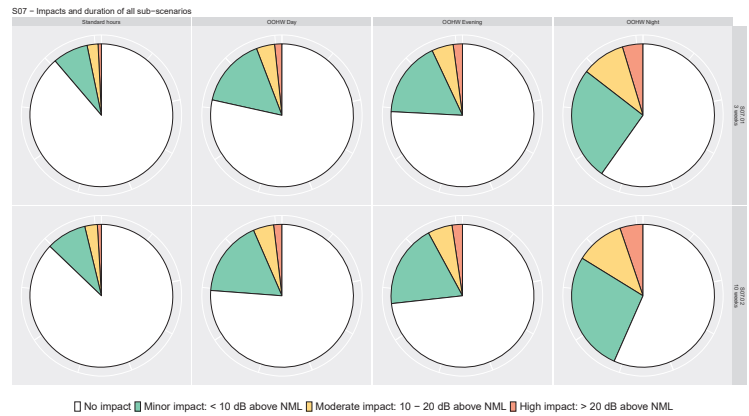
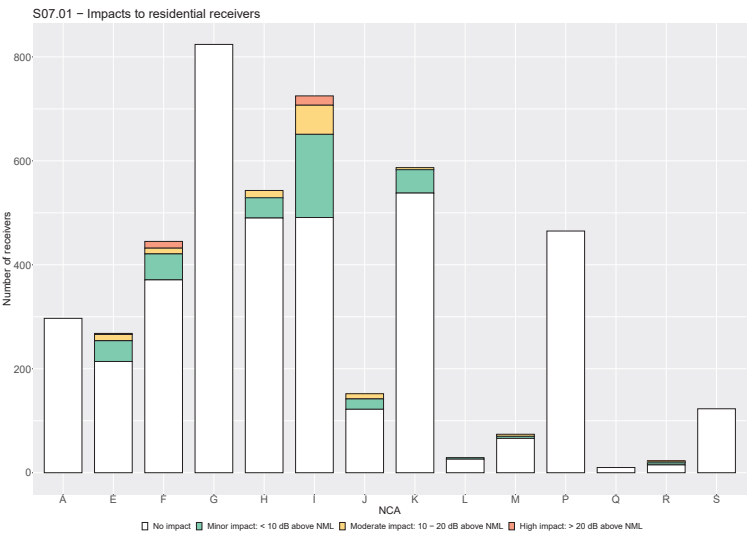
S07.01 – Range of noise levels per residential NCA

Noise management levels Standard hours OOHW Day OOHW Evening OOHW Night



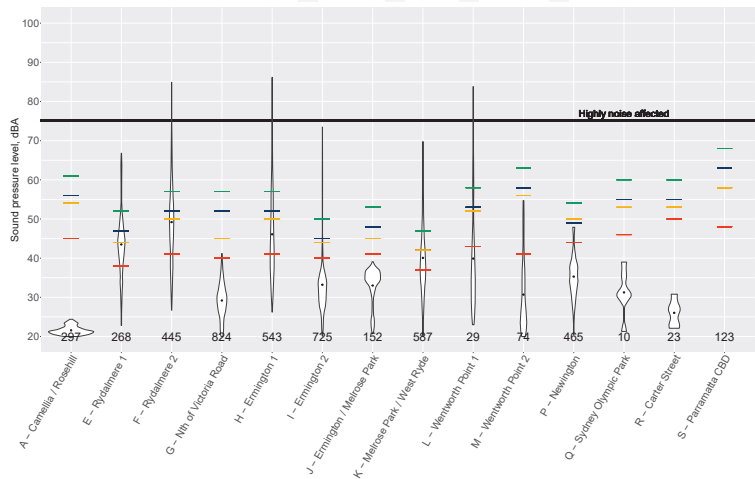
S07.01 – Range of noise levels per non-residential receiver type





S08.01 – Range of noise levels per residential NCA

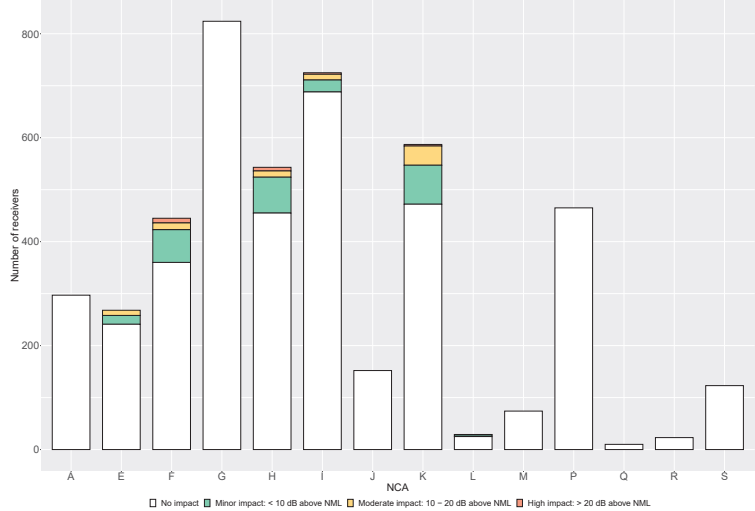
Noise management levels Standard hours OOHW Day OOHW Evening OOHW Night



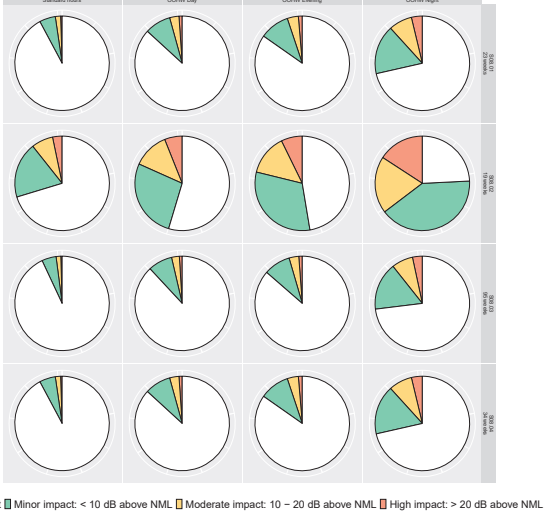
S08.01 – Range of noise levels per non-residential receiver type



S08.01 – Impacts to residential receivers

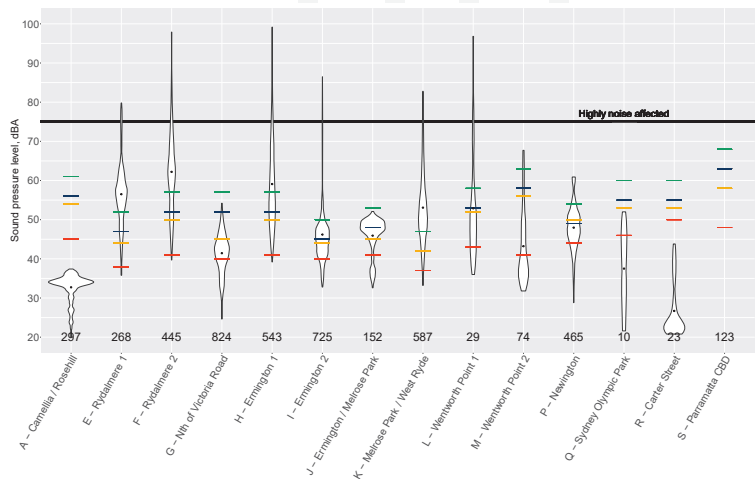


S08 – Impacts and duration of all sub-scenarios

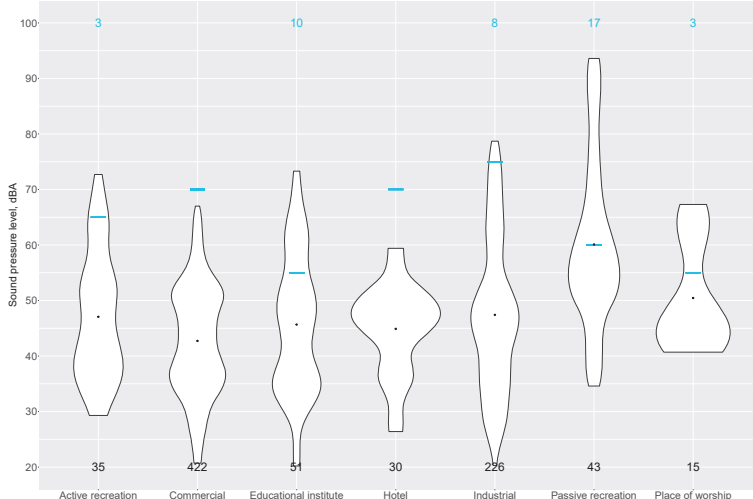


S08.02 – Range of noise levels per residential NCA

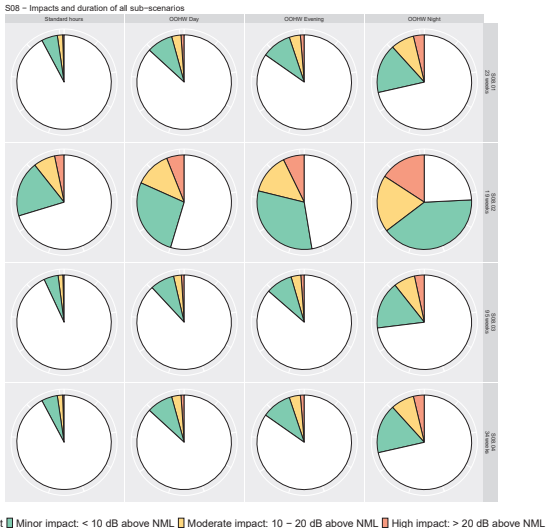
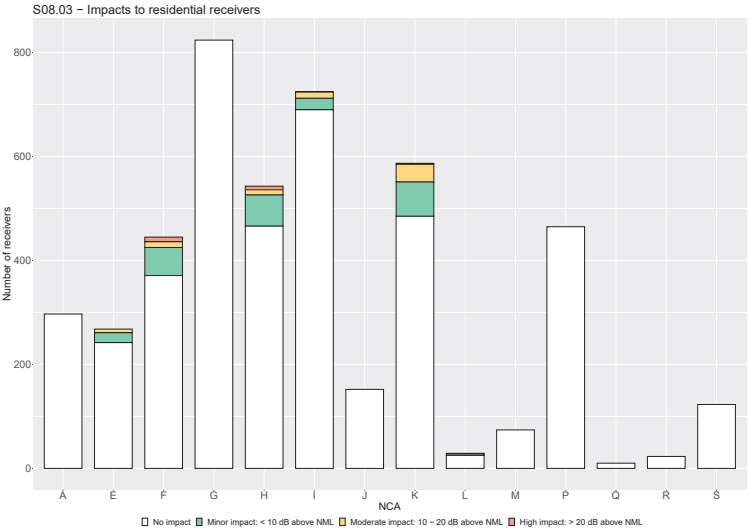
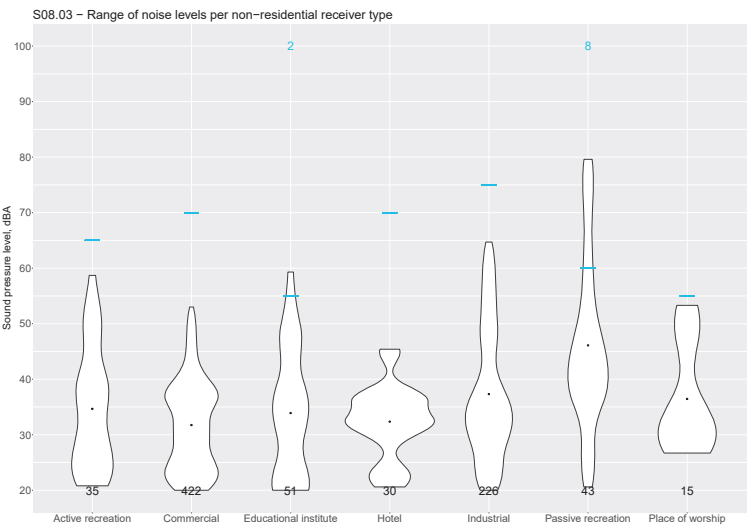
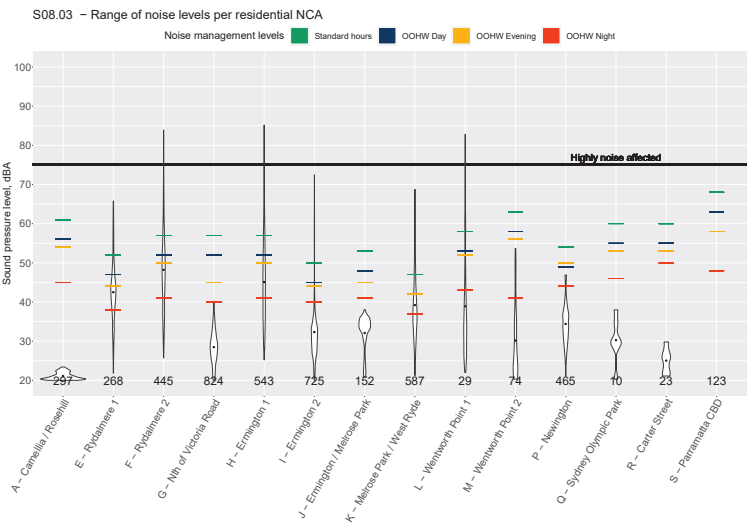
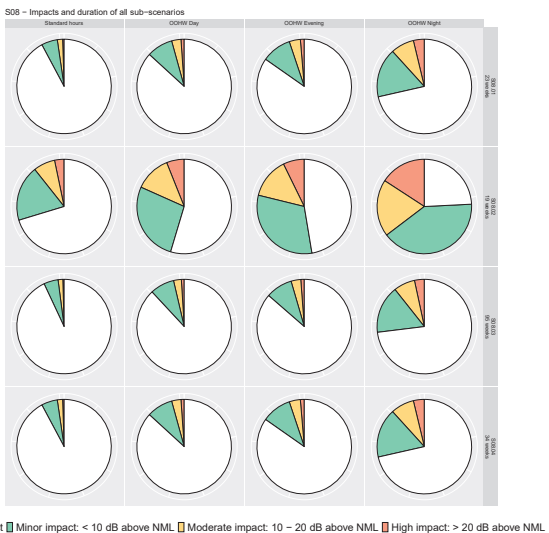
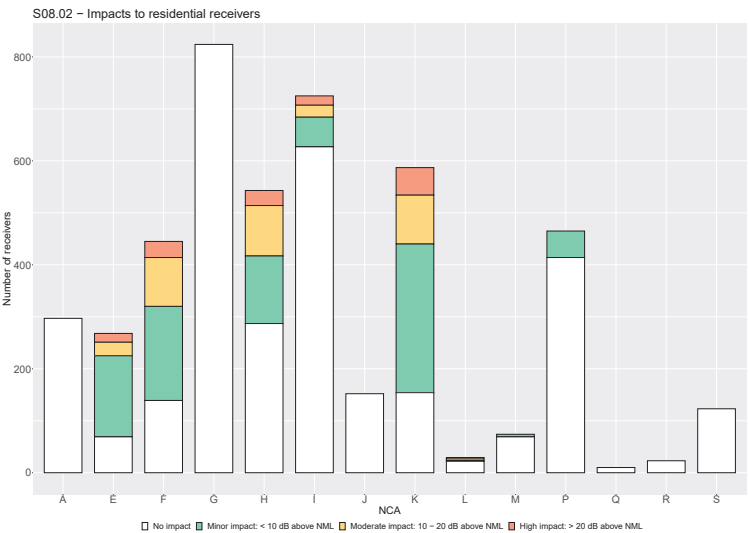
Noise management levels Standard hours OOHW Day OOHW Evening OOHW Night



S08.02 – Range of noise levels per non-residential receiver type

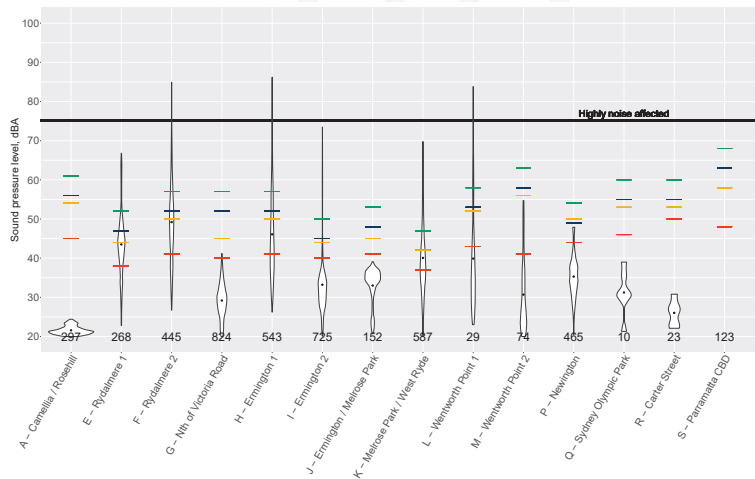






S08.04 – Range of noise levels per residential NCA

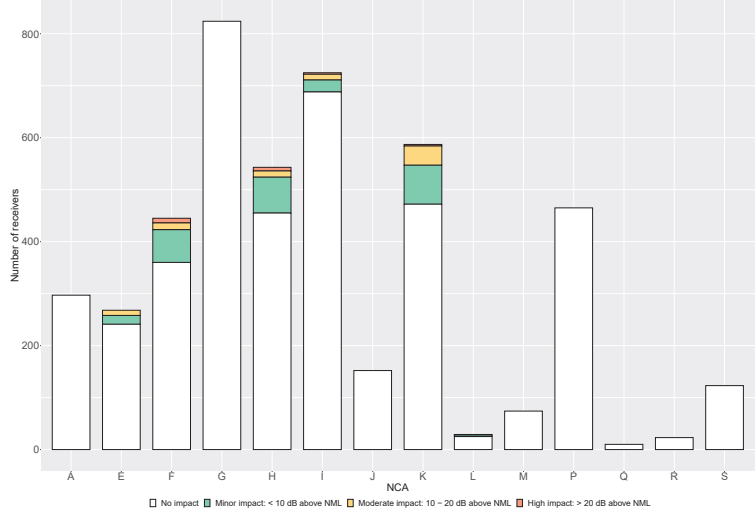
Noise management levels Standard hours OOHW Day OOHW Evening OOHW Night



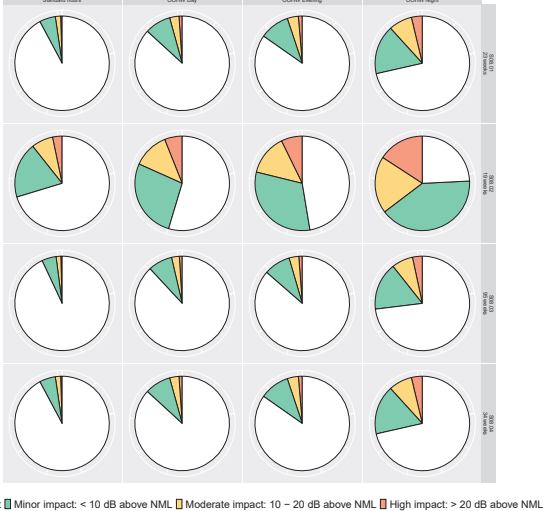
S08.04 – Range of noise levels per non-residential receiver type



S08.04 – Impacts to residential receivers

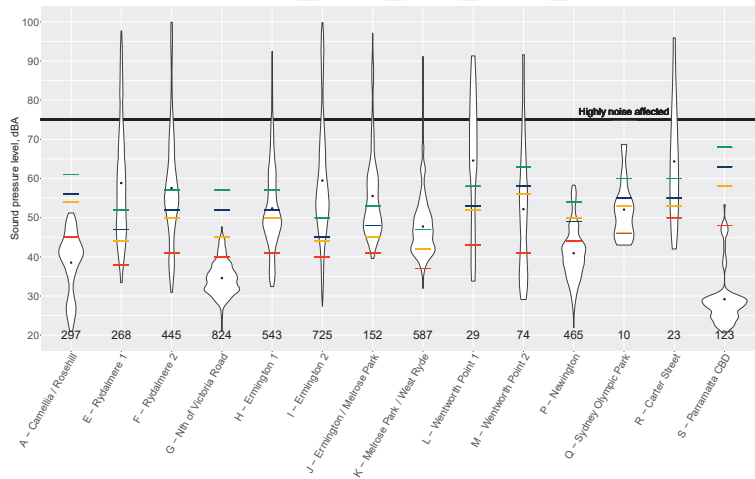


S08 – Impacts and duration of all sub-scenarios

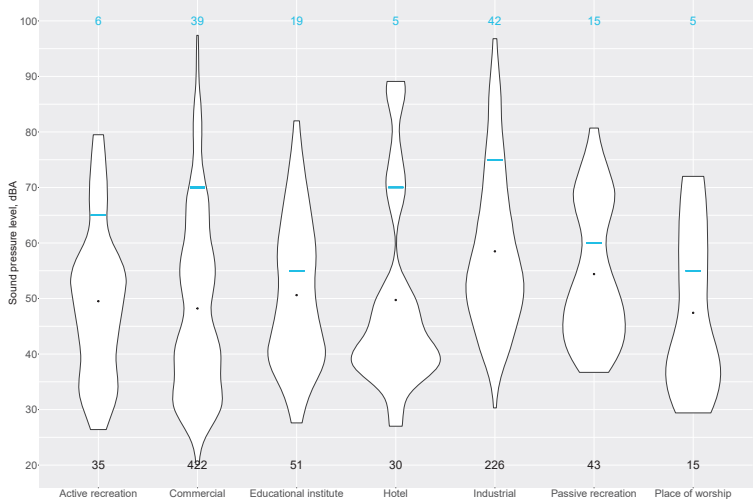


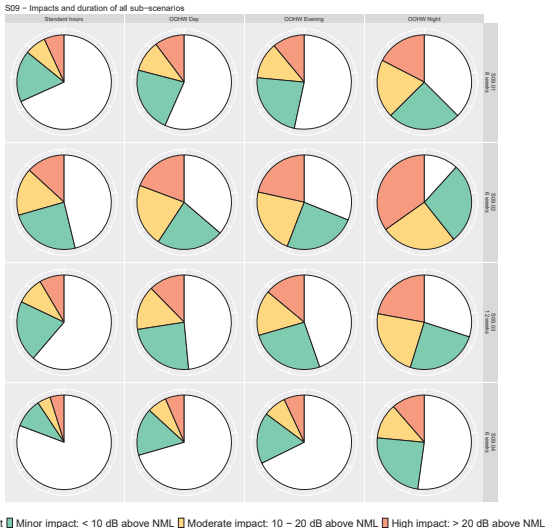
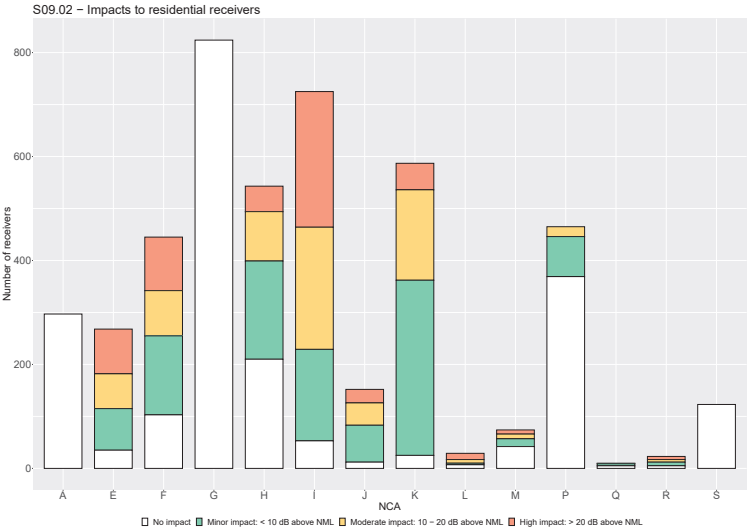
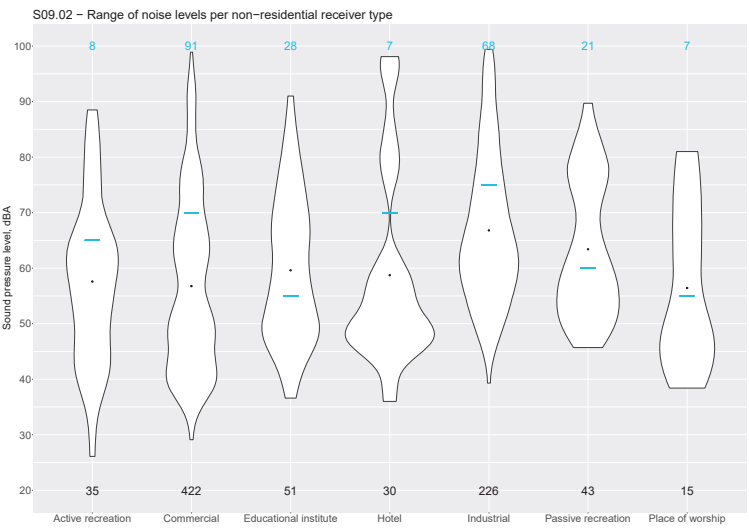
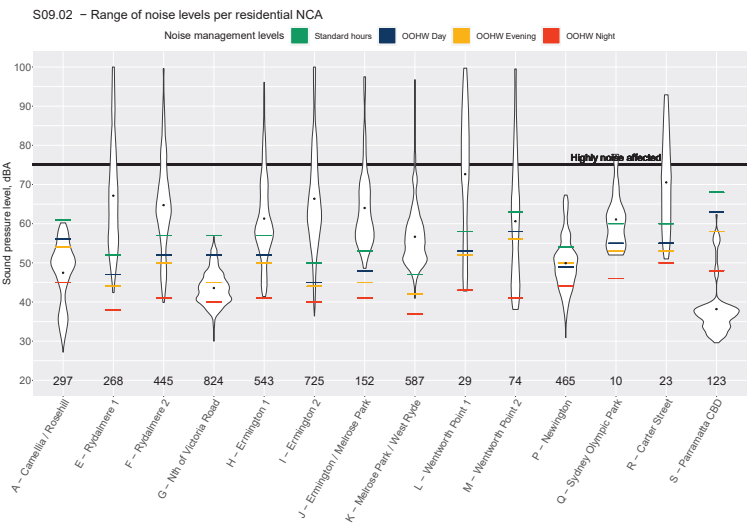
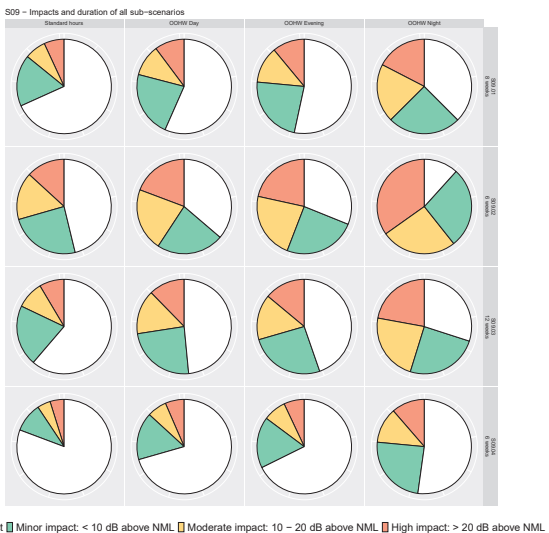
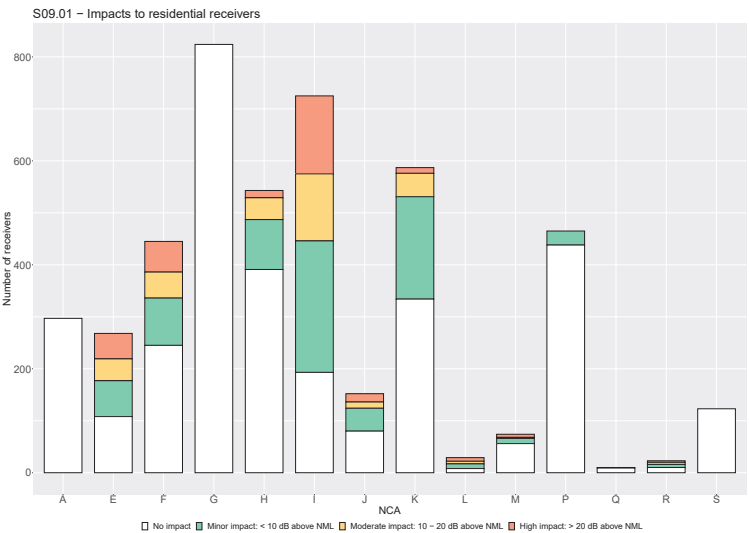
S09.01 – Range of noise levels per residential NCA

Noise management levels Standard hours OOHW Day OOHW Evening OOHW Night

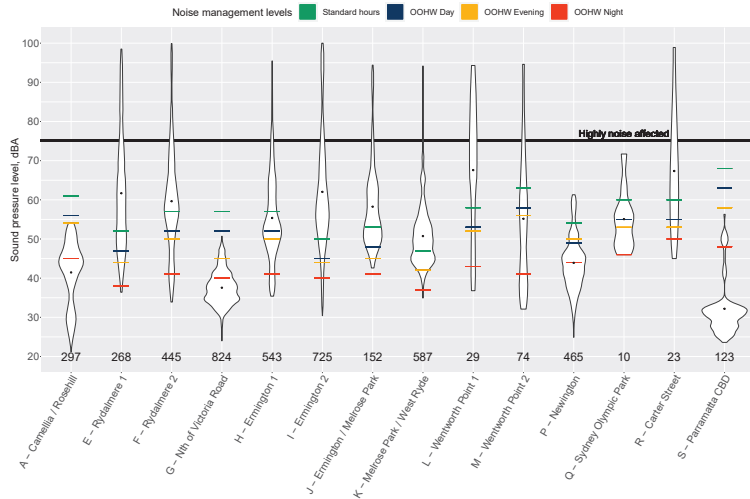


S09.01 – Range of noise levels per non-residential receiver type

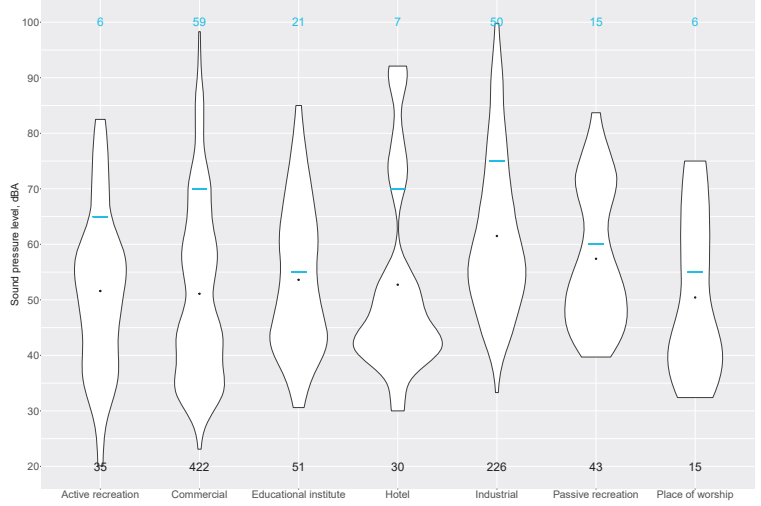




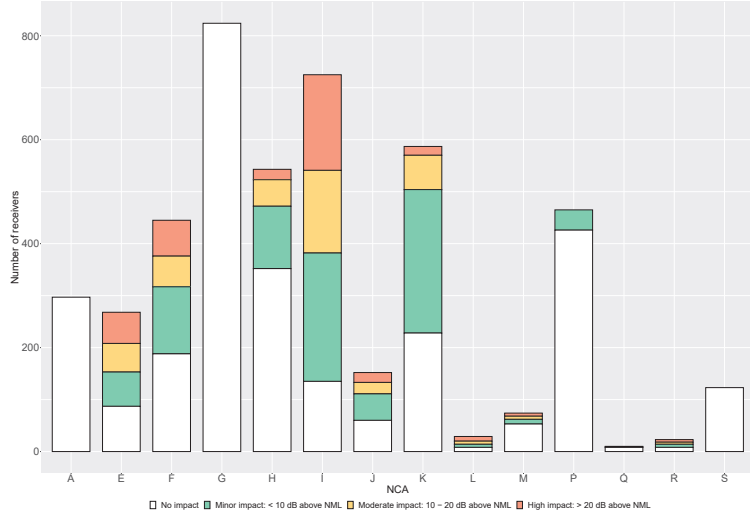
S09.03 – Range of noise levels per residential NCA



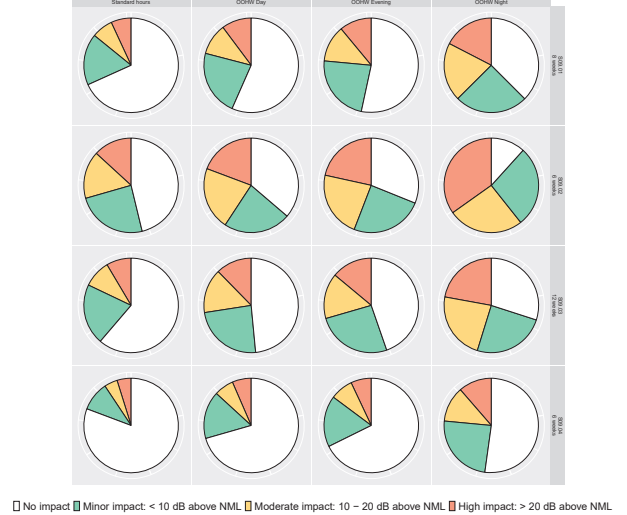
S09.03 – Range of noise levels per non-residential receiver type



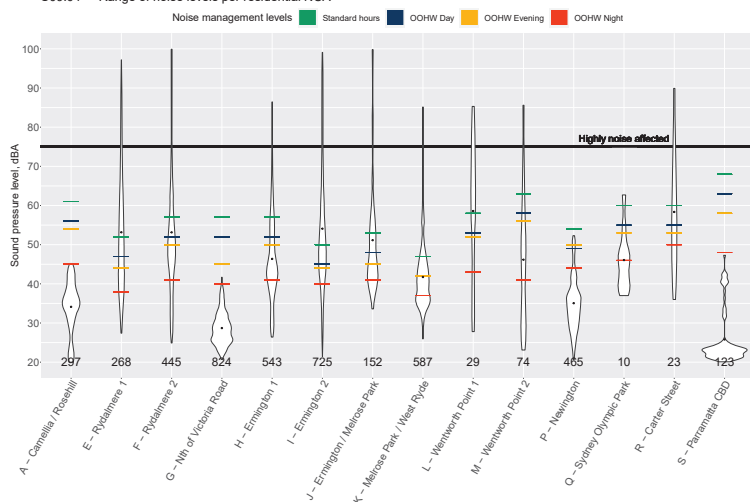
S09.03 – Impacts to residential receivers



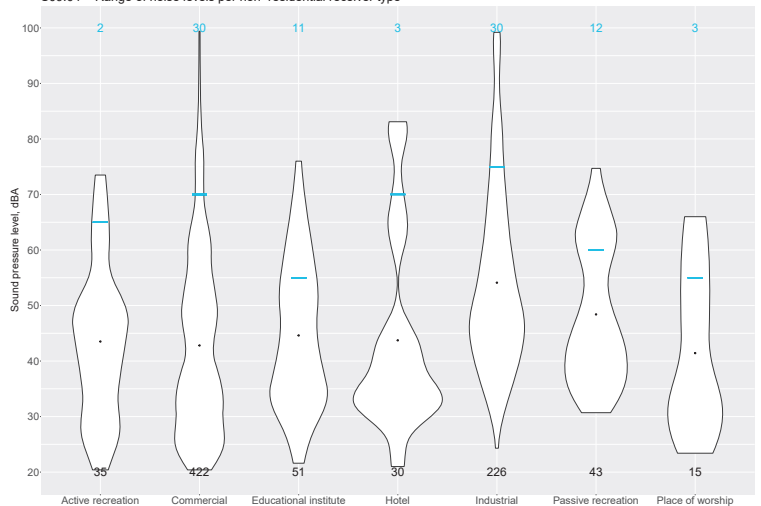
S09 – Impacts and duration of all sub-scenarios



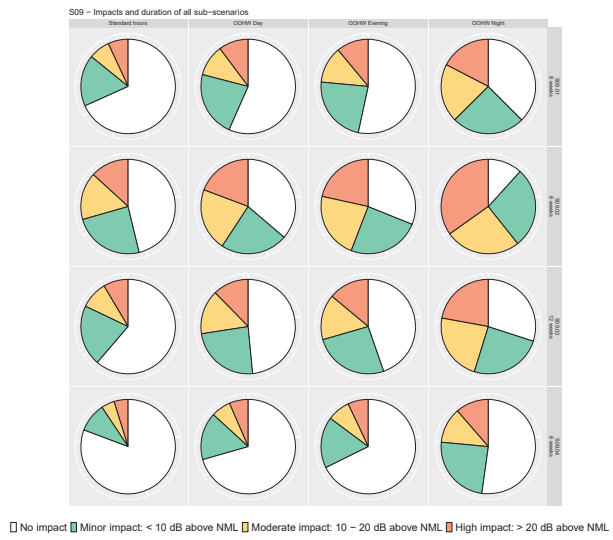
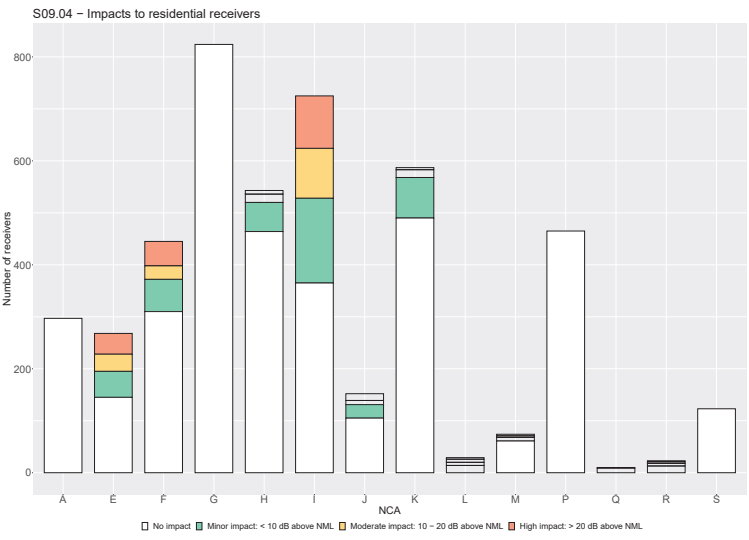
S09.04 – Range of noise levels per residential NCA



S09.04 – Range of noise levels per non-residential receiver type







## **F-3      Construction noise and vibration results at sensitive receivers**

[illegible]

[illegible]







[illegible]

[illegible]



[illegible]

		JANUARY												FEBRUARY												MARCH												APRIL												MAY												JUNE												JULY												AUGUST												SEPTEMBER												OCTOBER												NOVEMBER												DECEMBER												TOTAL												AVERAGE												STANDARD DEVIATION												COEFFICIENT OF VARIATION												CORRELATION COEFFICIENT												P-VALUE												SIGNIFICANCE LEVEL												CONFIDENCE INTERVAL												HYPOTHESIS TESTING												REGRESSION ANALYSIS												VARIATION ANALYSIS												DISCREPANCY ANALYSIS												TOLERANCE ANALYSIS												SENSITIVITY ANALYSIS												UNCERTAINTY ANALYSIS												RISK ANALYSIS												QUALITY ANALYSIS												COMPLIANCE ANALYSIS												PERFORMANCE ANALYSIS												BENCHMARKING												BEST PRACTICES												LESSONS LEARNED												ACTION PLAN												MONITORING												EVALUATION												REVISIONS												CLOSURE												ARCHIVE												REUSE												DISSEMINATION												STAKEHOLDER ENGAGEMENT												TRANSPARENCY												ACCOUNTABILITY												INTEGRITY												ETHICS												SUSTAINABILITY												INNOVATION												ADAPTABILITY												RESILIENCE												AGILITY												EMPOWERMENT												COLLABORATION												COMMUNICATION												CONFLICT RESOLUTION												DECISION MAKING												PROBLEM SOLVING												CRITICAL THINKING												CREATIVITY												INTEGRITY												ETHICS												SUSTAINABILITY												INNOVATION												ADAPTABILITY												RESILIENCE												AGILITY												EMPOWERMENT												COLLABORATION												COMMUNICATION												CONFLICT RESOLUTION												DECISION MAKING												PROBLEM SOLVING												CRITICAL 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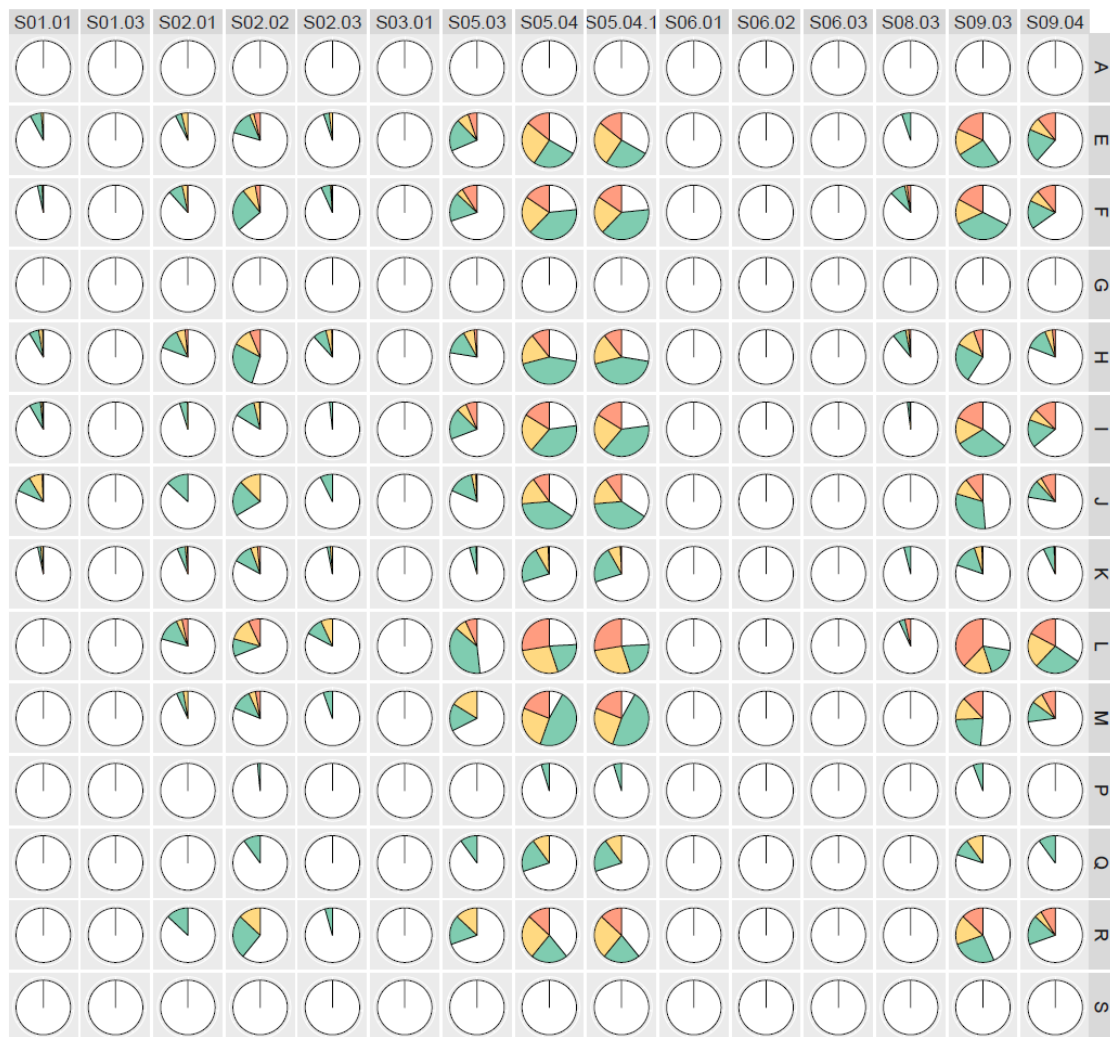




[illegible]

## F-4 Sleep disturbance impact charts

The proportion of receivers predicted to receive  $L_{AFmax}$  noise levels above the screening level of sleep disturbance are shown in Figure F.1 and assume a reduction of 10 dB of the unmitigated noise levels have been applied.



□ No impact    ■ Minor impact: < 10 dB above NML    ■ Moderate impact: 10 – 20 dB above NML    ■ High impact: > 20 dB above NML

**Figure F.1** *Proportion of residential receivers predicted to receive noise levels above screening level for sleep disturbance  $L_{AFmax}$*



## F-5 Standard mitigation and management measures

Table F.1 Standard management measures to reduce construction noise and vibration (Table 5 of the CNVS)

Action required	Applies to	Details
Implementation of any project specific mitigation measures required	Airborne noise Ground-borne noise & vibration	In addition to the measures set out in this table, any project specific mitigation measures identified in the EIA documentation (e.g. REF, submissions or representations report) or approval or licence conditions must be implemented.
Implement stakeholder consultation measures (refer to Sections 8.2.1 and 8.3 for further details of community consultation measures)	Airborne noise Ground-borne noise & vibration	<p>Periodic Notification (monthly letterbox drop and website notification) detailing all upcoming construction activities delivered to sensitive receivers at least 7 days prior to commencement of relevant works.</p> <p>In addition to Periodic Notification, the following strategies may be adopted on a case-by-case basis:</p> <ul style="list-style-type: none"> <li>– project specific website</li> <li>– project infoline</li> <li>– construction response line</li> <li>– email distribution list</li> <li>– web-based surveys</li> <li>– social media</li> <li>– community and stakeholder meetings and</li> <li>– community based forums (if required by approval conditions).</li> </ul>
Register of noise and vibrationsensitive receivers	Airborne noise Ground-borne noise & vibration	<p>A register of most affected noise and vibrationsensitive receivers (NVSRs) would be kept on site. The register would include the following details for each NVSR:</p> <ul style="list-style-type: none"> <li>– address of receiver</li> <li>– category of receiver (e.g. Residential, Commercial etc.)</li> <li>– contact name and contact details (if provided).</li> </ul> <p>The register may be included as part of the project's Community Liaison Plan or similar document and maintained in accordance with the requirements of this plan.</p>
Construction hours and scheduling	Airborne noise Ground-borne noise & vibration	Where feasible and reasonable, construction should be carried out during the standard daytime working hours. Work generating noise with special audible characteristics and/or vibration levels should be scheduled during less sensitive time periods.
Construction respite period	Ground-borne noise & vibration Airborne noise	<p>Noise with special audible characteristics and vibration generating activities (including jack and rock hammering, sheet and pile driving, rock breaking and vibratory rolling) may only be carried out in continuous blocks, not exceeding 3 hours each, with a minimum respite period of one hour between each block.</p> <p>'Continuous' includes any period during which there is less than a 1 hour respite between ceasing and recommencing any of the work.</p> <p>No more than two consecutive nights of noise with special audible characteristics and/or vibration generating work may be undertaken in the same NCA over any 7-day period, unless otherwise approved by the relevant authority.</p>

Action required	Applies to	Details
Site inductions	Airborne noise Ground-borne noise & vibration	All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include: <ul style="list-style-type: none"> <li>– all relevant project specific and standard noise and vibration mitigation measures</li> <li>– relevant licence and approval conditions</li> <li>– permissible hours of work</li> <li>– any limitations on noise generating activities with special audible characteristics</li> <li>– location of nearest sensitive receivers</li> <li>– construction employee parking areas</li> <li>– designated loading/unloading areas and procedures</li> <li>– site opening/closing times (including deliveries)</li> <li>– environmental incident procedures.</li> </ul>
Behavioural practices	Airborne noise	No swearing or unnecessary shouting or loud stereos/radios on site. No dropping of materials from height, throwing of metal items and slamming of doors. No excessive revving of plant and vehicle engines. Controlled release of compressed air.
Monitoring	Airborne noise Ground-borne noise & vibration	A noise monitoring program should be carried out for the duration of works in accordance with the Noise and Vibration Management Plan and any approval and licence conditions.
Attended vibration measurements	Ground-borne vibration	Attended vibration measurements shall be undertaken at all buildings within 25 m of vibration generating activities when these activities commence to confirm that vibration levels are within the acceptable range to prevent cosmetic building damage.
Update Construction Environmental Management Plans	Airborne noise Ground-borne noise & vibration	The CEMP must be regularly updated to account for changes in noise and vibration management issues and strategies.
Building condition surveys	Vibration blasting	Undertake building dilapidation surveys on all buildings located within the buffer zone prior to major project construction activities with the potential to cause property damage.

**Table F.2** Standard source mitigation measures to reduce construction noise and vibration (Table 6 of the CNVS)

Action required	Applies to	Details
Plan worksites and activities to minimise noise and vibration	Airborne noise Ground-borne vibration	Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site.
Equipment selection	Airborne noise Ground-borne noise & vibration	Use quieter and less vibration emitting construction methods where feasible and reasonable, see Appendix C of the CNVS. For example, when piling is required, bored piles rather than impact-driven piles would minimise noise and vibration impacts where feasible and reasonable. Similarly, diaphragm wall construction techniques, in lieu of sheet piling, would have significant noise and vibration benefits.
Maximum noise levels	Airborne-noise	The noise levels of plant and equipment must have operating Sound Power or Sound Pressure Levels compliant with the allowable noise levels in Appendix C of the CNVS.
Rental plant and equipment	Airborne-noise	The noise levels of plant and equipment items are to be considered in rental decisions and in any case cannot be used on site unless compliant with the allowable noise levels in Appendix C of the CNVS.

Action required	Applies to	Details
Use and siting of plant	Airborne-noise	Simultaneous operation of noisy plant within discernible range of a sensitive receiver is to be avoided. The offset distance between noisy plant and adjacent sensitive receivers is to be maximised. Plant used intermittently to be throttled down or shut down. Noise-emitting plant to be directed away from sensitive receivers.
Non-tonal reversing alarms	Airborne noise	Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work, including delivery vehicles.
Minimise disturbance arising from delivery of goods to construction sites	Airborne noise	Loading and unloading of materials/deliveries is to occur <i>as far as possible</i> from sensitive receivers. Select site access points and roads as far as possible away from sensitive receivers. Dedicated loading/unloading areas to be shielded if close to sensitive receivers. Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible.
Construction Related Traffic	Airborne noise	Schedule and route vehicle movements away from sensitive receivers and during less sensitive times. Limit the speed of vehicles and avoid the use of engine compression brakes. Maximise on-site storage capacity to reduce the need for truck movements during sensitive times.
Silencers on Mobile Plant	Airborne noise	Where possible reduce noise from mobile plant through additional fittings including: <ul style="list-style-type: none"> <li>– residential grade mufflers</li> <li>– damped hammers such as “City” Model Rammer Hammers</li> <li>– air Parking brake engagement is silenced.</li> </ul>
Prefabrication of materials off-site	Airborne noise	Where practicable, pre-fabricate and/or prepare materials off-site to reduce noise with special audible characteristics occurring on site. Materials can then be delivered to site for installation.
Engine compression brakes	Airborne noise	Limit the use of engine compression brakes at night and in residential areas. Ensure vehicles are fitted with a maintained original equipment manufacturer exhaust silencer or a silencer that complies with the National Transport Commission’s ‘In-service test procedure’ and standard.

**Table F.3** Standard path mitigation measures to reduce construction noise and vibration (Table 7 of the CNVS)

Action required	Applies to	Details
Shield stationary noise sources such as pumps, compressors, fans etc	Airborne noise	Stationary noise sources should be enclosed or shielded whilst ensuring that the occupational health and safety of workers is maintained. Appendix F of AS 2436: 1981 lists materials suitable for shielding.
Shield sensitive receivers from noisy activities	Airborne noise	Use structures to shield residential receivers from noise such as site shed placement; earth bunds; fencing; erection of operational stage noise barriers (where practicable) and consideration of site topography when siting plant.

## F-6 Additional mitigation

Table F.4 Additional management measures (Table 8 of the CNVS)

Measure	Description	Abbreviation
Periodic notification	<p>For each Transport for New South Wales Infrastructure and Place (IP) project, a notification entitled 'Project Update' or 'Construction Update' is produced and distributed to stakeholders via letterbox drop and distributed to the project postal and/or email mailing lists. The same information would be published on the Transport for New South Wales website (<a href="http://www.transport.nsw.gov.au">www.transport.nsw.gov.au</a>).</p> <p>Periodic notifications provide an overview of current and upcoming works across the project and other topics of interest. The objective is to engage, inform and provide project specific messages. Advanced warning of potential disruptions (e.g. traffic changes or noisy works) can assist in reducing the impact on stakeholders. The approval conditions for projects specify requirements for notification to sensitive receivers where works may impact on them.</p> <p>Content and length is determined on a project-by-project basis and must be approved by Transport for New South Wales prior to distribution.</p> <p>Most projects distribute notifications on a monthly basis. Each notification is graphically designed within a branded template.</p> <p>In certain circumstances media advertising may also be used to supplement Periodic Notifications, where considered effective.</p> <p>Periodic Notification may be advised by the IP Community Engagement Team in cases where the additional mitigation measures matrix are not triggered as shown in Tables 9 to 11, for example where community impacts extend beyond noise and vibration (traffic, light spill, parking etc). In these circumstances the IP Community Engagement Team would determine the community engagement strategy on a case-by-case basis.</p>	PN
Verification monitoring	<p>Verification monitoring of noise and/or vibration during construction may be conducted at the affected receiver(s) or a nominated representative location (typically the nearest receiver where more than one receiver has been identified). Monitoring can be in the form of either unattended logging (i.e. for vibration provided there is an immediate feedback mechanism such as SMS capabilities) or operator attended surveys (i.e. for specific periods of construction noise).</p> <p>The purpose of monitoring is to confirm that:</p> <ul style="list-style-type: none"> <li>– construction noise and vibration from the project are consistent with the predictions in the noise assessment</li> <li>– mitigation and management of construction noise and vibration is appropriate for receivers affected by the works.</li> </ul> <p>Where noise monitoring finds that the actual noise levels exceed those predicted in the noise assessment then immediate refinement of mitigation measures may be required and the CNVIS amended.</p>	V
Specific notification	<p>Specific notifications are in the form of a personalised letter or phone call to identified stakeholders no later than seven calendar days ahead of construction activities that are likely to exceed the noise objectives. Alternatively (or in addition to), communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities and provide an individual briefing.</p> <p>Letters may be letterbox dropped or hand distributed.</p> <p>Phone calls provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and their specific needs.</p> <p>Individual briefings are used to inform stakeholders about the impacts of noisy activities and mitigation measures that would be implemented. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the project.</p> <p>Specific notifications are used to support Periodic Notifications, or to advertise unscheduled works and must be approved by Transport for New South Wales prior to implementation/distribution.</p>	SN



Measure	Description	Abbreviation
Respite offer	The purpose of a project specific respite offer is to provide residents subjected to lengthy periods of noise or vibration respite from an ongoing impact. The offer could comprise pre-purchased movie tickets, bowling activities, meal vouchers or similar offer. This measure is determined on a case-by-case basis, and may not be applicable to all IP projects.	RO
Alternative accommodation	Alternative accommodation options may be provided for residents living in close proximity to construction works that are likely to incur unreasonably high impacts. Alternative accommodation would be determined on a case-by-case basis and should provide a like-for-like replacement for permanent residents, including provisions for pets, where reasonable and feasible.	AA
Alternative construction methodology	Where the vibration assessment identifies that the proposed construction method has a high risk of causing structural damage to buildings near the works, the proponent would need to consider alternative construction options that achieve compliance with the VMLs for building damage. For example, replace large rockbreaker with smaller rockbreakers or rock saws.	AC
Respite period	OOHW during evening and night periods would be restricted so that receivers are impacted for no more than 3 consecutive evenings and no more than 2 consecutive nights in the same NCA in any one week. A minimum respite period of 4 evenings/5 nights shall be implemented between periods of consecutive evening and/or night works. Strong justification must be provided where it is not reasonable and feasible to implement these period restrictions (e.g. to minimise impacts to rail operations), and approval must be given by Transport for New South Wales through the OOHV Approval Protocol (Section 6). Note: this management measure does not apply to OOHV Period 1 – Days.	RP
Duration reduction	<p>Where Respite Periods (see management measure above) are considered to be counterproductive to reducing noise and vibration impacts to the community it may be beneficial to increase the number of consecutive evenings and/or nights through Duration Reduction to minimise the duration of the activity. This measure is determined on a project-by-project basis, and may not be applicable to all IP projects.</p> <p>Impacted receivers must be consulted and evidence of community support for the Duration Reduction must be provided as justification for the Duration Reduction. A community engagement strategy must be agreed with and implemented in consultation with IP Community Engagement Representatives.</p>	DR

# **Appendix G**

**Operational noise contours**

## **G-1      Operational noise contours – $L_{Aeq(9hour)}$ 2040**



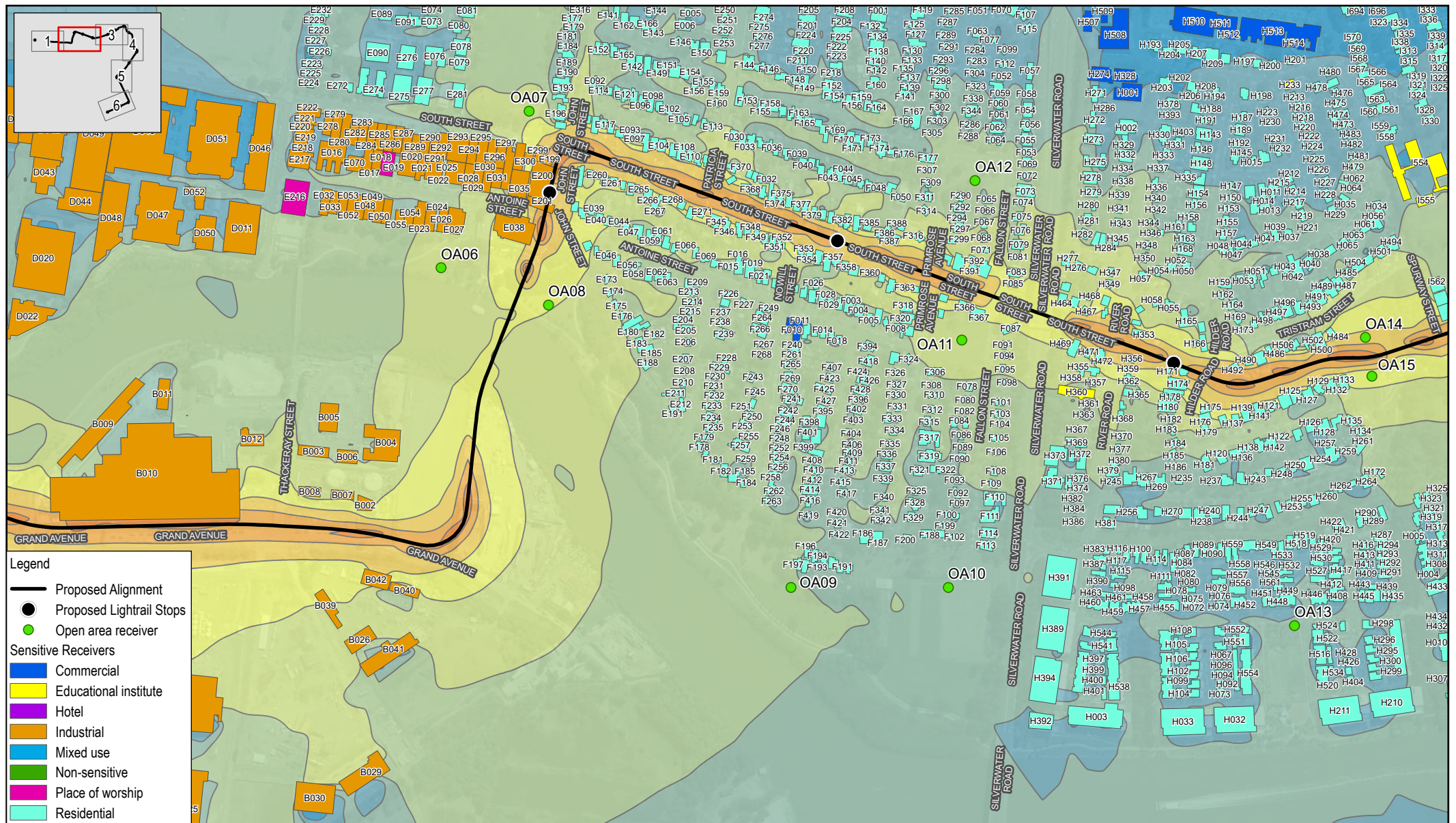
Transport for NSW  
Parramatta Light Rail Stage 2 EIS  
Noise and vibration impact assessment

Operational noise contour,  
LAeq(9 hour) dBA -  
Opening year + 10 years

Project No. 12557728  
Revision No. -  
Date 28/06/2022

**FIGURE G-1.1**













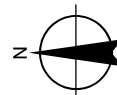
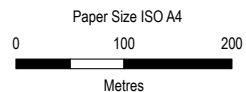
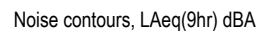
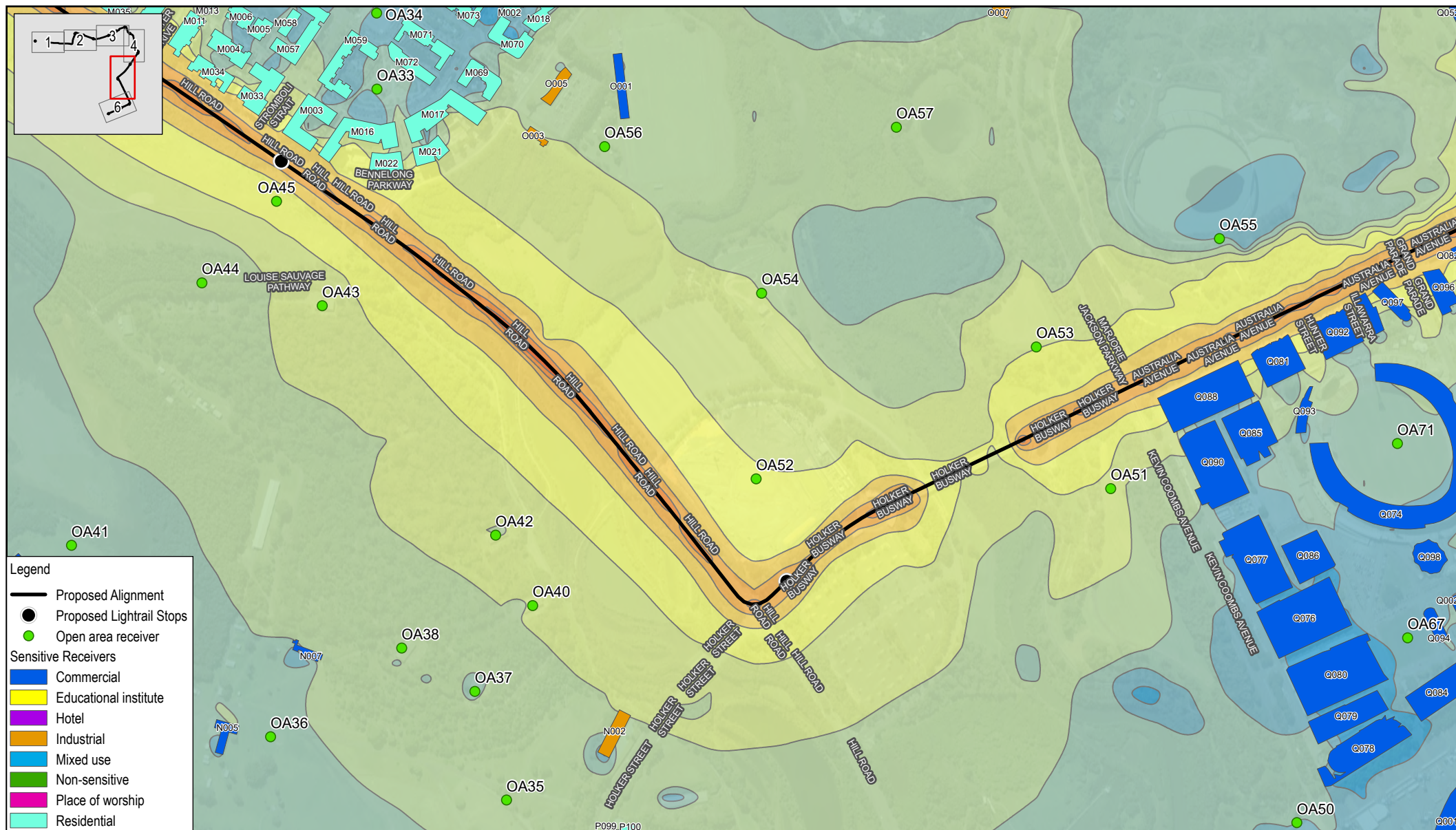
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LAeq(9 hour) dBA -  
Opening year + 10 years

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**FIGURE G-1.4**

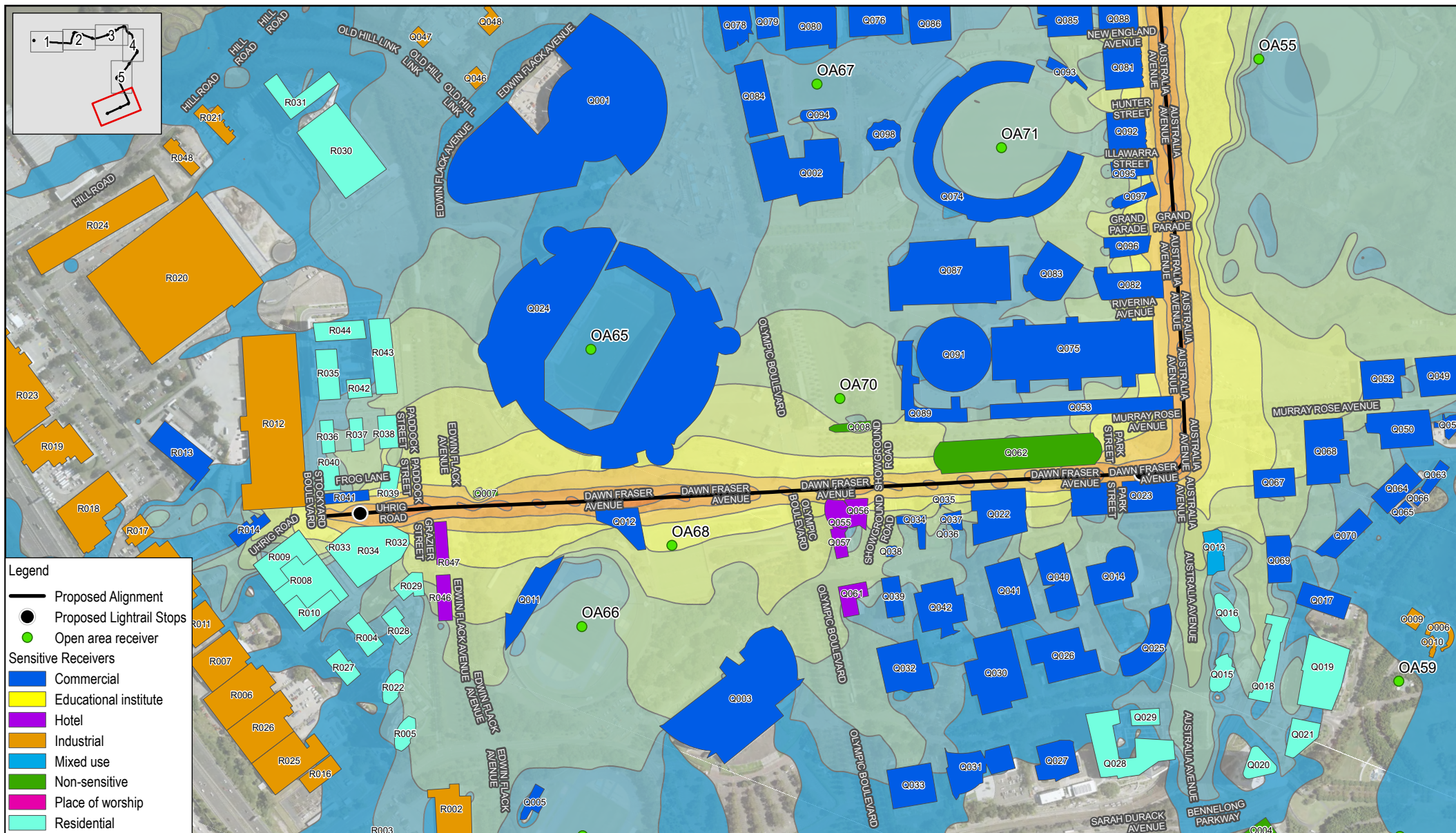




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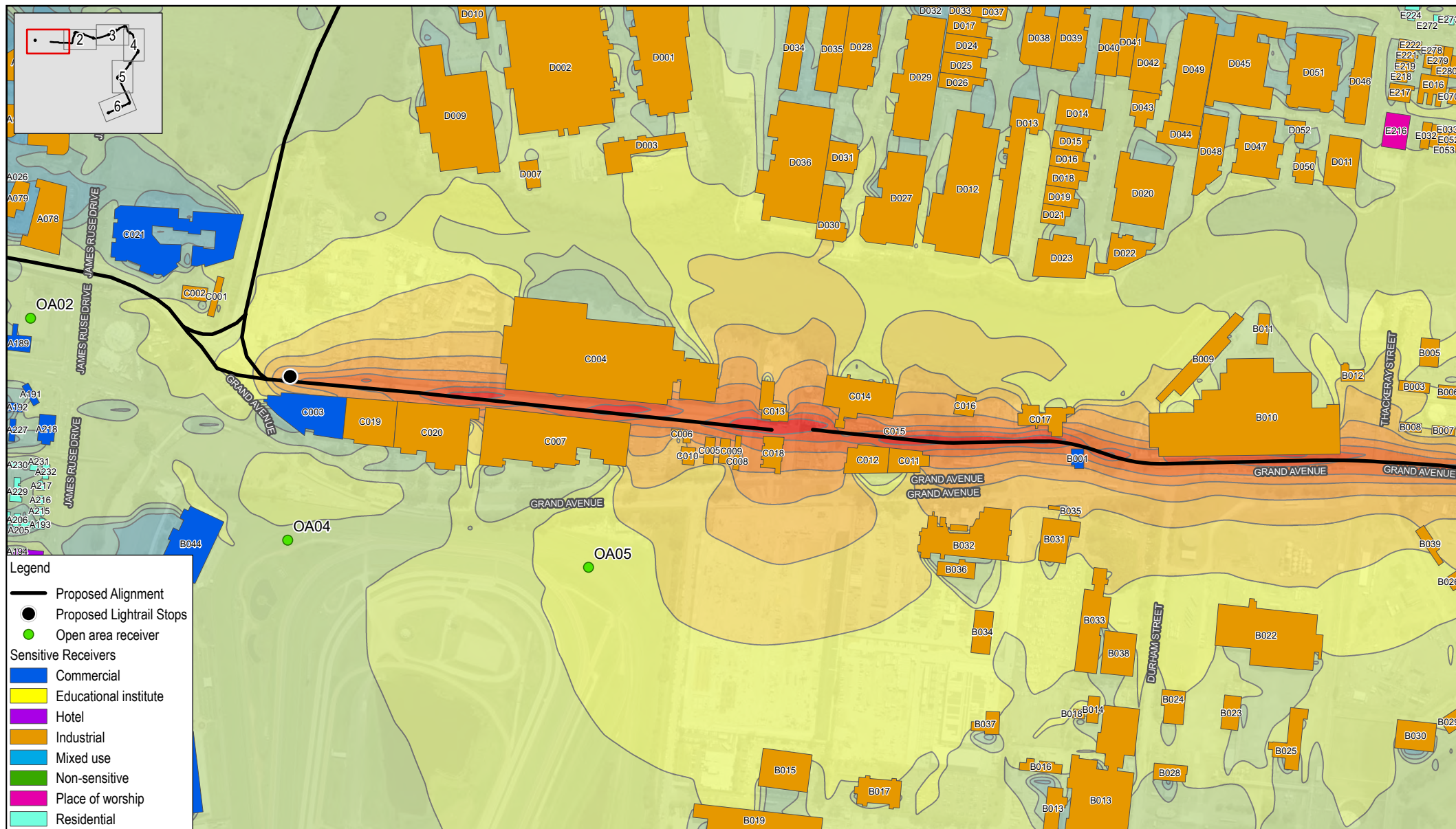
Operational noise contour,  
LAeq(9 hour) dBA -  
Opening year + 10 years

Project No. 12557728  
Revision No. -  
Date 28/06/2022

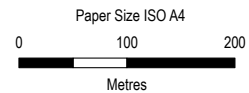
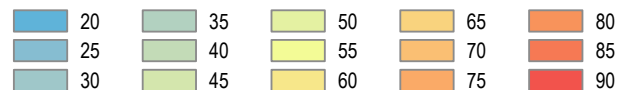
**FIGURE G-1.6**

## **G-2    Operational noise contours – $L_{AFmax(95\%)}$**





Noise contours, LAeq(Max) dBA



Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 56



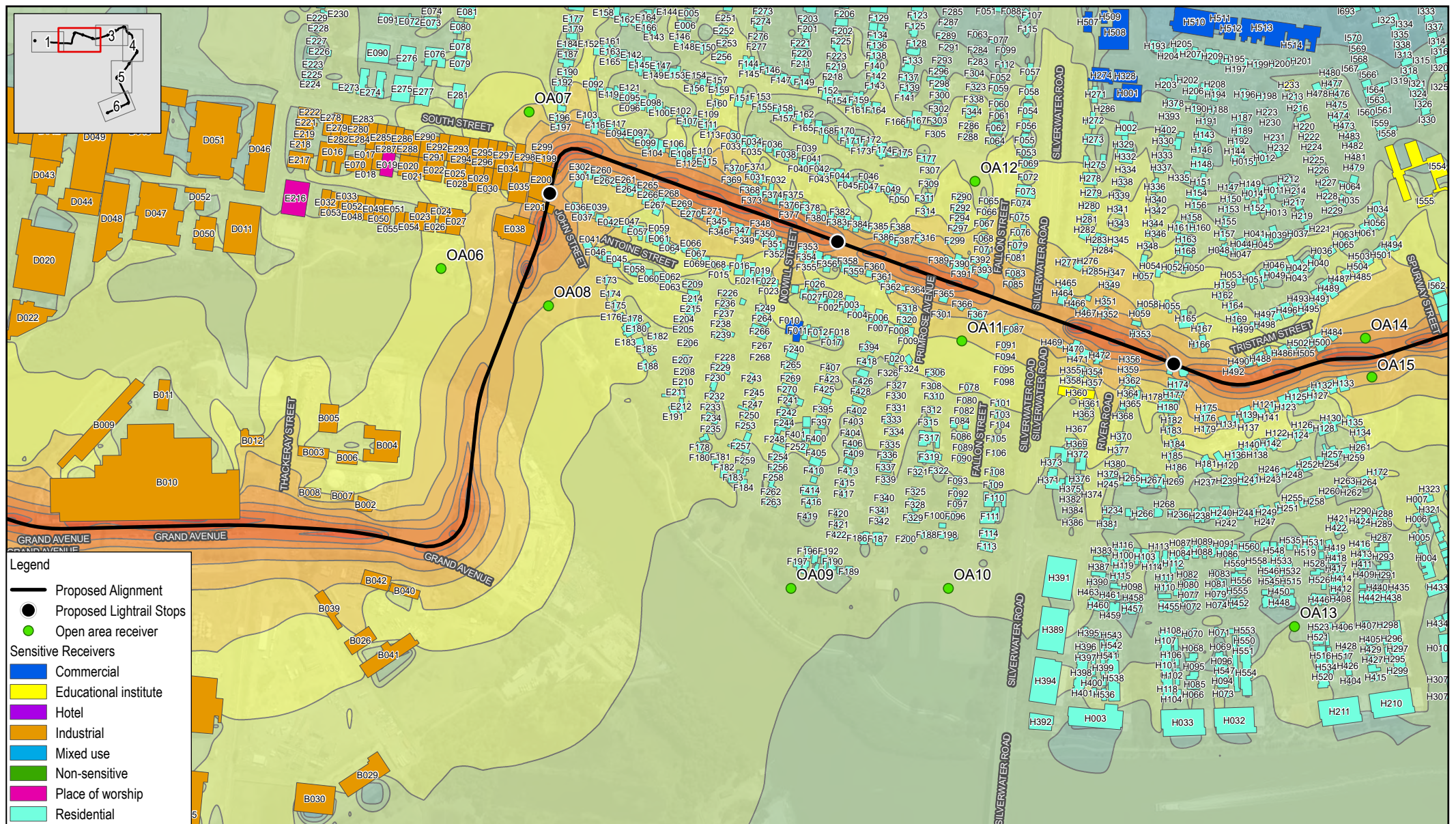
Transport for NSW  
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Operational noise contour, L<sub>max</sub> dBA -  
Opening year + 10 years

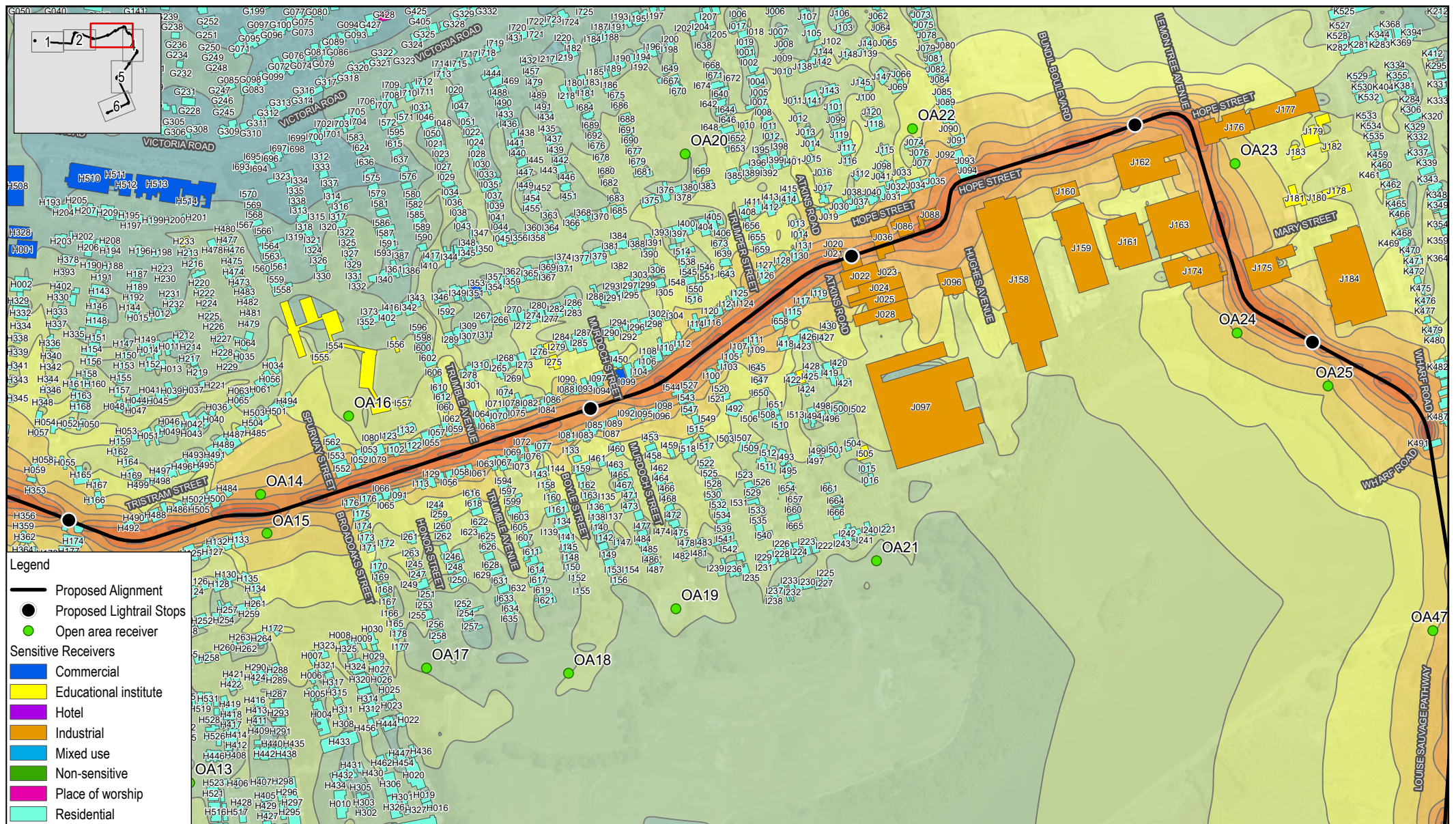
Project No. 12557728  
Revision No. -  
Date 28/06/2022

**FIGURE G-2.1**









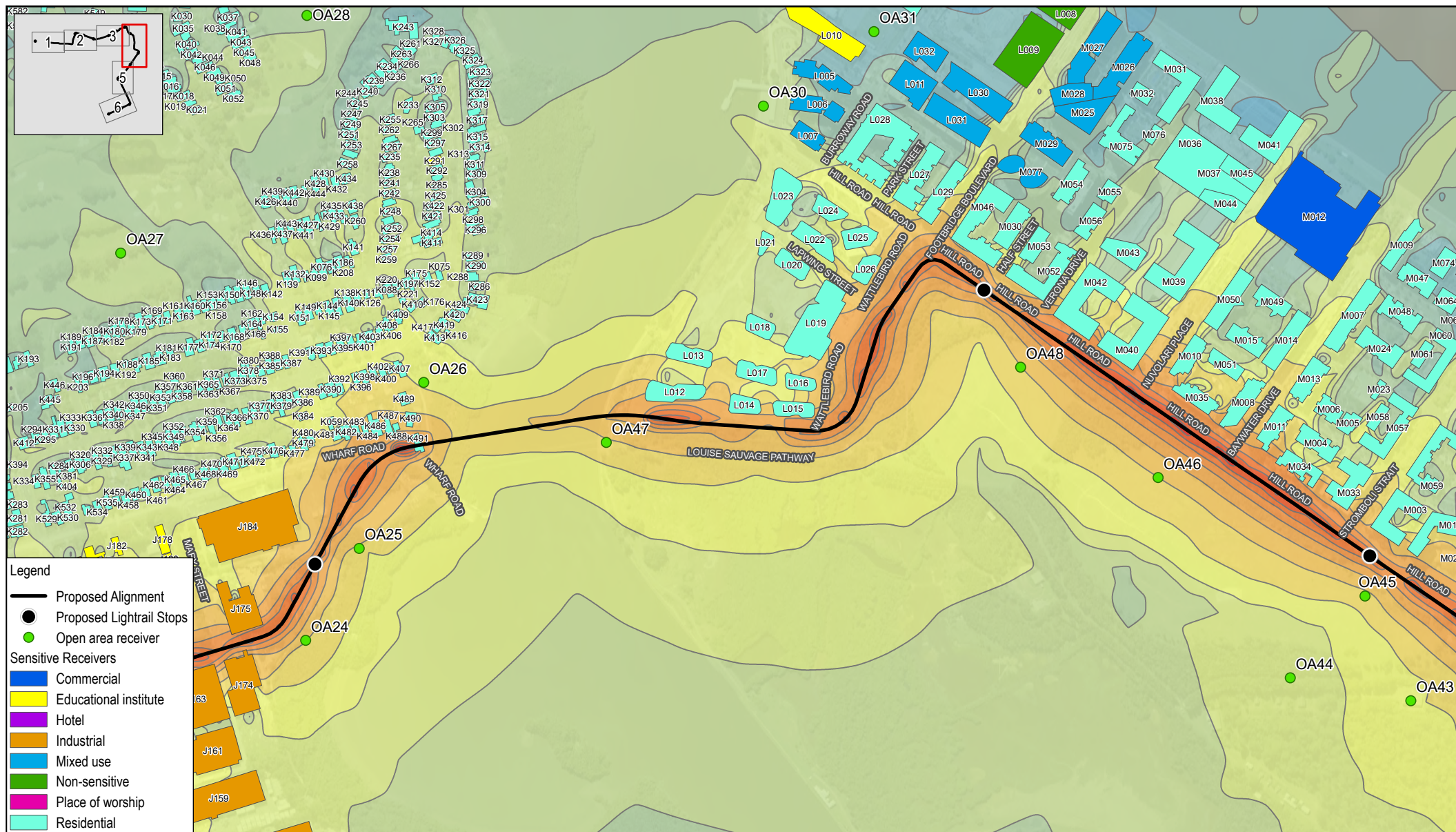
Transport for NSW  
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Noise and vibration impact assessment

Operational noise contour, L<sub>Amax</sub> dBA -  
Opening year + 10 years

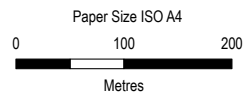
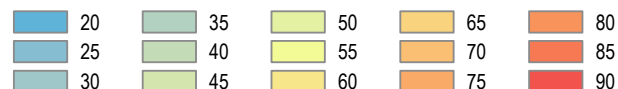
Project No. 12557728  
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**FIGURE G-2.3**

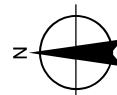




Noise contours, LAeq(Max) dBA



Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 56



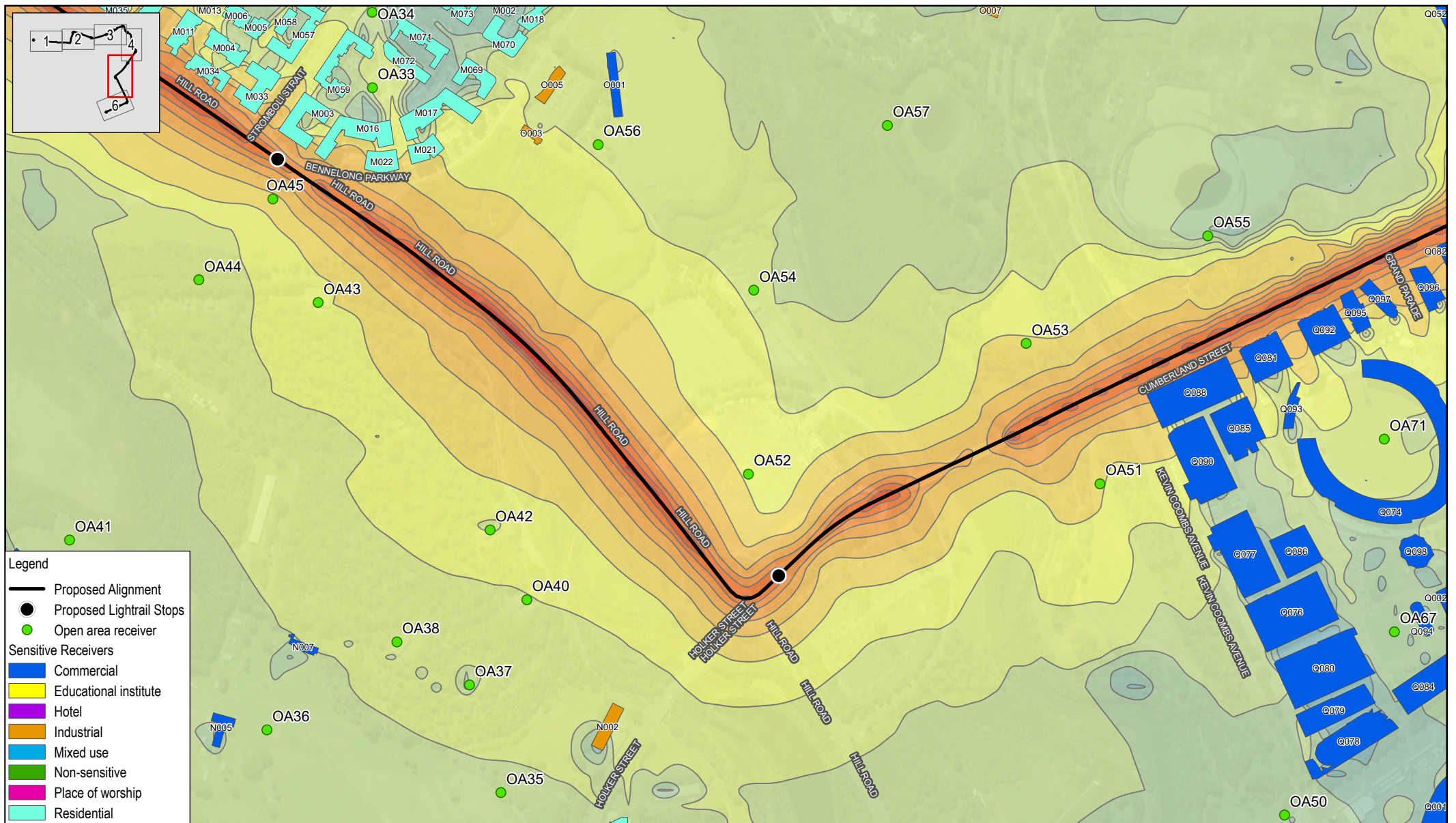
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Operational noise contour, L<sub>A</sub>max dBA -  
Opening year + 10 years

Project No. 12557728  
Revision No. -  
Date 28/06/2022

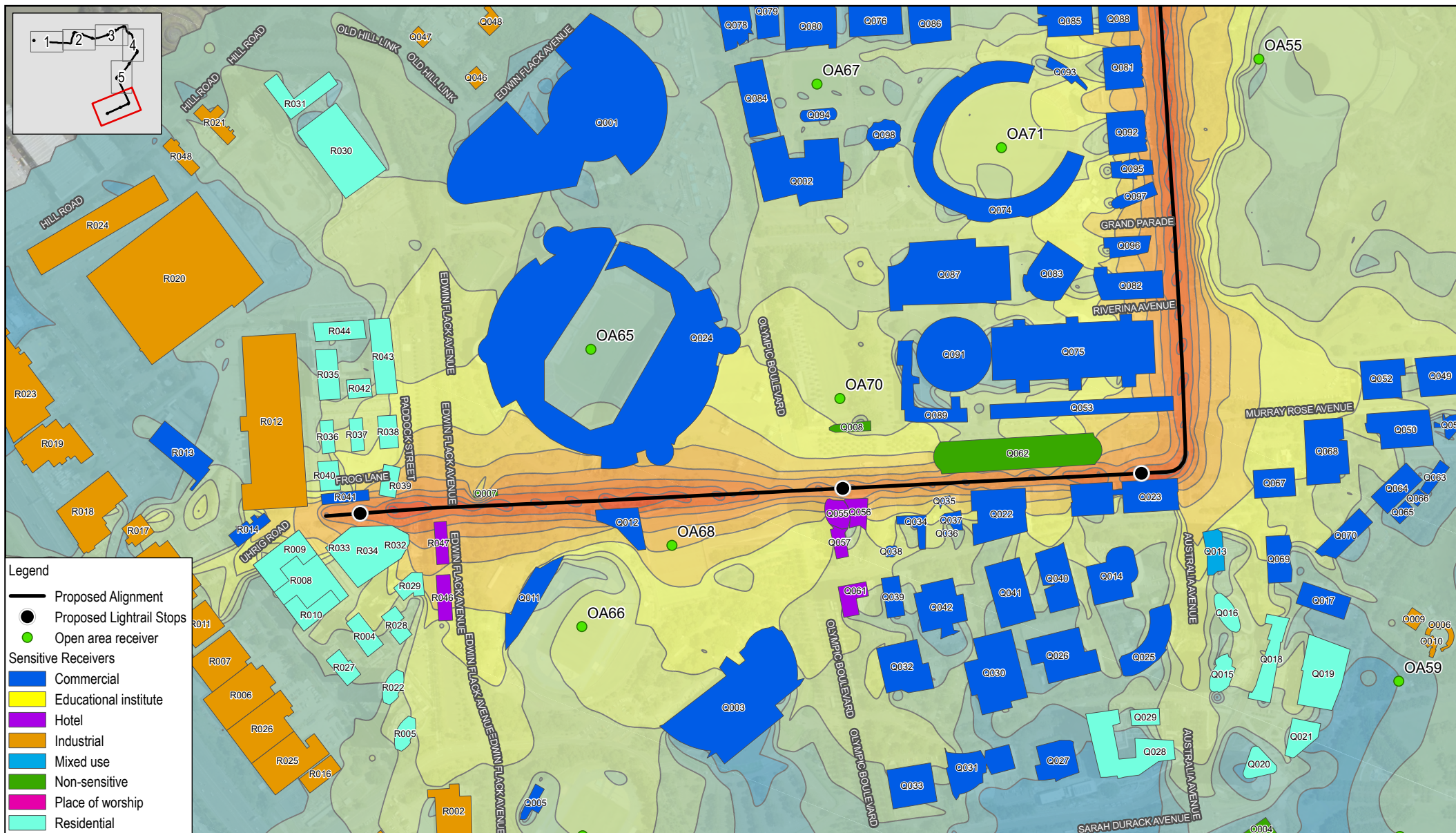
**FIGURE G-2.4**



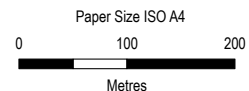
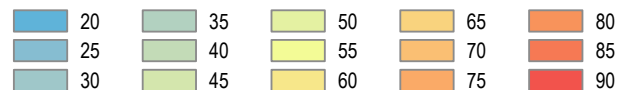


**FIGURE G-2.5**





Noise contours, LAeq(Max) dBA



Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 56



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Operational noise contour, L<sub>A</sub>max dBA -  
Opening year + 10 years

Project No. 12557728  
Revision No. -  
Date 28/06/2022

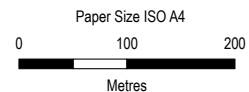
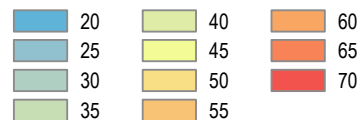
**FIGURE G-2.6**



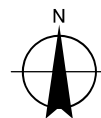
## **G-3    Operational noise contours – $L_{Aeq(1hour)}$ 2040**



Noise contours, LAeq(1hr) dBA



Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 56



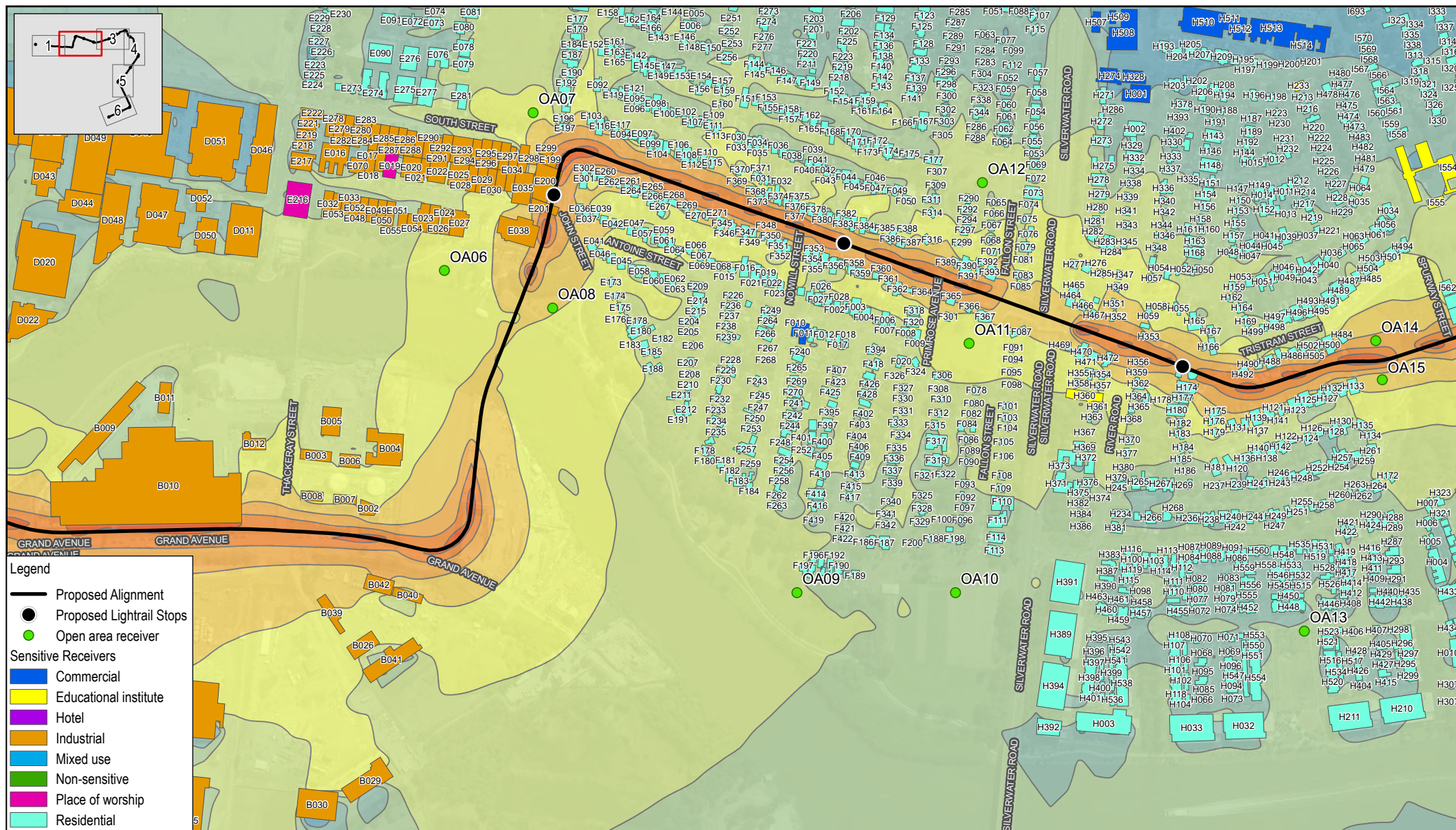
Transport for NSW  
Parramatta Light Rail Stage 2 EIS  
Noise and vibration impact assessment

Operational noise contour,  
LAeq(1 hour) dBA -  
Opening year + 10 years

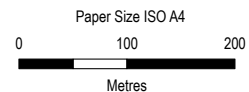
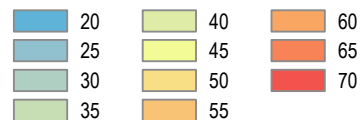
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**FIGURE G-3.1**

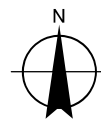




Noise contours, LAeq(1hr) dBA



Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 56



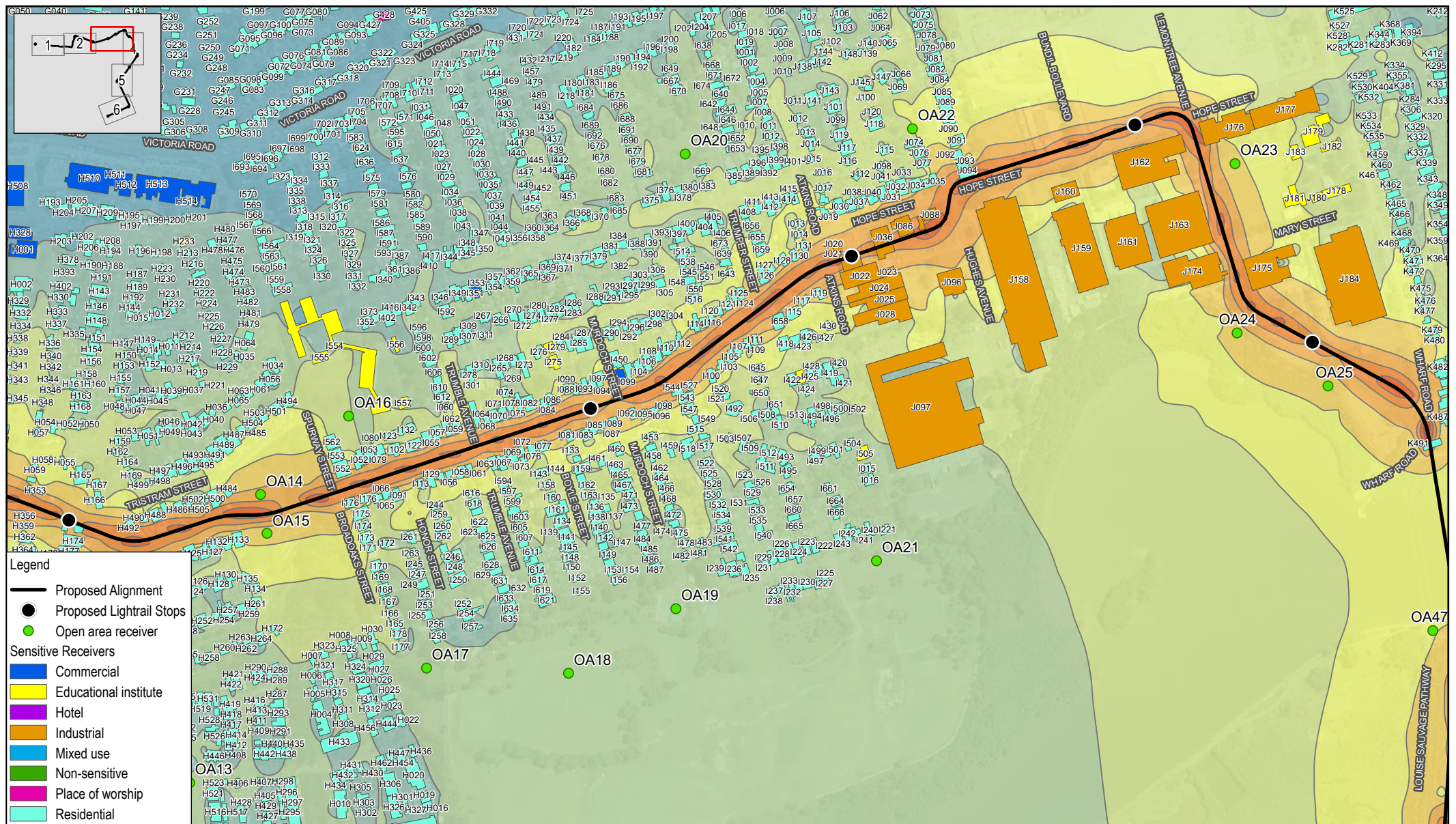
Transport for NSW  
Parramatta Light Rail Stage 2 EIS  
Noise and vibration impact assessment

Operational noise contour,  
LAeq(1 hour) dBA -  
Opening year + 10 years

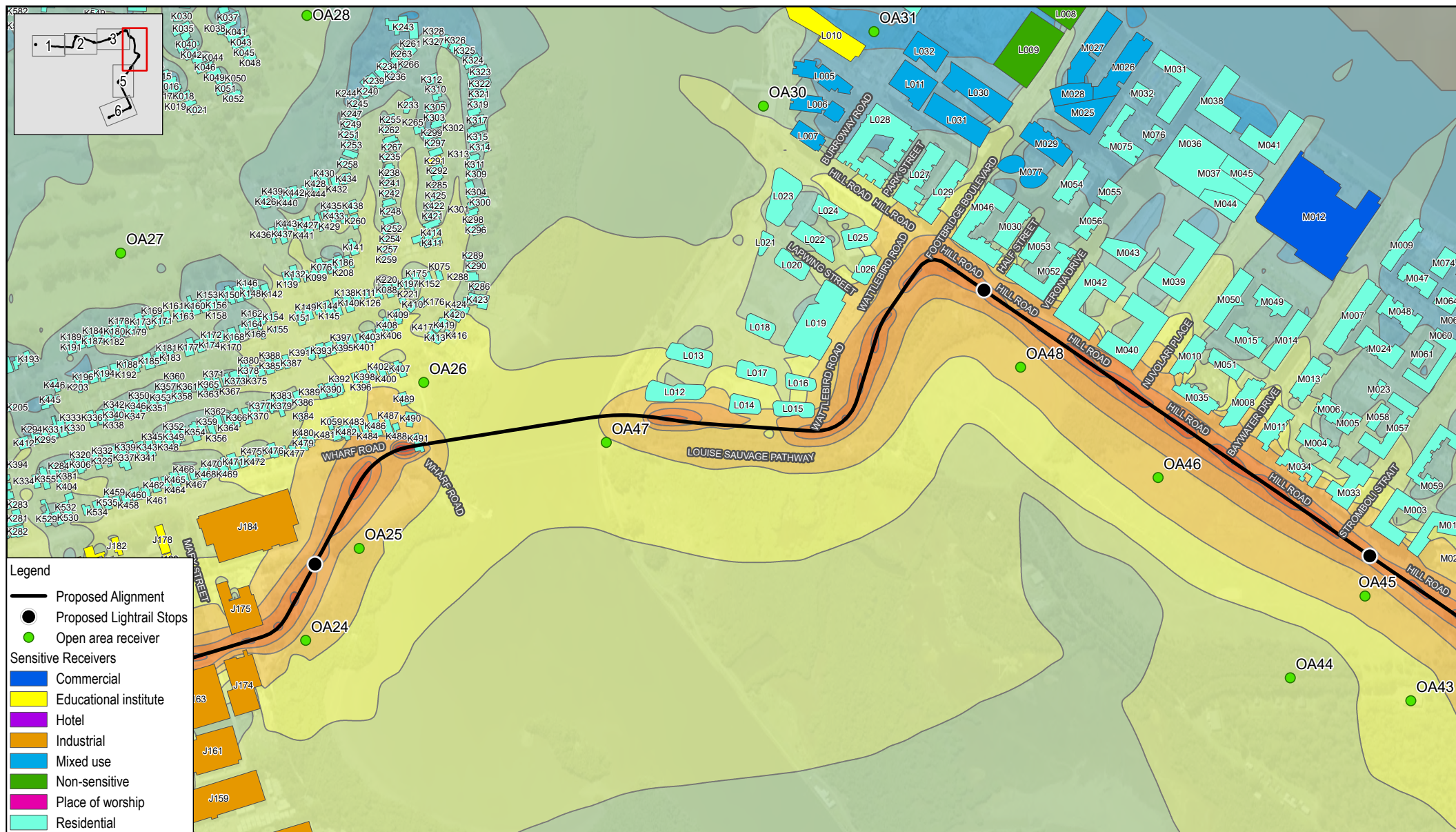
Project No. 12557728  
Revision No. -  
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**FIGURE G-3.2**

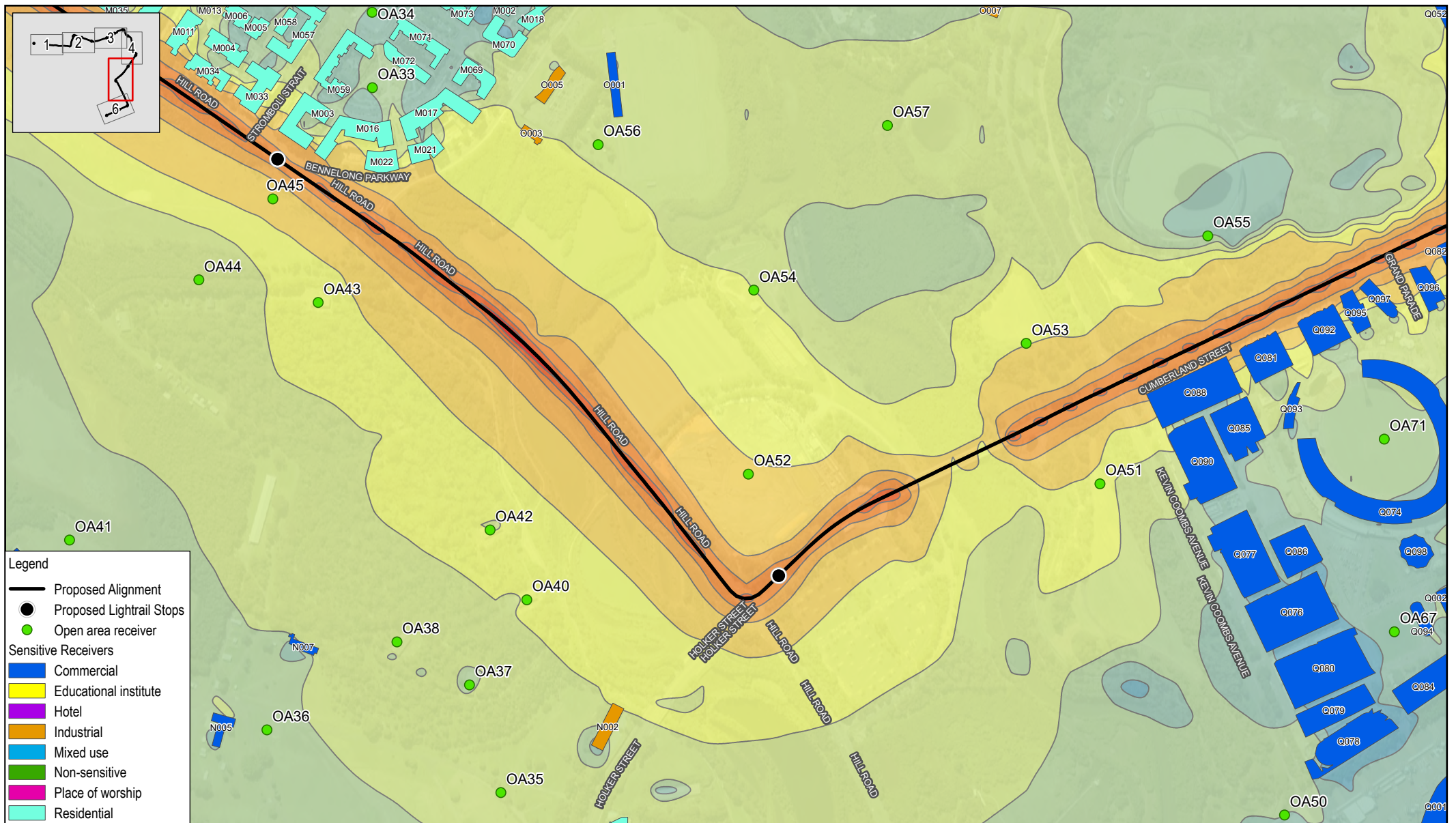




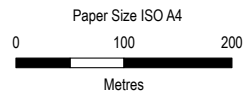
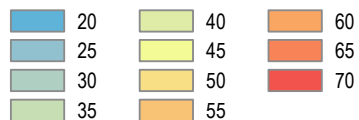




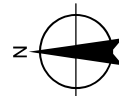




Noise contours, LAeq(1hr) dBA



Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 56



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Noise and vibration impact assessment

Operational noise contour,  
LAeq(1 hour) dBA -  
Opening year + 10 years

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**FIGURE G-3.5**





## **G-4    Operational noise and vibration results at sensitive receivers**



RID	Acquired	Type	Address	Name	2039 15/9 hour			2039 1 hour		Trigger levels			Qualifies? (Airborne)	GBN LASmax	Trigger level	Qualifies? (GBN)	Future		
					Laeq(15h)	Laeq(9hr)	LAMax	LAeq(1hr)	LAeq(1hr)	Day Criteria	Night Criteria	Max Criteria					eVDV Day	eVDV Night	PPV
B001	TRUE	Industrial	21 Grand Avenue Camellia		67	63	88	68	66				No	55			0.027	0.019	0.077
B002		Industrial	35 Grand Avenue Camellia		52	48	69	53	51				No	33			0.004	0.003	0.009
B003		Industrial	14 Thackeray Street Camellia		46	41	62	47	44				No	9			0.001	0.000	0.001
B004		Industrial	14 Thackeray Street Camellia		48	44	57	49	47				No	6			0.000	0.000	0.001
B005		Industrial	14 Thackeray Street Camellia		42	38	55	43	41				No	0			0.000	0.000	0.001
B006		Industrial	14 Thackeray Street Camellia		45	40	58	46	43				No	10			0.001	0.000	0.001
B007		Industrial	2-8 Thackeray Street Camellia		50	46	65	51	49				No	29			0.002	0.002	0.006
B008		Industrial	2-8 Thackeray Street Camellia		50	46	68	51	49				No	30			0.002	0.002	0.007
B009		Industrial	3 Thackeray Street Camellia		46	41	61	46	44				No	11			0.001	0.000	0.001
B010		Industrial	3 Thackeray Street Camellia		64	59	85	64	62				No	51			0.017	0.012	0.049
B012		Industrial	3 Thackeray Street Camellia		46	42	63	47	45				No	7			0.000	0.000	0.001
B026		Industrial	9 Devon Street Rosehill		44	40	58	45	43				No	0			0.000	0.000	0.001
B031		Industrial	10 Grand Avenue Rosehill		49	44	61	50	47				No	6			0.000	0.000	0.001
B032		Industrial	10 Grand Avenue Rosehill		52	47	68	53	51				No	11			0.001	0.000	0.002
B035		Industrial	10 Grand Avenue Rosehill		53	48	65	54	51				No	11			0.001	0.000	0.001
B039		Industrial	12 Grand Avenue Rosehill		51	46	62	52	49				No	13			0.001	0.000	0.002
B040		Industrial	12 Grand Avenue Rosehill		51	47	64	52	50				No	16			0.001	0.001	0.002
B041		Industrial	12 Grand Avenue Rosehill		45	40	58	46	44				No	0			0.000	0.000	0.000
B042		Industrial	12 Grand Avenue Rosehill		53	48	66	53	51				No	24			0.001	0.001	0.004
C003		Commercial	1 Grand Avenue Camellia		56	52	68	57	55	60			No	32			0.004	0.003	0.007
C004		Industrial	11 Grand Avenue Camellia		65	61	83	66	64				No	47			0.015	0.010	0.036
C005		Industrial	11 Grand Avenue Camellia		62	57	78	63	61				No	40			0.006	0.005	0.017
C006		Industrial	11 Grand Avenue Camellia		64	59	80	64	62				No	44			0.011	0.008	0.026
C007		Industrial	11-11 Grand Avenue Camellia		64	60	81	65	63				No	46			0.012	0.009	0.029
C008		Industrial	11-11 Grand Avenue Camellia		65	60	83	65	63				No	50			0.018	0.013	0.048
C009		Industrial	11-11 Grand Avenue Camellia		62	58	79	63	61				No	40			0.007	0.005	0.017
C010		Industrial	11-11 Grand Avenue Camellia		54	50	69	55	53				No	31			0.003	0.002	0.008
C011		Industrial	13 Grand Avenue Camellia		62	58	82	63	61				No	46			0.011	0.008	0.032
C012		Industrial	13 Grand Avenue Camellia		62	58	82	63	61				No	47			0.012	0.008	0.034
C013		Industrial	13 Grand Avenue Camellia		71	67	95	72	70				No	54			0.029	0.021	0.073
C014		Industrial	15 Grand Avenue Camellia		67	63	90	68	66				No	55			0.027	0.019	0.080
C015		Industrial	15 Grand Avenue Camellia		66	62	88	67	65				No	54			0.024	0.017	0.070
C016		Industrial	15 Grand Avenue Camellia		56	52	74	57	55				No	32			0.003	0.002	0.008
C017		Industrial	19 Grand Avenue Camellia		66	61	88	67	64				No	51			0.019	0.013	0.052
C018	TRUE	Industrial	27 Grand Avenue Camellia		65	61	87	66	64				No	46			0.011	0.008	0.031
C019		Industrial	3 Grand Avenue Camellia		60	56	75	61	59				No	39			0.007	0.005	0.015
C020		Industrial	7 Grand Avenue Camellia		62	58	79	63	61				No	43			0.010	0.007	0.024
E025		Industrial	29 Antoine Street Rydalmere		42	38	56	43	41				No	0			0.000	0.000	0.000
E026		Industrial	30 Antoine Street Rydalmere		44	39	56	44	42				No	0			0.000	0.000	0.001
E027		Industrial	32 Antoine Street Rydalmere		47	42	60	48	46				No	5			0.000	0.000	0.001
E028		Industrial	33 Antoine Street Rydalmere		45	40	57	45	43				No	1			0.000	0.000	0.001
E029		Industrial	35 Antoine Street Rydalmere		45	41	59	46	44				No	4			0.000	0.000	0.001
E030		Industrial	37 Antoine Street Rydalmere		47	43	62	48	46				No	11			0.000	0.000	0.001
E031		Industrial	39 Antoine Street Rydalmere		46	42	62	47	45				No	12			0.001	0.000	0.001
E034		Industrial	41 Antoine Street Rydalmere		43	39	57	44	42				No	17			0.001	0.001	0.002
E035		Industrial	43 Antoine Street Rydalmere		53	49	68	54	52				No	29			0.002	0.002	0.005
E036		Residential	47 Antoine Street Rydalmere		54	49	71	55	53	60	50	80	No	33	35		0.003	0.002	0.007
E037		Residential	47 Antoine Street Rydalmere		52	48	70	53	51	60	50	80	No	28	35		0.002	0.001	0.005
E038	TRUE	Industrial	48 Antoine Street Rydalmere		59	55	81	60	58				No	47			0.012	0.009	0.034
E039		Residential	51 Antoine Street Rydalmere		50	45	67	51	48	60	50	80	No	22	35		0.001	0.001	0.003
E040		Residential	53 Antoine Street Rydalmere		50	45	67	51	48	60	50	80	No	18	35		0.001	0.001	0.002
E041		Residential	54 Antoine Street Rydalmere		53	48	70	53	51	60	50	80	No	22	35		0.001	0.001	0.003
E042		Residential	55 Antoine Street Rydalmere		48	44	65	49	47	60	50	80	No	14	35		0.001	0.000	0.001
E043		Residential	56 Antoine Street Rydalmere		49	44	66	50	48	60	50	80	No	17	35		0.001	0.001	0.002
E044		Residential	57 Antoine Street Rydalmere		48	43	65	49	46	60	50	80	No	15	35		0.001	0.000	0.002
E045		Residential	58 Antoine Street Rydalmere		46	41	60	47	44	60	50	80	No	7	35		0.000	0.000	0.001
E046		Residential	58 Antoine Street Rydalmere		47	43	62	48	46	60	50	80	No	12	35		0.001	0.000	0.001
E047		Residential	59 Antoine Street Rydalmere		47	42	63	48	46	60	50	80	No	15	35		0.001	0.000	0.002
E056		Residential	60 Antoine Street Rydalmere		46	41	60	46	44	60	50	80	No	2	35		0.000	0.000	0.001
E057		Residential	61 Antoine Street Rydalmere		46	42	62	47	45	60	50	80	No	19	35		0.001	0.001	0.002
E058		Residential	62 Antoine Street Rydalmere		45	40	60	46	44	60	50	80	No	3	35		0.000	0.000	0.001
E059		Residential	63 Antoine Street Rydalmere		44	40	56	45	43	60	50	80	No	19	35		0.001	0.001	0.002
E060		Residential	64 Antoine Street Rydalmere		43	39	56	44	42	60	50	80	No	3	35		0.000	0.000	0.001
E061		Residential	65 Antoine Street Rydalmere		44	40	59	45	43	60	50	80	No	22	35		0.001	0.001	0.003
E062		Residential	66 Antoine Street Rydalmere		46	42	60	47	45	60	50	80	No	3	35		0.000	0.000	0.001
E063		Residential	66 Antoine Street Rydalmere		43	38	54	44	42	60	50	80	No	4	35		0.000	0.000	0.001
E064		Residential	67 Antoine Street Rydalmere		44	40	60	45	43	60	50	80	No	20	35		0.001	0.001	0.003
E065		Residential	69 Antoine Street Rydalmere		47	42	60	47	45	60	50	80	No	18	35		0.001	0.001	0.002
E066		Residential	71 Antoine Street Rydalmere		45	40	60	46	44	60	50	80	No	20	35		0.001	0.001	0.003
E067		Residential	73 Antoine Street Rydalmere		44	40	60	45	43	60	50	80	No	21	35		0.001	0.001	0.003
E068		Residential	75 Antoine Street Rydalmere		44	39	59	45	42	60	50	80	No	18	35		0.001	0.001	0.002
E069		Residential	75 Antoine Street Rydalmere		44	39	60	45	42	60	50	80	No	18	35		0.001	0.001	0.002
E092		Residential	1 Dorothy Street Rydalmere		48	44	60	49	47	60	50	80	No	10	35		0.000	0.000	0.001
E093		Residential	10 Dorothy Street Rydalmere		54	49	68	54	52	60	50	80	No	30	35		0.002	0.002	0.005
E094		Residential	10 Dorothy Street Rydalmere		55	50	70	55	53	60	50	80	No	32	35		0.003	0.002	0.006
E095		Residential	11 Dorothy Street Rydalmere		47	42	57	48	46	60	50	80	No	11	35		0.000	0.000	0.001
E096		Residential	13 Dorothy Street Rydalmere		42	38	53	43	41	60	50	80	No	11	35		0.000	0.000	0.001
E097		Residential	14 Dorothy Street Rydalmere		54	49	67	55	52	60	50	80	No	31	35		0.003	0.002	0.006

RID	Acquired	Type	Address	Name	2039 15/9 hour			2039 1 hour		Trigger levels			Qualifies? (Airborne)	GBN LASmax	Trigger level	Qualifies? (GBN)	Future		
					Laeq(15h)	Laeq(9hr)	LAMax	LAeq(1hr)	LAeq(1hr)	Day Criteria	Night Criteria	Max Criteria					eVDV Day	eVDV Night	PPV
E098		Residential	15 Dorothy Street Rydalmere		47	42	57	48	46	60	50	80	No	13	35		0.001	0.000	0.001
E099		Residential	16 Dorothy Street Rydalmere		55	51	71	56	54	60	50	80	No	39	35		0.005	0.004	0.014
E100		Residential	17 Dorothy Street Rydalmere		41	36	55	42	39	60	50	80	No	12	35		0.000	0.000	0.001
E101		Residential	18 Dorothy Street Rydalmere		53	49	69	54	52	60	50	80	No	35	35		0.004	0.003	0.009
E102		Residential	19 Dorothy Street Rydalmere		41	36	56	42	39	60	50	80	No	14	35		0.001	0.000	0.001
E103		Residential	2 Dorothy Street Rydalmere		55	50	71	56	54	60	50	80	No	30	35		0.002	0.002	0.005
E104		Residential	20 Dorothy Street Rydalmere		54	50	70	55	53	60	50	80	No	36	35		0.004	0.003	0.011
E105		Residential	21 Dorothy Street Rydalmere		47	42	60	48	45	60	50	80	No	17	35		0.001	0.001	0.002
E106		Residential	22 Dorothy Street Rydalmere		55	50	71	55	53	60	50	80	No	38	35		0.005	0.003	0.012
E107		Residential	23 Dorothy Street Rydalmere		47	43	60	48	46	60	50	80	No	18	35		0.001	0.001	0.002
E108		Residential	24 Dorothy Street Rydalmere		55	50	72	56	53	60	50	80	No	39	35		0.005	0.004	0.014
E109		Residential	25 Dorothy Street Rydalmere		47	43	60	48	46	60	50	80	No	16	35		0.001	0.001	0.002
E110		Residential	26 Dorothy Street Rydalmere		55	50	72	55	53	60	50	80	No	38	35		0.005	0.003	0.013
E111		Residential	27 Dorothy Street Rydalmere		47	43	59	48	46	60	50	80	No	17	35		0.001	0.001	0.002
E112		Residential	28 Dorothy Street Rydalmere		55	50	72	56	53	60	50	80	No	39	35		0.005	0.004	0.014
E113		Residential	29 Dorothy Street Rydalmere		47	43	61	48	46	60	50	80	No	17	35		0.001	0.001	0.002
E114		Residential	3 Dorothy Street Rydalmere		43	38	57	44	41	60	50	80	No	11	35		0.000	0.000	0.001
E115		Residential	30 Dorothy Street Rydalmere		54	50	72	55	53	60	50	80	No	38	35		0.004	0.003	0.012
E116		Residential	4 Dorothy Street Rydalmere		57	52	74	58	55	60	50	80	No	35	35		0.004	0.003	0.009
E117		Residential	4 Dorothy Street Rydalmere		53	48	69	54	51	60	50	80	No	30	35		0.002	0.002	0.005
E118		Residential	5 Dorothy Street Rydalmere		43	38	57	43	41	60	50	80	No	10	35		0.000	0.000	0.001
E119		Residential	7 Dorothy Street Rydalmere		47	43	58	48	46	60	50	80	No	10	35		0.000	0.000	0.001
E120		Residential	8 Dorothy Street Rydalmere		54	50	70	55	53	60	50	80	No	31	35		0.003	0.002	0.006
E121		Residential	9 Dorothy Street Rydalmere		47	43	58	48	46	60	50	80	No	11	35		0.000	0.000	0.001
E142		Residential	10 Gladys Street Rydalmere		45	41	58	46	44	60	50	80	No	0	35		0.000	0.000	0.000
E145		Residential	12 Gladys Street Rydalmere		39	35	49	40	38	60	50	80	No	0	35		0.000	0.000	0.000
E147		Residential	14 Gladys Street Rydalmere		39	34	48	40	37	60	50	80	No	0	35		0.000	0.000	0.000
E149		Residential	16 Gladys Street Rydalmere		42	38	53	43	41	60	50	80	No	0	35		0.000	0.000	0.000
E151		Residential	18 Gladys Street Rydalmere		45	40	56	46	43	60	50	80	No	0	35		0.000	0.000	0.000
E152		Residential	2 Gladys Street Rydalmere		46	41	57	46	44	60	50	80	No	0	35		0.000	0.000	0.000
E153		Residential	20 Gladys Street Rydalmere		45	40	55	46	44	60	50	80	No	0	35		0.000	0.000	0.000
E154		Residential	22 Gladys Street Rydalmere		44	40	56	45	43	60	50	80	No	0	35		0.000	0.000	0.000
E155		Residential	24 Gladys Street Rydalmere		38	34	51	39	37	60	50	80	No	0	35		0.000	0.000	0.001
E156		Residential	24 Gladys Street Rydalmere		41	37	54	42	40	60	50	80	No	2	35		0.000	0.000	0.001
E157		Residential	28 Gladys Street Rydalmere		43	39	55	44	42	60	50	80	No	0	35		0.000	0.000	0.001
E159		Residential	30 Gladys Street Rydalmere		44	39	57	44	42	60	50	80	No	1	35		0.000	0.000	0.001
E160		Residential	30 Gladys Street Rydalmere		41	37	56	42	40	60	50	80	No	5	35		0.000	0.000	0.001
E161		Residential	4 Gladys Street Rydalmere		40	36	51	41	39	60	50	80	No	0	35		0.000	0.000	0.000
E163		Residential	6 Gladys Street Rydalmere		44	40	56	45	43	60	50	80	No	0	35		0.000	0.000	0.000
E165		Residential	8 Gladys Street Rydalmere		44	40	57	45	43	60	50	80	No	0	35		0.000	0.000	0.000
E173		Residential	15 John Street Rydalmere		48	43	62	48	46	60	50	80	No	9	35		0.000	0.000	0.001
E174		Residential	17 John Street Rydalmere		49	44	63	50	47	60	50	80	No	5	35		0.000	0.000	0.001
E175		Residential	19 John Street Rydalmere		46	41	59	46	44	60	50	80	No	2	35		0.000	0.000	0.001
E176		Residential	21 John Street Rydalmere		45	41	58	46	44	60	50	80	No	0	35		0.000	0.000	0.001
E184		Residential	28 John Street Rydalmere		41	36	54	42	39	60	50	80	No	0	35		0.000	0.000	0.000
E187		Residential	30 John Street Rydalmere		39	35	50	40	38	60	50	80	No	0	35		0.000	0.000	0.000
E189		Residential	32 John Street Rydalmere		38	33	47	38	36	60	50	80	No	0	35		0.000	0.000	0.000
E190		Residential	34 John Street Rydalmere		45	40	60	45	43	60	50	80	No	3	35		0.000	0.000	0.001
E192		Residential	36 John Street Rydalmere		47	43	62	48	46	60	50	80	No	8	35		0.000	0.000	0.001
E193		Residential	38 John Street Rydalmere		46	42	62	47	45	60	50	80	No	12	35		0.000	0.000	0.001
E194		Residential	40 John Street Rydalmere		49	45	65	50	48	60	50	80	No	18	35		0.001	0.001	0.002
E195		Residential	42 John Street Rydalmere		50	45	66	51	48	60	50	80	No	22	35		0.001	0.001	0.002
E196		Residential	44 John Street Rydalmere		50	45	67	51	49	60	50	80	No	27	35		0.002	0.001	0.004
E197		Residential	46 John Street Rydalmere		56	51	72	57	54	60	50	80	No	33	35		0.003	0.002	0.007
E199	TRUE	Industrial	52 John Street Rydalmere		67	62	86	67	65				No	46			0.012	0.009	0.028
E200	TRUE	Industrial	54 John Street Rydalmere		69	64	88	70	67				No	55			0.031	0.022	0.074
E201	TRUE	Industrial	60 John Street Rydalmere		58	53	77	59	57				No	45			0.010	0.007	0.027
E209		Residential	2 Milton Street Rydalmere		43	38	54	44	41	60	50	80	No	6	35		0.000	0.000	0.001
E213		Residential	4 Milton Street Rydalmere		43	38	55	44	42	60	50	80	No	2	35		0.000	0.000	0.001
E214		Residential	6 Milton Street Rydalmere		43	39	56	44	42	60	50	80	No	0	35		0.000	0.000	0.001
E260		Residential	102 South Street Rydalmere		55	51	72	56	54	60	50	80	No	38	35		0.005	0.004	0.011
E261		Residential	104 South Street Rydalmere		55	50	68	55	53	60	50	80	No	38	35	Yes	0.005	0.004	0.012
E262		Residential	104 South Street Rydalmere		55	50	69	55	53	60	50	80	No	37	35		0.005	0.003	0.011
E263		Residential	108 South Street Rydalmere		54	50	68	55	53	60	50	80	No	38	35		0.005	0.004	0.011
E264		Residential	110 South Street Rydalmere		56	51	71	56	54	60	50	80	No	40	35	Yes	0.006	0.005	0.014
E265		Residential	112 South Street Rydalmere		55	51	71	56	54	60	50	80	No	41	35	Yes	0.007	0.005	0.017
E266		Residential	114 South Street Rydalmere		56	51	72	56	54	60	50	80	No	42	35		0.008	0.006	0.018
E267		Residential	116 South Street Rydalmere		56	51	73	57	55	60	50	80	No	42	35		0.008	0.006	0.019
E268		Residential	116 South Street Rydalmere		56	52	74	57	55	60	50	80	No	43	35	Yes	0.009	0.006	0.021
E269		Residential	120 South Street Rydalmere		57	53	76	58	56	60	50	80	No	45	35	Yes	0.010	0.007	0.025
E270		Residential	122 South Street Rydalmere		56	51	74	57	55	60	50	80	No	44	35		0.009	0.006	0.022
E271		Residential	124 South Street Rydalmere		56	52	74	57	55	60	50	80	No	44	35	Yes	0.009	0.006	0.024
E293		Industrial	80 South Street Rydalmere		38	34	54	39	37				No	0			0.000	0.000	0.000
E294		Industrial	84 South Street Rydalmere		35	30	43	36	33				No	0			0.000	0.000	0.000
E295		Industrial	86 South Street Rydalmere		42	38	57	43	41				No	0			0.000	0.000	0.000
E296		Industrial	88 South Street Rydalmere		43	39	58	44	42				No	2			0.000	0.000	0.001
E297		Industrial	90 South Street Rydalmere		44	40	60	45	43				No	9			0.000	0.000	0.001
E298		Industrial	94 South Street Rydalmere		51	47	67	52	50				No	21			0.001	0.001	0.002

RID	Acquired	Type	Address	Name	2039 15/9 hour			2039 1 hour		Trigger levels			Qualifies? (Airborne)	GBN LASmax	Trigger level	Qualifies? (GBN)	Future		
					Laeq(15h)	Laeq(9hr)	LAMax	LAeq(1hr)	LAeq(1hr)	Day Criteria	Night Criteria	Max Criteria					eVDV Day	eVDV Night	PPV
E299	TRUE	Industrial	96 South Street Rydalmere		59	55	77	60	58				No	36			0.004	0.003	0.010
E300		Industrial	96 South Street Rydalmere		54	49	70	54	52				No	26			0.002	0.001	0.004
E301		Residential	98 South Street Rydalmere		58	53	75	59	56	60	50	80	No	39	35		0.006	0.004	0.012
E302		Residential	98 South Street Rydalmere		56	51	72	56	54	60	50	80	No	37	35		0.005	0.003	0.011
F002		Residential	101 Antoine Street Rydalmere		43	39	52	44	42	60	50	80	No	14	35		0.001	0.000	0.001
F003		Residential	103 Antoine Street Rydalmere		45	40	57	46	44	60	50	80	No	17	35		0.001	0.001	0.002
F004		Residential	105 Antoine Street Rydalmere		46	41	58	46	44	60	50	80	No	15	35		0.001	0.000	0.002
F005		Residential	107 Antoine Street Rydalmere		43	38	54	44	42	60	50	80	No	15	35		0.001	0.000	0.002
F006		Residential	109 Antoine Street Rydalmere		45	40	57	45	43	60	50	80	No	20	35		0.001	0.001	0.002
F007		Residential	111 Antoine Street Rydalmere		43	38	56	43	41	60	50	80	No	17	35		0.001	0.001	0.002
F008		Residential	113 Antoine Street Rydalmere		41	37	54	42	40	60	50	80	No	17	35		0.001	0.001	0.002
F009		Residential	115 Antoine Street Rydalmere		47	43	62	48	46	60	50	80	No	18	35		0.001	0.001	0.002
F010		Commercial	70 Antoine Street Rydalmere		43	39	55	44	42	60			No	0			0.000	0.000	0.001
F011		Commercial	72 Antoine Street Rydalmere		43	38	54	44	41	60			No	0			0.000	0.000	0.001
F012		Residential	74 Antoine Street Rydalmere		42	38	55	43	41	60	50	80	No	1	35		0.000	0.000	0.001
F013		Residential	76 Antoine Street Rydalmere		42	38	55	43	41	60	50	80	No	0	35		0.000	0.000	0.000
F014		Residential	76 Antoine Street Rydalmere		45	41	56	46	44	60	50	80	No	0	35		0.000	0.000	0.000
F015		Residential	79 Antoine Street Rydalmere		43	38	59	44	41	60	50	80	No	18	35		0.001	0.001	0.002
F016		Residential	79 Antoine Street Rydalmere		46	41	61	47	45	60	50	80	No	26	35		0.002	0.001	0.004
F017		Residential	80 Antoine Street Rydalmere		42	37	54	43	40	60	50	80	No	0	35		0.000	0.000	0.000
F018		Residential	82 Antoine Street Rydalmere		41	36	52	41	39	60	50	80	No	0	35		0.000	0.000	0.000
F019		Residential	83 Antoine Street Rydalmere		48	43	63	48	46	60	50	80	No	23	35		0.001	0.001	0.003
F020		Residential	84 Antoine Street Rydalmere		47	42	58	48	45	60	50	80	No	4	35		0.000	0.000	0.001
F021		Residential	85 Antoine Street Rydalmere		42	38	57	43	41	60	50	80	No	20	35		0.001	0.001	0.003
F022		Residential	87 Antoine Street Rydalmere		45	41	61	46	44	60	50	80	No	22	35		0.001	0.001	0.003
F023		Residential	89 Antoine Street Rydalmere		46	41	61	47	45	60	50	80	No	19	35		0.001	0.001	0.002
F024		Residential	91 Antoine Street Rydalmere		44	40	61	45	43	60	50	80	No	19	35		0.001	0.001	0.002
F025		Residential	93 Antoine Street Rydalmere		44	39	61	45	42	60	50	80	No	19	35		0.001	0.001	0.002
F026		Residential	95 Antoine Street Rydalmere		44	39	60	45	43	60	50	80	No	24	35		0.001	0.001	0.003
F027		Residential	95 Antoine Street Rydalmere		43	38	56	44	41	60	50	80	No	17	35		0.001	0.001	0.002
F028		Residential	97 Antoine Street Rydalmere		44	40	55	45	43	60	50	80	No	17	35		0.001	0.001	0.002
F029		Residential	99 Antoine Street Rydalmere		47	43	58	48	46	60	50	80	No	13	35		0.001	0.000	0.001
F030		Residential	31 Dorothy Street Rydalmere		48	43	63	49	47	60	50	80	No	18	35		0.001	0.001	0.002
F031		Residential	32 Dorothy Street Rydalmere		46	41	64	47	44	60	50	80	No	37	35	Yes	0.004	0.003	0.011
F032		Residential	32 Dorothy Street Rydalmere		42	37	59	43	40	60	50	80	No	34	35		0.003	0.002	0.009
F033		Residential	33 Dorothy Street Rydalmere		48	43	62	49	46	60	50	80	No	19	35		0.001	0.001	0.002
F034		Residential	35 Dorothy Street Rydalmere		46	42	58	47	45	60	50	80	No	18	35		0.001	0.001	0.002
F035		Residential	37 Dorothy Street Rydalmere		46	41	57	47	44	60	50	80	No	17	35		0.001	0.001	0.002
F036		Residential	39 Dorothy Street Rydalmere		42	37	53	42	40	60	50	80	No	17	35		0.001	0.001	0.002
F037		Residential	41 Dorothy Street Rydalmere		42	38	54	43	41	60	50	80	No	18	35		0.001	0.001	0.002
F038		Residential	43 Dorothy Street Rydalmere		46	42	58	47	45	60	50	80	No	18	35		0.001	0.001	0.002
F039		Residential	45 Dorothy Street Rydalmere		45	40	57	45	43	60	50	80	No	16	35		0.001	0.001	0.002
F040		Residential	47 Dorothy Street Rydalmere		44	40	56	45	43	60	50	80	No	17	35		0.001	0.001	0.002
F041		Residential	49 Dorothy Street Rydalmere		44	40	56	45	43	60	50	80	No	16	35		0.001	0.001	0.002
F042		Residential	51 Dorothy Street Rydalmere		47	42	58	47	45	60	50	80	No	17	35		0.001	0.001	0.002
F043		Residential	53 Dorothy Street Rydalmere		47	42	58	48	45	60	50	80	No	17	35		0.001	0.001	0.002
F044		Residential	55 Dorothy Street Rydalmere		45	40	55	46	43	60	50	80	No	16	35		0.001	0.000	0.002
F045		Residential	57 Dorothy Street Rydalmere		45	40	53	45	43	60	50	80	No	15	35		0.001	0.000	0.002
F046		Residential	59 Dorothy Street Rydalmere		47	42	56	47	45	60	50	80	No	13	35		0.001	0.000	0.001
F047		Residential	61 Dorothy Street Rydalmere		47	42	57	48	45	60	50	80	No	12	35		0.001	0.000	0.001
F048		Residential	63 Dorothy Street Rydalmere		45	40	56	45	43	60	50	80	No	9	35		0.000	0.000	0.001
F049		Residential	65 Dorothy Street Rydalmere		47	42	59	48	45	60	50	80	No	10	35		0.000	0.000	0.001
F050		Residential	67 Dorothy Street Rydalmere		43	39	57	44	42	60	50	80	No	14	35		0.001	0.000	0.001
F065		Residential	22 Fallon Street Rydalmere		44	39	60	44	42	60	50	80	No	5	35		0.000	0.000	0.001
F066		Residential	24 Fallon Street Rydalmere		47	42	62	48	45	60	50	80	No	10	35		0.000	0.000	0.001
F067		Residential	26 Fallon Street Rydalmere		45	41	61	46	44	60	50	80	No	17	35		0.001	0.001	0.002
F068		Residential	28 Fallon Street Rydalmere		47	43	63	48	46	60	50	80	No	24	35		0.001	0.001	0.003
F071		Residential	30 Fallon Street Rydalmere		52	48	68	53	51	60	50	80	No	29	35		0.002	0.002	0.006
F073		Residential	33 Fallon Street Rydalmere		45	41	59	46	44	60	50	80	No	0	35		0.000	0.000	0.001
F074		Residential	35 Fallon Street Rydalmere		44	40	59	45	43	60	50	80	No	2	35		0.000	0.000	0.001
F075		Residential	37 Fallon Street Rydalmere		45	41	62	46	44	60	50	80	No	8	35		0.000	0.000	0.001
F076		Residential	39 Fallon Street Rydalmere		48	43	63	49	46	60	50	80	No	14	35		0.001	0.000	0.002
F078		Residential	40 Fallon Street Rydalmere		44	40	56	45	43	60	50	80	No	3	35		0.000	0.000	0.001
F079		Residential	41 Fallon Street Rydalmere		46	42	64	47	45	60	50	80	No	21	35		0.001	0.001	0.003
F080		Residential	42 Fallon Street Rydalmere		42	38	54	43	41	60	50	80	No	0	35		0.000	0.000	0.001
F081		Residential	43 Fallon Street Rydalmere		53	49	70	54	52	60	50	80	No	27	35		0.002	0.001	0.005
F083		Residential	45 Fallon Street Rydalmere		51	47	69	52	50	60	50	80	No	38	35	Yes	0.005	0.003	0.013
F085		Residential	47 Fallon Street Rydalmere		56	51	74	57	54	60	50	80	No	45	35	Yes	0.010	0.007	0.026
F087	TRUE	Residential	49 Fallon Street Rydalmere		50	45	66	51	48	60	50	80	No	41	35		0.006	0.005	0.017
F091		Residential	53 Fallon Street Rydalmere		48	43	63	48	46	60	50	80	No	29	35		0.002	0.002	0.005
F094		Residential	55 Fallon Street Rydalmere		45	41	60	46	44	60	50	80	No	23	35		0.001	0.001	0.003
F095		Residential	57 Fallon Street Rydalmere		48	44	61	49	47	60	50	80	No	16	35		0.001	0.001	0.002
F098		Residential	59 Fallon Street Rydalmere		42	38	56	43	41	60	50	80	No	10	35		0.000	0.000	0.001
F101		Residential	61 Fallon Street Rydalmere		43	38	55	44	42	60	50	80	No	2	35		0.000	0.000	0.001
F103		Residential	63 Fallon Street Rydalmere		41	37	55	42	40	60	50	80	No	0	35		0.000	0.000	0.001
F151		Residential	32 Gladys Street Rydalmere		42	38	56	43	41	60	50	80	No	2	35		0.000	0.000	0.001
F153		Residential	34 Gladys Street Rydalmere		41	36	51	42	40	60	50	80	No	0	35		0.000	0.000	0.001
F155		Residential	36 Gladys Street Rydalmere		41	37	53	42	40	60	50	80	No	2	35		0.000	0.000	0.001



RID	Acquired	Type	Address	Name	2039 15/9 hour			2039 1 hour		Trigger levels			Qualifies? (Airborne)	GBN LASmax	Trigger level	Qualifies? (GBN)	Future		
					Laeq(15h)	Laeq(9hr)	LAMax	LAeq(1hr)	LAeq(1hr)	Day Criteria	Night Criteria	Max Criteria					eVDV Day	eVDV Night	PPV
F157		Residential	38 Gladys Street Rydalmere		41	37	52	42	40	60	50	80	No	1	35		0.000	0.000	0.001
F158		Residential	38 Gladys Street Rydalmere		41	36	51	41	39	60	50	80	No	0	35		0.000	0.000	0.001
F162		Residential	42 Gladys Street Rydalmere		41	37	51	42	40	60	50	80	No	1	35		0.000	0.000	0.001
F163		Residential	42 Gladys Street Rydalmere		44	39	55	44	42	60	50	80	No	0	35		0.000	0.000	0.001
F165		Residential	46 Gladys Street Rydalmere		43	39	54	44	42	60	50	80	No	0	35		0.000	0.000	0.001
F168		Residential	50 Gladys Street Rydalmere		44	40	54	45	43	60	50	80	No	3	35		0.000	0.000	0.001
F169		Residential	52 Gladys Street Rydalmere		39	34	49	40	37	60	50	80	No	0	35		0.000	0.000	0.001
F170		Residential	54 Gladys Street Rydalmere		43	38	54	44	42	60	50	80	No	0	35		0.000	0.000	0.001
F171		Residential	56 Gladys Street Rydalmere		44	40	54	45	43	60	50	80	No	1	35		0.000	0.000	0.001
F172		Residential	58 Gladys Street Rydalmere		45	40	54	45	43	60	50	80	No	0	35		0.000	0.000	0.001
F173		Residential	60 Gladys Street Rydalmere		44	39	54	45	42	60	50	80	No	0	35		0.000	0.000	0.000
F174		Residential	62 Gladys Street Rydalmere		42	37	54	43	40	60	50	80	No	0	35		0.000	0.000	0.000
F175		Residential	64 Gladys Street Rydalmere		42	38	54	43	41	60	50	80	No	0	35		0.000	0.000	0.000
F176		Residential	66 Gladys Street Rydalmere		44	40	55	45	43	60	50	80	No	0	35		0.000	0.000	0.000
F177		Residential	68 Gladys Street Rydalmere		44	40	56	45	43	60	50	80	No	0	35		0.000	0.000	0.000
F226		Residential	1 Milton Street Rydalmere		43	38	55	44	41	60	50	80	No	7	35		0.000	0.000	0.001
F227		Residential	1 Milton Street Rydalmere		42	37	52	43	40	60	50	80	No	5	35		0.000	0.000	0.001
F236		Residential	3 Milton Street Rydalmere		44	40	56	45	43	60	50	80	No	3	35		0.000	0.000	0.001
F237		Residential	5 Milton Street Rydalmere		41	37	54	42	40	60	50	80	No	0	35		0.000	0.000	0.001
F249		Residential	2 Nowill Street Rydalmere		42	37	56	43	40	60	50	80	No	6	35		0.000	0.000	0.001
F264		Residential	4 Nowill Street Rydalmere		42	38	55	43	41	60	50	80	No	3	35		0.000	0.000	0.001
F266		Residential	6 Nowill Street Rydalmere		42	37	55	42	40	60	50	80	No	0	35		0.000	0.000	0.001
F290		Residential	15 Primrose Avenue Rydalmere		42	38	57	43	41	60	50	80	No	7	35		0.000	0.000	0.001
F292		Residential	17 Primrose Avenue Rydalmere		44	39	58	45	42	60	50	80	No	11	35		0.000	0.000	0.001
F294		Residential	19 Primrose Avenue Rydalmere		45	40	60	45	43	60	50	80	No	17	35		0.001	0.001	0.002
F297		Residential	21 Primrose Avenue Rydalmere		46	41	62	47	44	60	50	80	No	23	35		0.001	0.001	0.003
F299		Residential	23 Primrose Avenue Rydalmere		49	44	66	50	47	60	50	80	No	30	35		0.002	0.002	0.006
F301		Residential	25 Primrose Avenue Rydalmere		49	45	65	50	48	60	50	80	No	34	35		0.003	0.002	0.008
F306		Residential	33 Primrose Avenue Rydalmere		47	42	58	47	45	60	50	80	No	4	35		0.000	0.000	0.001
F307		Residential	34 Primrose Avenue Rydalmere		41	36	54	42	39	60	50	80	No	0	35		0.000	0.000	0.001
F308		Residential	35 Primrose Avenue Rydalmere		41	37	55	42	40	60	50	80	No	0	35		0.000	0.000	0.001
F309		Residential	36 Primrose Avenue Rydalmere		44	40	58	45	43	60	50	80	No	5	35		0.000	0.000	0.001
F310		Residential	37 Primrose Avenue Rydalmere		44	40	56	45	43	60	50	80	No	0	35		0.000	0.000	0.001
F311		Residential	38 Primrose Avenue Rydalmere		42	38	57	43	41	60	50	80	No	12	35		0.001	0.000	0.001
F314		Residential	40 Primrose Avenue Rydalmere		48	43	62	49	46	60	50	80	No	18	35		0.001	0.001	0.002
F316		Residential	42 Primrose Avenue Rydalmere		53	48	69	53	51	60	50	80	No	35	35		0.004	0.003	0.009
F318		Residential	46 Primrose Avenue Rydalmere		49	44	65	49	47	60	50	80	No	30	35		0.002	0.002	0.005
F320		Residential	48 Primrose Avenue Rydalmere		52	47	65	52	50	60	50	80	No	24	35		0.001	0.001	0.003
F324		Residential	50 Primrose Avenue Rydalmere		46	41	57	46	44	60	50	80	No	5	35		0.000	0.000	0.001
F326		Residential	52 Primrose Avenue Rydalmere		43	38	55	43	41	60	50	80	No	0	35		0.000	0.000	0.001
F345		Residential	126 South Street Rydalmere		57	53	75	58	56	60	50	80	No	45	35	Yes	0.010	0.007	0.026
F346		Residential	128 South Street Rydalmere		58	53	76	58	56	60	50	80	No	46	35	Yes	0.011	0.008	0.029
F347		Residential	130 South Street Rydalmere		57	53	76	58	56	60	50	80	No	46	35	Yes	0.010	0.007	0.027
F348		Residential	130 South Street Rydalmere		57	52	75	58	56	60	50	80	No	45	35	Yes	0.010	0.007	0.026
F349		Residential	134 South Street Rydalmere		57	52	75	57	55	60	50	80	No	44	35	Yes	0.009	0.006	0.024
F350		Residential	136 South Street Rydalmere		56	51	74	57	54	60	50	80	No	44	35	Yes	0.008	0.006	0.023
F351		Residential	138 South Street Rydalmere		57	52	75	58	55	60	50	80	No	44	35	Yes	0.008	0.006	0.023
F352		Residential	140 South Street Rydalmere		57	53	76	58	56	60	50	80	No	45	35	Yes	0.010	0.007	0.026
F353		Residential	142 South Street Rydalmere		55	51	74	56	54	60	50	80	No	44	35	Yes	0.008	0.006	0.024
F354		Residential	144 South Street Rydalmere		55	50	73	55	53	60	50	80	No	43	35	Yes	0.008	0.005	0.021
F355		Residential	146 South Street Rydalmere		55	50	73	56	53	60	50	80	No	43	35	Yes	0.008	0.006	0.021
F356		Residential	148 South Street Rydalmere		54	50	71	55	53	60	50	80	No	42	35	Yes	0.007	0.005	0.019
F357		Residential	148 South Street Rydalmere		54	50	70	55	53	60	50	80	No	41	35	Yes	0.006	0.004	0.016
F358		Residential	152 South Street Rydalmere		54	49	68	55	53	60	50	80	No	38	35	Yes	0.005	0.004	0.011
F359		Residential	154 South Street Rydalmere		54	49	66	55	52	60	50	80	No	37	35	Yes	0.005	0.003	0.010
F360		Residential	156 South Street Rydalmere		54	50	68	55	53	60	50	80	No	38	35		0.005	0.004	0.012
F361		Residential	158 South Street Rydalmere		55	51	71	56	54	60	50	80	No	41	35	Yes	0.007	0.005	0.015
F362		Residential	160 South Street Rydalmere		55	51	71	56	54	60	50	80	No	41	35		0.007	0.005	0.015
F363		Residential	162 South Street Rydalmere		56	51	72	56	54	60	50	80	No	42	35	Yes	0.007	0.005	0.018
F364		Residential	164 South Street Rydalmere		56	52	73	57	55	60	50	80	No	43	35	Yes	0.008	0.006	0.021
F365		Residential	166 South Street Rydalmere		57	52	75	57	55	60	50	80	No	46	35	Yes	0.010	0.007	0.026
F366		Residential	168 South Street Rydalmere		58	54	76	59	57	60	50	80	No	46	35	Yes	0.010	0.008	0.027
F367		Residential	170 South Street Rydalmere		53	48	71	54	51	60	50	80	No	44	35	Yes	0.009	0.006	0.022
F368		Residential	61 South Street Rydalmere		58	54	77	59	57	60	50	80	No	46	35	Yes	0.010	0.007	0.028
F369		Residential	61 South Street Rydalmere		57	52	75	58	55	60	50	80	No	43	35	Yes	0.008	0.006	0.022
F370		Residential	61 South Street Rydalmere		53	49	71	54	52	60	50	80	No	36	35		0.004	0.003	0.010
F371		Residential	61 South Street Rydalmere		48	44	67	49	47	60	50	80	No	35	35		0.004	0.003	0.010
F372		Residential	61 South Street Rydalmere		46	41	62	47	44	60	50	80	No	36	35	Yes	0.004	0.003	0.011
F373		Residential	63 South Street Rydalmere		58	54	77	59	57	60	50	80	No	46	35	Yes	0.011	0.008	0.029
F374		Residential	65 South Street Rydalmere		58	54	78	59	57	60	50	80	No	48	35	Yes	0.012	0.009	0.033
F375		Residential	67 South Street Rydalmere		58	53	76	59	56	60	50	80	No	46	35	Yes	0.010	0.007	0.027
F376		Residential	69 South Street Rydalmere		58	53	76	59	56	60	50	80	No	45	35	Yes	0.010	0.007	0.026
F377		Residential	71 South Street Rydalmere		58	53	76	59	56	60	50	80	No	45	35	Yes	0.010	0.007	0.025
F378		Residential	73 South Street Rydalmere		57	53	75	58	56	60	50	80	No	44	35	Yes	0.010	0.007	0.023
F379		Residential	75 South Street Rydalmere		57	53	74	58	56	60	50	80	No	43	35		0.009	0.006	0.021
F380		Residential	77 South Street Rydalmere		56	52	73	57	55	60	50	80	No	42	35	Yes	0.008	0.006	0.019
F381		Residential	79 South Street Rydalmere		56	52	73	57	55	60	50	80	No	42	35	Yes	0.008	0.005	0.018
F382		Residential	81 South Street Rydalmere		56	51	73	56	54	60	50	80	No	41	35		0.007	0.005	0.016



RID	Acquired	Type	Address	Name	2039 15/9 hour			2039 1 hour		Trigger levels			Qualifies? (Airborne)	GBN LASmax	Trigger level	Qualifies? (GBN)	Future		
					Laeq(15h)	Laeq(9hr)	LAMax	LAeq(1hr)	LAeq(1hr)	Day Criteria	Night Criteria	Max Criteria					eVDV Day	eVDV Night	PPV
F383		Residential	83 South Street Rydalmere		55	51	71	56	54	60	50	80	No	40	35	Yes	0.007	0.005	0.015
F384		Residential	85 South Street Rydalmere		55	50	69	55	53	60	50	80	No	39	35		0.006	0.004	0.012
F385		Residential	85 South Street Rydalmere		52	47	65	53	50	60	50	80	No	35	35		0.004	0.003	0.008
F386		Residential	89 South Street Rydalmere		55	51	71	56	54	60	50	80	No	42	35	Yes	0.007	0.005	0.017
F387		Residential	91 South Street Rydalmere		56	51	72	57	54	60	50	80	No	43	35		0.008	0.005	0.019
F388		Residential	91 South Street Rydalmere		49	44	66	50	48	60	50	80	No	31	35		0.002	0.002	0.006
F389		Residential	93 South Street Rydalmere		58	53	76	58	56	60	50	80	No	46	35	Yes	0.011	0.008	0.029
F390		Residential	95 South Street Rydalmere		58	54	77	59	57	60	50	80	No	48	35	Yes	0.012	0.009	0.034
F391		Residential	97 South Street Rydalmere		57	53	76	58	56	60	50	80	No	45	35	Yes	0.009	0.007	0.026
F392		Residential	97 South Street Rydalmere		47	43	66	48	46	60	50	80	No	37	35	Yes	0.004	0.003	0.012
F393		Residential	99 South Street Rydalmere		58	53	76	59	57	60	50	80	No	46	35	Yes	0.010	0.007	0.028
F394		Residential	1 Sylvia Street Rydalmere		40	36	52	41	39	60	50	80	No	3	35		0.000	0.000	0.001
F418		Residential	3 Sylvia Street Rydalmere		41	36	53	41	39	60	50	80	No	0	35		0.000	0.000	0.001
H036		Residential	11 Coffey Street Ermington		42	38	56	43	41	60	50	80	No	0	35		0.000	0.000	0.000
H038		Residential	13 Coffey Street Ermington		41	37	55	42	40	60	50	80	No	0	35		0.000	0.000	0.000
H040		Residential	15 Coffey Street Ermington		37	33	49	38	36	60	50	80	No	0	35		0.000	0.000	0.001
H042		Residential	17 Coffey Street Ermington		40	35	53	41	39	60	50	80	No	2	35		0.000	0.000	0.001
H043		Residential	19 Coffey Street Ermington		38	33	48	38	36	60	50	80	No	0	35		0.000	0.000	0.001
H046		Residential	21 Coffey Street Ermington		40	35	54	40	38	60	50	80	No	0	35		0.000	0.000	0.000
H049		Residential	23 Coffey Street Ermington		40	35	53	40	38	60	50	80	No	0	35		0.000	0.000	0.000
H050		Residential	24 Coffey Street Ermington		44	39	58	45	42	60	50	80	No	2	35		0.000	0.000	0.001
H051		Residential	25 Coffey Street Ermington		40	36	54	41	39	60	50	80	No	0	35		0.000	0.000	0.000
H052		Residential	26 Coffey Street Ermington		43	38	58	44	42	60	50	80	No	5	35		0.000	0.000	0.001
H053		Residential	27 Coffey Street Ermington		39	35	53	40	38	60	50	80	No	0	35		0.000	0.000	0.000
H054		Residential	28 Coffey Street Ermington		45	41	60	46	44	60	50	80	No	9	35		0.000	0.000	0.001
H055		Residential	29 Coffey Street Ermington		48	44	63	49	47	60	50	80	No	22	35		0.001	0.001	0.003
H057		Residential	30 Coffey Street Ermington		48	43	61	48	46	60	50	80	No	13	35		0.001	0.000	0.001
H058		Residential	31 Coffey Street Ermington		47	42	61	48	46	60	50	80	No	23	35		0.001	0.001	0.003
H059		Residential	33 Coffey Street Ermington		52	47	67	52	50	60	50	80	No	31	35		0.002	0.002	0.006
H060		Residential	33 Coffey Street Ermington		54	50	71	55	53	60	50	80	No	39	35	Yes	0.005	0.004	0.014
H120		Residential	1 Heysen Avenue Ermington		44	40	59	45	43	60	50	80	No	7	35		0.000	0.000	0.001
H121		Residential	10 Heysen Avenue Ermington		55	50	72	56	54	60	50	80	No	33	35		0.003	0.002	0.007
H122		Residential	11 Heysen Avenue Ermington		43	38	57	43	41	60	50	80	No	13	35		0.001	0.000	0.001
H123		Residential	12 Heysen Avenue Ermington		56	51	73	56	54	60	50	80	No	36	35		0.004	0.003	0.009
H124		Residential	13 Heysen Avenue Ermington		42	38	55	43	41	60	50	80	No	13	35		0.001	0.000	0.001
H125		Residential	14 Heysen Avenue Ermington		56	52	73	57	55	60	50	80	No	38	35		0.005	0.004	0.011
H126		Residential	15 Heysen Avenue Ermington		42	38	54	43	41	60	50	80	No	14	35		0.001	0.000	0.001
H127		Residential	16 Heysen Avenue Ermington		54	50	69	55	53	60	50	80	No	36	35		0.004	0.003	0.009
H128		Residential	17 Heysen Avenue Ermington		43	39	55	44	42	60	50	80	No	14	35		0.001	0.000	0.001
H129		Residential	18 Heysen Avenue Ermington		54	49	70	54	52	60	50	80	No	37	35		0.005	0.003	0.011
H130		Residential	19 Heysen Avenue Ermington		44	39	56	45	42	60	50	80	No	16	35		0.001	0.001	0.002
H131		Residential	2 Heysen Avenue Ermington		52	48	68	53	51	60	50	80	No	27	35		0.002	0.001	0.004
H132		Residential	20 Heysen Avenue Ermington		56	51	73	57	55	60	50	80	No	39	35	Yes	0.005	0.004	0.013
H133		Residential	22 Heysen Avenue Ermington		56	52	73	57	55	60	50	80	No	41	35	Yes	0.007	0.005	0.016
H134		Residential	23 Heysen Avenue Ermington		43	39	55	44	42	60	50	80	No	10	35		0.000	0.000	0.001
H135		Residential	23 Heysen Avenue Ermington		45	40	58	46	43	60	50	80	No	15	35		0.001	0.000	0.002
H136		Residential	3 Heysen Avenue Ermington		43	39	58	44	42	60	50	80	No	9	35		0.000	0.000	0.001
H137		Residential	4 Heysen Avenue Ermington		53	48	69	54	51	60	50	80	No	29	35		0.002	0.001	0.005
H138		Residential	5 Heysen Avenue Ermington		41	36	57	42	39	60	50	80	No	11	35		0.000	0.000	0.001
H139		Residential	6 Heysen Avenue Ermington		56	51	73	57	54	60	50	80	No	34	35		0.004	0.003	0.008
H140		Residential	7 Heysen Avenue Ermington		43	39	59	44	42	60	50	80	No	14	35		0.001	0.000	0.001
H141		Residential	8 Heysen Avenue Ermington		56	52	73	57	55	60	50	80	No	36	35		0.004	0.003	0.009
H142		Residential	9 Heysen Avenue Ermington		44	39	59	45	42	60	50	80	No	13	35		0.001	0.000	0.001
H159		Residential	23 Hilder Road Ermington		43	39	56	44	42	60	50	80	No	0	35		0.000	0.000	0.000
H162		Residential	25 Hilder Road Ermington		42	38	54	43	41	60	50	80	No	2	35		0.000	0.000	0.001
H164		Residential	27 Hilder Road Ermington		43	39	56	44	42	60	50	80	No	5	35		0.000	0.000	0.001
H165		Residential	28 Hilder Road Ermington		49	44	64	50	47	60	50	80	No	25	35		0.001	0.001	0.003
H166		Residential	28 Hilder Road Ermington		53	49	70	54	52	60	50	80	No	33	35		0.003	0.002	0.007
H167		Residential	28 Hilder Road Ermington		47	43	63	48	46	60	50	80	No	21	35		0.001	0.001	0.002
H168		Residential	28 Hilder Road Ermington		43	38	59	44	41	60	50	80	No	0	35		0.000	0.000	0.000
H169		Residential	29 Hilder Road Ermington		43	38	55	44	41	60	50	80	No	11	35		0.000	0.000	0.001
H170	TRUE	Residential	30 Hilder Road Ermington		65	60	83	65	63	60	50	80	No	56	35		0.033	0.023	0.076
H171	TRUE	Residential	30 Hilder Road Ermington		60	55	77	60	58	60	50	80	No	51	35		0.018	0.013	0.043
H173		Residential	31 Hilder Road Ermington		46	42	60	47	45	60	50	80	No	15	35		0.001	0.000	0.001
H174	TRUE	Residential	32 Hilder Road Ermington		55	51	69	56	54	60	50	80	No	42	35		0.007	0.005	0.017
H175		Residential	33 Hilder Road Ermington		53	49	69	54	52	60	50	80	No	29	35		0.002	0.002	0.005
H176		Residential	33 Hilder Road Ermington		51	47	67	52	50	60	50	80	No	25	35		0.002	0.001	0.003
H177		Residential	34 Hilder Road Ermington		54	49	69	55	52	60	50	80	No	32	35		0.003	0.002	0.006
H178		Residential	34 Hilder Road Ermington		50	46	67	51	49	60	50	80	No	28	35		0.002	0.001	0.004
H179		Residential	35 Hilder Road Ermington		45	40	62	45	43	60	50	80	No	18	35		0.001	0.001	0.002
H180		Residential	36 Hilder Road Ermington		49	45	65	50	48	60	50	80	No	25	35		0.001	0.001	0.003
H181		Residential	37 Hilder Road Ermington		43	39	57	44	42	60	50	80	No	4	35		0.000	0.000	0.001
H182		Residential	38 Hilder Road Ermington		47	42	62	48	45	60	50	80	No	16	35		0.001	0.000	0.001
H183		Residential	38 Hilder Road Ermington		44	40	59	45	43	60	50	80	No	10	35		0.000	0.000	0.001
H184		Residential	42 Hilder Road Ermington		41	37	56	42	40	60	50	80	No	5	35		0.000	0.000	0.001
H185		Residential	44 Hilder Road Ermington		44	39	58	45	42	60	50	80	No	0	35		0.000	0.000	0.000
H186		Residential	46 Hilder Road Ermington		38	34	52	39	37	60	50	80	No	0	35		0.000	0.000	0.000
H235		Residential	10 Lindsay Avenue Ermington		42	37	57	43	40	60	50	80	No	0	35		0.000	0.000	0.000

RID	Acquired	Type	Address	Name	2039 15/9 hour			2039 1 hour		Trigger levels			Qualifies? (Airborne)	GBN LASmax	Trigger level	Qualifies? (GBN)	Future		
					Laeq(15h)	Laeq(9hr)	LAMax	LAeq(1hr)	LAeq(1hr)	Day Criteria	Night Criteria	Max Criteria					eVDV Day	eVDV Night	PPV
H237		Residential	12 Lindsay Avenue Ermington		34	30	44	35	33	60	50	80	No	0	35		0.000	0.000	0.000
H239		Residential	14 Lindsay Avenue Ermington		39	34	52	40	37	60	50	80	No	0	35		0.000	0.000	0.000
H241		Residential	16 Lindsay Avenue Ermington		40	36	54	41	39	60	50	80	No	0	35		0.000	0.000	0.000
H243		Residential	18 Lindsay Avenue Ermington		40	35	53	40	38	60	50	80	No	0	35		0.000	0.000	0.000
H246		Residential	20 Lindsay Avenue Ermington		39	34	52	39	37	60	50	80	No	0	35		0.000	0.000	0.000
H248		Residential	22 Lindsay Avenue Ermington		35	31	49	36	34	60	50	80	No	0	35		0.000	0.000	0.000
H250		Residential	24 Lindsay Avenue Ermington		35	30	49	35	33	60	50	80	No	0	35		0.000	0.000	0.000
H252		Residential	26 Lindsay Avenue Ermington		38	34	51	39	37	60	50	80	No	0	35		0.000	0.000	0.000
H254		Residential	28 Lindsay Avenue Ermington		34	29	45	35	32	60	50	80	No	0	35		0.000	0.000	0.000
H257		Residential	30 Lindsay Avenue Ermington		37	32	49	38	35	60	50	80	No	2	35		0.000	0.000	0.001
H259		Residential	32 Lindsay Avenue Ermington		37	32	48	38	36	60	50	80	No	1	35		0.000	0.000	0.001
H261		Residential	34 Lindsay Avenue Ermington		44	39	56	45	42	60	50	80	No	4	35		0.000	0.000	0.001
H269		Residential	8 Lindsay Avenue Ermington		43	39	58	44	42	60	50	80	No	0	35		0.000	0.000	0.000
H276		Residential	2 Lister Avenue Ermington		46	42	62	47	45	60	50	80	No	21	35		0.001	0.001	0.003
H277		Residential	2 Lister Avenue Ermington		46	42	61	47	45	60	50	80	No	21	35		0.001	0.001	0.003
H281		Residential	27 Lister Avenue Ermington		44	40	58	45	43	60	50	80	No	0	35		0.000	0.000	0.001
H282		Residential	29 Lister Avenue Ermington		48	43	62	49	46	60	50	80	No	6	35		0.000	0.000	0.001
H283		Residential	31 Lister Avenue Ermington		48	44	63	49	47	60	50	80	No	7	35		0.000	0.000	0.001
H284		Residential	33 Lister Avenue Ermington		48	43	63	49	47	60	50	80	No	7	35		0.000	0.000	0.001
H285		Residential	6 Lister Avenue Ermington		47	43	63	48	46	60	50	80	No	20	35		0.001	0.001	0.003
H343		Residential	22 River Road Ermington		40	36	55	41	39	60	50	80	No	0	35		0.000	0.000	0.001
H345		Residential	24 River Road Ermington		46	41	60	46	44	60	50	80	No	4	35		0.000	0.000	0.001
H347		Residential	26 River Road Ermington		50	45	65	51	48	60	50	80	No	18	35		0.001	0.001	0.002
H348		Residential	27 River Road Ermington		44	40	57	45	43	60	50	80	No	1	35		0.000	0.000	0.001
H349		Residential	28 River Road Ermington		49	45	65	50	48	60	50	80	No	25	35		0.001	0.001	0.004
H350		Residential	29 River Road Ermington		48	43	62	48	46	60	50	80	No	6	35		0.000	0.000	0.001
H351		Residential	30 River Road Ermington		51	47	70	52	50	60	50	80	No	35	35		0.004	0.003	0.010
H352		Residential	32 River Road Ermington		58	53	76	59	56	60	50	80	No	44	35	Yes	0.009	0.006	0.024
H353		Residential	33 River Road Ermington		58	53	76	59	56	60	50	80	No	47	35	Yes	0.012	0.008	0.030
H354		Residential	34 River Road Ermington		48	44	66	49	47	60	50	80	No	33	35		0.003	0.002	0.008
H355		Residential	34 River Road Ermington		45	41	61	46	44	60	50	80	No	32	35		0.003	0.002	0.007
H356	TRUE	Residential	35 River Road Ermington		59	55	79	60	58	60	50	80	No	51	35		0.018	0.013	0.047
H357		Residential	36 River Road Ermington		46	41	63	46	44	60	50	80	No	26	35		0.002	0.001	0.004
H358		Residential	36 River Road Ermington		45	41	60	46	44	60	50	80	No	24	35		0.001	0.001	0.003
H359		Residential	37 River Road Ermington		55	50	72	56	53	60	50	80	No	41	35	Yes	0.007	0.005	0.017
H360		Educational institute	38 River Road Ermington	Future Starts Early Learning Centre	46	42	61	47	45	50			No	14	40		0.001	0.001	0.002
H361		Residential	38 River Road Ermington		44	40	59	45	43	60	50	80	No	15	35		0.001	0.000	0.002
H362		Residential	39 River Road Ermington		52	47	67	52	50	60	50	80	No	36	35	Yes	0.004	0.003	0.010
H363		Residential	40 River Road Ermington		43	38	57	43	41	60	50	80	No	10	35		0.000	0.000	0.001
H364		Residential	41 River Road Ermington		47	42	64	48	45	60	50	80	No	26	35		0.002	0.001	0.004
H365		Residential	41 River Road Ermington		49	44	64	50	48	60	50	80	No	27	35		0.002	0.001	0.004
H366		Residential	43 River Road Ermington		45	41	61	46	44	60	50	80	No	19	35		0.001	0.001	0.002
H367		Residential	44 River Road Ermington		43	38	57	44	42	60	50	80	No	2	35		0.000	0.000	0.001
H368		Residential	45 River Road Ermington		44	40	59	45	43	60	50	80	No	13	35		0.001	0.000	0.001
H369		Residential	46 River Road Ermington		43	39	57	44	42	60	50	80	No	0	35		0.000	0.000	0.001
H370		Residential	47 River Road Ermington		43	39	57	44	42	60	50	80	No	3	35		0.000	0.000	0.001
H377		Residential	49 River Road Ermington		42	38	55	43	41	60	50	80	No	0	35		0.000	0.000	0.000
H464		Residential	101 South Street Ermington		54	49	71	55	52	60	50	80	No	44	35	Yes	0.009	0.006	0.023
H465		Residential	101 South Street Ermington		46	42	64	47	45	60	50	80	No	35	35		0.003	0.002	0.009
H466		Residential	103 South Street Ermington		56	51	73	57	54	60	50	80	No	44	35	Yes	0.009	0.006	0.023
H467		Residential	105 South Street Ermington		55	50	73	56	54	60	50	80	No	47	35	Yes	0.011	0.008	0.030
H468		Residential	105 South Street Ermington		49	45	67	50	48	60	50	80	No	36	35		0.004	0.003	0.010
H469	TRUE	Residential	172 South Street Ermington		52	47	69	53	50	60	50	80	No	44	35		0.009	0.006	0.023
H470		Residential	174 South Street Ermington		59	55	79	60	58	60	50	80	No	48	35	Yes	0.013	0.009	0.035
H471		Residential	176 South Street Ermington		56	51	74	57	54	60	50	80	No	44	35	Yes	0.008	0.006	0.022
H472		Residential	178 South Street Ermington		58	54	77	59	57	60	50	80	No	48	35	Yes	0.013	0.009	0.035
H484		Residential	1 Tristram Street Ermington		56	51	73	56	54	60	50	80	No	39	35		0.005	0.004	0.013
H485		Residential	10 Tristram Street Ermington		47	43	60	48	46	60	50	80	No	4	35		0.000	0.000	0.001
H486		Residential	11 Tristram Street Ermington		56	52	74	57	55	60	50	80	No	36	35		0.004	0.003	0.010
H487		Residential	12 Tristram Street Ermington		48	44	61	49	47	60	50	80	No	10	35		0.000	0.000	0.001
H488		Residential	13 Tristram Street Ermington		59	54	77	59	57	60	50	80	No	40	35		0.006	0.004	0.014
H489		Residential	14 Tristram Street Ermington		48	44	63	49	47	60	50	80	No	13	35		0.001	0.000	0.001
H490		Residential	15 Tristram Street Ermington		58	53	76	59	56	60	50	80	No	38	35		0.005	0.004	0.011
H491		Residential	16 Tristram Street Ermington		48	44	63	49	47	60	50	80	No	17	35		0.001	0.001	0.002
H492		Residential	17 Tristram Street Ermington		61	56	80	62	60	60	50	80	No	44	35	Yes	0.009	0.006	0.021
H493		Residential	18 Tristram Street Ermington		47	42	60	48	46	60	50	80	No	18	35		0.001	0.001	0.002
H494		Residential	2 Tristram Street Ermington		45	41	59	46	44	60	50	80	No	0	35		0.000	0.000	0.001
H495		Residential	20 Tristram Street Ermington		45	41	58	46	44	60	50	80	No	19	35		0.001	0.001	0.002
H496		Residential	22 Tristram Street Ermington		45	41	57	46	44	60	50	80	No	17	35		0.001	0.001	0.002
H497		Residential	24 Tristram Street Ermington		45	40	55	45	43	60	50	80	No	16	35		0.001	0.000	0.002
H498		Residential	26 Tristram Street Ermington		44	39	56	44	42	60	50	80	No	16	35		0.001	0.000	0.002
H499		Residential	28 Tristram Street Ermington		43	38	55	44	42	60	50	80	No	16	35		0.001	0.000	0.001
H500		Residential	3 Tristram Street Ermington		59	55	79	60	58	60	50	80	No	48	35		0.013	0.009	0.032
H501		Residential	4 Tristram Street Ermington		46	42	60	47	45	60	50	80	No	0	35		0.000	0.000	0.001
H502		Residential	5 Tristram Street Ermington		57	53	74	58	56	60	50	80	No	43	35	Yes	0.008	0.006	0.021
H503		Residential	6 Tristram Street Ermington		47	42	60	47	45	60	50	80	No	1	35		0.000	0.000	0.001
H504		Residential	8 Tristram Street Ermington		46	42	59	47	45	60	50	80	No	2	35		0.000	0.000	0.001
H505		Residential	9 Tristram Street Ermington		56	52	72	57	55	60	50	80	No	38	35		0.005	0.004	0.012



RID	Acquired	Type	Address	Name	2039 15/9 hour			2039 1 hour		Trigger levels			Qualifies? (Airborne)	GBN LASmax	Trigger level	Qualifies? (GBN)	Future		
					Laeq(15h)	Laeq(9hr)	LAMax	LAeq(1hr)	LAeq(1hr)	Day Criteria	Night Criteria	Max Criteria					eVDV Day	eVDV Night	PPV
H506		Residential	9 Tristram Street Ermington		56	51	73	57	55	60	50	80	No	37	35		0.005	0.003	0.011
I013		Residential	30 Atkins Road Ermington		48	43	62	48	46	60	50	80	No	23	35		0.001	0.001	0.003
I014		Residential	32 Atkins Road Ermington		50	46	65	51	49	60	50	80	No	28	35		0.002	0.002	0.005
I052		Residential	1 Boronia Street Ermington		57	53	76	58	56	60	50	80	No	46	35	Yes	0.010	0.007	0.027
I053		Residential	1 Boronia Street Ermington		57	52	74	57	55	60	50	80	No	43	35	Yes	0.008	0.006	0.021
I054		Residential	10 Boronia Street Ermington		57	52	75	57	55	60	50	80	No	47	35	Yes	0.011	0.008	0.030
I055		Residential	11 Boronia Street Ermington		56	52	74	57	55	60	50	80	No	43	35	Yes	0.008	0.005	0.020
I056		Residential	12 Boronia Street Ermington		57	52	75	57	55	60	50	80	No	46	35	Yes	0.010	0.007	0.028
I057		Residential	13 Boronia Street Ermington		54	50	72	55	53	60	50	80	No	42	35		0.007	0.005	0.019
I058		Residential	14 Boronia Street Ermington		57	53	76	58	56	60	50	80	No	47	35	Yes	0.011	0.008	0.030
I059		Residential	15 Boronia Street Ermington		55	50	73	56	53	60	50	80	No	42	35		0.007	0.005	0.018
I060		Residential	15 Boronia Street Ermington		47	42	62	48	45	60	50	80	No	26	35		0.002	0.001	0.004
I061		Residential	16 Boronia Street Ermington		56	52	76	57	55	60	50	80	No	46	35	Yes	0.010	0.007	0.028
I062		Residential	17 Boronia Street Ermington		56	52	74	57	55	60	50	80	No	41	35		0.007	0.005	0.017
I063		Residential	18 Boronia Street Ermington		56	52	75	57	55	60	50	80	No	46	35	Yes	0.010	0.007	0.027
I064		Residential	19 Boronia Street Ermington		56	51	74	56	54	60	50	80	No	41	35		0.007	0.005	0.018
I065		Residential	2 Boronia Street Ermington		59	54	77	59	57	60	50	80	No	48	35	Yes	0.012	0.009	0.033
I066		Residential	2 Boronia Street Ermington		56	52	74	57	55	60	50	80	No	46	35	Yes	0.011	0.008	0.029
I067		Residential	20 Boronia Street Ermington		56	52	75	57	55	60	50	80	No	45	35	Yes	0.009	0.007	0.025
I068		Residential	21 Boronia Street Ermington		55	51	73	56	54	60	50	80	No	41	35	Yes	0.007	0.005	0.018
I069		Residential	22 Boronia Street Ermington		56	52	75	57	55	60	50	80	No	45	35	Yes	0.009	0.007	0.026
I070		Residential	23 Boronia Street Ermington		56	52	74	57	55	60	50	80	No	42	35	Yes	0.007	0.005	0.018
I071		Residential	23 Boronia Street Ermington		55	51	73	56	54	60	50	80	No	41	35	Yes	0.007	0.005	0.017
I072		Residential	24 Boronia Street Ermington		57	52	75	58	55	60	50	80	No	46	35	Yes	0.010	0.007	0.028
I073		Residential	24 Boronia Street Ermington		45	41	64	46	44	60	50	80	No	37	35	Yes	0.004	0.003	0.012
I074		Residential	25 Boronia Street Ermington		41	37	56	42	40	60	50	80	No	27	35		0.002	0.001	0.005
I075		Residential	25 Boronia Street Ermington		56	51	73	56	54	60	50	80	No	42	35	Yes	0.007	0.005	0.018
I076		Residential	26 Boronia Street Ermington		56	51	74	57	54	60	50	80	No	44	35	Yes	0.008	0.006	0.023
I077		Residential	28 Boronia Street Ermington		56	52	74	57	55	60	50	80	No	45	35	Yes	0.009	0.006	0.024
I078		Residential	29 Boronia Street Ermington		56	51	73	57	54	60	50	80	No	41	35		0.007	0.005	0.016
I079		Residential	3 Boronia Street Ermington		52	47	69	52	50	60	50	80	No	40	35	Yes	0.006	0.004	0.015
I080		Residential	3 Boronia Street Ermington		40	35	55	41	38	60	50	80	No	30	35		0.002	0.002	0.006
I081		Residential	30 Boronia Street Ermington		57	52	75	58	55	60	50	80	No	46	35	Yes	0.010	0.007	0.028
I082		Residential	31 Boronia Street Ermington		56	51	73	56	54	60	50	80	No	41	35		0.007	0.005	0.017
I083		Residential	32 Boronia Street Ermington		54	50	71	55	53	60	50	80	No	41	35	Yes	0.006	0.004	0.016
I084		Residential	33 Boronia Street Ermington		56	52	73	57	55	60	50	80	No	42	35	Yes	0.008	0.006	0.019
I085		Residential	34 Boronia Street Ermington		55	50	71	56	53	60	50	80	No	42	35	Yes	0.007	0.005	0.018
I086		Residential	35 Boronia Street Ermington		56	51	73	56	54	60	50	80	No	41	35	Yes	0.007	0.005	0.017
I087		Residential	36 Boronia Street Ermington		54	50	70	55	53	60	50	80	No	40	35	Yes	0.006	0.004	0.015
I088		Residential	37 Boronia Street Ermington		53	48	70	54	52	60	50	80	No	37	35		0.005	0.003	0.011
I089		Residential	38 Boronia Street Ermington		55	50	68	56	54	60	50	80	No	39	35	Yes	0.005	0.004	0.012
I090		Residential	39 Boronia Street Ermington		54	50	70	55	53	60	50	80	No	39	35		0.006	0.004	0.013
I091		Residential	4 Boronia Street Ermington		58	53	76	58	56	60	50	80	No	46	35	Yes	0.010	0.007	0.027
I092	TRUE	Residential	40 Boronia Street Ermington		56	52	72	57	55	60	50	80	No	41	35		0.008	0.006	0.016
I093		Residential	41 Boronia Street Ermington		54	49	69	54	52	60	50	80	No	37	35		0.005	0.004	0.011
I094		Residential	41 Boronia Street Ermington		53	48	67	54	52	60	50	80	No	36	35		0.004	0.003	0.009
I095		Residential	42 Boronia Street Ermington		55	51	72	56	54	60	50	80	No	39	35	Yes	0.006	0.004	0.014
I096		Residential	44 Boronia Street Ermington		55	50	72	56	54	60	50	80	No	39	35	Yes	0.006	0.004	0.014
I097		Residential	45 Boronia Street Ermington		53	49	67	54	52	60	50	80	No	36	35		0.004	0.003	0.009
I098		Residential	46 Boronia Street Ermington		56	51	74	57	55	60	50	80	No	42	35		0.007	0.005	0.018
I099		Commercial	47 Boronia Street Ermington	Cafe 4TY7 Ermington	56	51	73	57	54	60			No	38			0.005	0.003	0.012
I100		Residential	48 Boronia Street Ermington		56	52	73	57	55	60	50	80	No	42	35		0.007	0.005	0.019
I101		Residential	49 Boronia Street Ermington		56	52	74	57	55	60	50	80	No	43	35	Yes	0.008	0.006	0.020
I102		Residential	5 Boronia Street Ermington		55	50	72	56	54	60	50	80	No	45	35	Yes	0.010	0.007	0.026
I103		Residential	50 Boronia Street Ermington		56	52	74	57	55	60	50	80	No	43	35	Yes	0.008	0.006	0.021
I104		Residential	51 Boronia Street Ermington		57	52	75	58	55	60	50	80	No	43	35	Yes	0.008	0.005	0.020
I105		Residential	52 Boronia Street Ermington		57	53	76	58	56	60	50	80	No	45	35	Yes	0.010	0.007	0.025
I106		Residential	53 Boronia Street Ermington		57	53	76	58	56	60	50	80	No	43	35	Yes	0.008	0.006	0.021
I107		Residential	54 Boronia Street Ermington		57	52	74	57	55	60	50	80	No	44	35	Yes	0.008	0.006	0.022
I108		Residential	55 Boronia Street Ermington		56	52	75	57	55	60	50	80	No	41	35		0.007	0.005	0.017
I109		Residential	56 Boronia Street Ermington		57	53	75	58	56	60	50	80	No	45	35	Yes	0.010	0.007	0.026
I110		Residential	57 Boronia Street Ermington		57	52	75	57	55	60	50	80	No	42	35	Yes	0.007	0.005	0.018
I111		Residential	58 Boronia Street Ermington		57	53	75	58	56	60	50	80	No	44	35	Yes	0.009	0.006	0.023
I112		Residential	59 Boronia Street Ermington		56	52	74	57	55	60	50	80	No	42	35	Yes	0.007	0.005	0.018
I113		Residential	6 Boronia Street Ermington		58	54	77	59	57	60	50	80	No	47	35	Yes	0.012	0.008	0.032
I114		Residential	61 Boronia Street Ermington		56	51	72	57	55	60	50	80	No	40	35		0.006	0.004	0.016
I115		Residential	62 Boronia Street Ermington		57	52	74	57	55	60	50	80	No	43	35		0.007	0.005	0.020
I116		Residential	63 Boronia Street Ermington		56	52	73	57	55	60	50	80	No	42	35	Yes	0.007	0.005	0.019
I117		Residential	64 Boronia Street Ermington		57	53	74	58	56	60	50	80	No	44	35	Yes	0.009	0.006	0.023
I118		Residential	65 Boronia Street Ermington		57	52	74	57	55	60	50	80	No	43	35	Yes	0.008	0.006	0.021
I119		Residential	66 Boronia Street Ermington		57	52	74	58	56	60	50	80	No	43	35	Yes	0.008	0.006	0.022
I120		Residential	67 Boronia Street Ermington		56	51	73	57	54	60	50	80	No	42	35	Yes	0.007	0.005	0.018
I121		Residential	69 Boronia Street Ermington		57	52	74	57	55	60	50	80	No	43	35	Yes	0.008	0.006	0.021
I122		Residential	7 Boronia Street Ermington		55	50	72	56	53	60	50	80	No	45	35	Yes	0.010	0.007	0.026
I123		Residential	7 Boronia Street Ermington		46	42	61	47	45	60	50	80	No	32	35		0.003	0.002	0.007
I124		Residential	71 Boronia Street Ermington		57	52	74	57	55	60	50	80	No	43	35	Yes	0.008	0.006	0.021
I125		Residential	73 Boronia Street Ermington		57	52	74	57	55	60	50	80	No	43	35	Yes	0.008	0.005	0.020
I126		Residential	75 Boronia Street Ermington		57	52	74	57	55	60	50	80	No	43	35	Yes	0.008	0.006	0.022

RID	Acquired	Type	Address	Name	2039 15/9 hour			2039 1 hour		Trigger levels			Qualifies? (Airborne)	GBN LASmax	Trigger level	Qualifies? (GBN)	Future		
					Laeq(15h)	Laeq(9hr)	LAMax	LAeq(1hr)	LAeq(1hr)	Day Criteria	Night Criteria	Max Criteria					eVDV Day	eVDV Night	PPV
I127		Residential	75 Boronia Street Ermington		56	51	73	57	54	60	50	80	No	39	35	Yes	0.006	0.004	0.014
I128		Residential	79 Boronia Street Ermington		57	52	74	58	55	60	50	80	No	41	35		0.007	0.005	0.016
I129		Residential	8 Boronia Street Ermington		56	52	74	57	55	60	50	80	No	47	35	Yes	0.011	0.008	0.030
I130		Residential	81 Boronia Street Ermington		57	53	75	58	56	60	50	80	No	42	35		0.008	0.005	0.018
I131		Residential	83 Boronia Street Ermington		56	51	73	57	54	60	50	80	No	39	35		0.006	0.004	0.013
I132		Residential	9 Boronia Street Ermington		42	37	57	42	40	60	50	80	No	33	35		0.003	0.002	0.008
I133		Residential	1 Boyle Street Ermington		46	42	65	47	45	60	50	80	No	33	35		0.003	0.002	0.008
I134		Residential	10 Boyle Street Ermington		40	35	51	40	38	60	50	80	No	2	35		0.000	0.000	0.001
I135		Residential	11 Boyle Street Ermington		42	37	55	43	40	60	50	80	No	3	35		0.000	0.000	0.001
I136		Residential	13 Boyle Street Ermington		39	35	53	40	38	60	50	80	No	0	35		0.000	0.000	0.001
I137		Residential	13 Boyle Street Ermington		41	37	53	42	40	60	50	80	No	0	35		0.000	0.000	0.001
I138		Residential	15 Boyle Street Ermington		40	35	54	40	38	60	50	80	No	0	35		0.000	0.000	0.000
I139		Residential	16 Boyle Street Ermington		39	35	52	40	38	60	50	80	No	0	35		0.000	0.000	0.001
I143		Residential	2 Boyle Street Ermington		44	40	58	45	43	60	50	80	No	27	35		0.002	0.001	0.004
I144		Residential	2 Boyle Street Ermington		47	42	61	48	45	60	50	80	No	26	35		0.002	0.001	0.004
I157		Residential	3 Boyle Street Ermington		48	43	63	48	46	60	50	80	No	26	35		0.002	0.001	0.004
I158		Residential	4 Boyle Street Ermington		43	38	58	43	41	60	50	80	No	19	35		0.001	0.001	0.002
I159		Residential	5 Boyle Street Ermington		44	39	60	45	42	60	50	80	No	21	35		0.001	0.001	0.003
I160		Residential	6 Boyle Street Ermington		43	39	57	44	42	60	50	80	No	13	35		0.001	0.000	0.001
I161		Residential	8 Boyle Street Ermington		44	39	55	45	42	60	50	80	No	7	35		0.000	0.000	0.001
I162		Residential	9 Boyle Street Ermington		41	36	56	42	39	60	50	80	No	10	35		0.000	0.000	0.001
I163		Residential	9 Boyle Street Ermington		41	37	55	42	40	60	50	80	No	7	35		0.000	0.000	0.001
I164		Residential	9 Boyle Street Ermington		40	36	56	41	39	60	50	80	No	14	35		0.001	0.000	0.001
I168		Residential	17 Broadoaks Street Ermington		44	39	56	44	42	60	50	80	No	0	35		0.000	0.000	0.001
I169		Residential	19 Broadoaks Street Ermington		44	40	57	45	43	60	50	80	No	2	35		0.000	0.000	0.001
I170		Residential	21 Broadoaks Street Ermington		47	42	61	48	46	60	50	80	No	8	35		0.000	0.000	0.001
I171		Residential	23 Broadoaks Street Ermington		44	39	58	44	42	60	50	80	No	14	35		0.001	0.000	0.002
I172		Residential	23 Broadoaks Street Ermington		45	40	57	45	43	60	50	80	No	17	35		0.001	0.001	0.002
I173		Residential	25 Broadoaks Street Ermington		49	44	64	49	47	60	50	80	No	23	35		0.001	0.001	0.003
I174		Residential	27 Broadoaks Street Ermington		48	44	64	49	47	60	50	80	No	29	35		0.002	0.002	0.006
I175		Residential	29 Broadoaks Street Ermington		52	47	68	53	50	60	50	80	No	39	35		0.005	0.004	0.014
I176		Residential	31A Broadoaks Street Ermington		60	55	79	60	58	60	50	80	No	50	35	Yes	0.016	0.011	0.042
I176A	TRUE	Residential	31 Broadoaks Street Ermington		60	56	79	61	59	60	50	80	No	50	35		0.016	0.011	0.041
I244		Residential	1 Honor Street Ermington		44	40	59	45	43	60	50	80	No	28	35		0.002	0.001	0.005
I245		Residential	10 Honor Street Ermington		41	36	55	42	40	60	50	80	No	4	35		0.000	0.000	0.001
I246		Residential	11 Honor Street Ermington		40	36	54	41	39	60	50	80	No	3	35		0.000	0.000	0.001
I247		Residential	12 Honor Street Ermington		43	39	57	44	42	60	50	80	No	0	35		0.000	0.000	0.001
I259		Residential	3 Honor Street Ermington		44	39	56	44	42	60	50	80	No	23	35		0.001	0.001	0.003
I260		Residential	5 Honor Street Ermington		43	38	57	44	42	60	50	80	No	18	35		0.001	0.001	0.002
I261		Residential	6 Honor Street Ermington		46	42	60	47	45	60	50	80	No	17	35		0.001	0.001	0.002
I262		Residential	7 Honor Street Ermington		40	35	55	41	38	60	50	80	No	10	35		0.000	0.000	0.001
I263		Residential	8 Honor Street Ermington		43	39	57	44	42	60	50	80	No	9	35		0.000	0.000	0.001
I264		Residential	9 Honor Street Ermington		42	38	51	43	41	60	50	80	No	6	35		0.000	0.000	0.001
I265		Residential	10 Macartney Street Ermington		39	34	52	40	37	60	50	80	No	17	35		0.001	0.001	0.002
I266		Residential	11 Macartney Street Ermington		38	33	50	38	36	60	50	80	No	0	35		0.000	0.000	0.000
I268		Residential	12 Macartney Street Ermington		39	35	50	40	38	60	50	80	No	14	35		0.001	0.000	0.002
I269		Residential	12 Macartney Street Ermington		41	36	54	42	39	60	50	80	No	20	35		0.001	0.001	0.002
I270		Residential	13 Macartney Street Ermington		40	36	53	41	39	60	50	80	No	0	35		0.000	0.000	0.000
I271		Residential	14 Macartney Street Ermington		38	33	49	39	37	60	50	80	No	13	35		0.001	0.000	0.001
I272		Residential	15 Macartney Street Ermington		42	37	53	42	40	60	50	80	No	0	35		0.000	0.000	0.000
I273		Residential	16 Macartney Street Ermington		41	37	56	42	40	60	50	80	No	20	35		0.001	0.001	0.002
I274		Residential	17 Macartney Street Ermington		39	35	50	40	38	60	50	80	No	0	35		0.000	0.000	0.000
I275		Educational institute	18 Macartney Street Ermington	Ermington Rainbow College	43	39	59	44	42	50			No	15	40		0.001	0.001	0.002
I276		Residential	18 Macartney Street Ermington		41	37	56	42	40	60	50	80	No	13	35		0.001	0.000	0.001
I277		Residential	19 Macartney Street Ermington		40	35	51	40	38	60	50	80	No	0	35		0.000	0.000	0.000
I278		Residential	2 Macartney Street Ermington		44	40	59	45	43	60	50	80	No	11	35		0.001	0.000	0.001
I279		Educational institute	20 Macartney Street Ermington	Ermington Rainbow College	38	33	52	39	36	50			No	7	40		0.000	0.000	0.001
I280		Residential	21 Macartney Street Ermington		40	35	51	41	39	60	50	80	No	0	35		0.000	0.000	0.000
I281		Residential	22 Macartney Street Ermington		42	37	56	43	40	60	50	80	No	11	35		0.000	0.000	0.001
I282		Residential	23 Macartney Street Ermington		40	36	51	41	39	60	50	80	No	0	35		0.000	0.000	0.000
I283		Residential	23 Macartney Street Ermington		40	35	49	40	38	60	50	80	No	0	35		0.000	0.000	0.000
I284		Residential	24 Macartney Street Ermington		42	38	56	43	41	60	50	80	No	12	35		0.000	0.000	0.001
I285		Residential	26 Macartney Street Ermington		46	42	58	47	45	60	50	80	No	12	35		0.001	0.000	0.001
I286		Residential	27 Macartney Street Ermington		40	35	48	40	38	60	50	80	No	0	35		0.000	0.000	0.000
I287		Residential	28 Macartney Street Ermington		47	42	58	47	45	60	50	80	No	12	35		0.001	0.000	0.001
I288		Residential	29 Macartney Street Ermington		40	35	50	41	39	60	50	80	No	0	35		0.000	0.000	0.000
I289		Residential	3 Macartney Street Ermington		39	35	54	40	38	60	50	80	No	0	35		0.000	0.000	0.001
I290		Residential	30 Macartney Street Ermington		46	42	58	47	45	60	50	80	No	14	35		0.001	0.000	0.001
I291		Residential	31 Macartney Street Ermington		41	36	50	41	39	60	50	80	No	0	35		0.000	0.000	0.001
I292		Residential	32 Macartney Street Ermington		42	37	53	43	40	60	50	80	No	14	35		0.001	0.000	0.001
I293		Residential	33 Macartney Street Ermington		40	36	49	41	39	60	50	80	No	0	35		0.000	0.000	0.001
I294		Residential	34 Macartney Street Ermington		42	38	54	43	41	60	50	80	No	16	35		0.001	0.000	0.002
I295		Residential	35 Macartney Street Ermington		41	36	50	41	39	60	50	80	No	2	35		0.000	0.000	0.001
I296		Residential	36 Macartney Street Ermington		42	37	54	43	40	60	50	80	No	19	35		0.001	0.001	0.002
I297		Residential	37 Macartney Street Ermington		40	36	50	41	39	60	50	80	No	2	35		0.000	0.000	0.001
I298		Residential	38 Macartney Street Ermington		43	38	53	43	41	60	50	80	No	20	35		0.001	0.001	0.002
I299		Residential	39 Macartney Street Ermington		41	36	51	42	39	60	50	80	No	4	35		0.000	0.000	0.001
I300		Residential	4 Macartney Street Ermington		44	40	57	45	43	60	50	80	No	10	35		0.000	0.000	0.001



RID	Acquired	Type	Address	Name	2039 15/9 hour			2039 1 hour		Trigger levels			Qualifies? (Airborne)	GBN LASmax	Trigger level	Qualifies? (GBN)	Future		
					Laeq(15h)	Laeq(9hr)	LAMax	LAeq(1hr)	LAeq(1hr)	Day Criteria	Night Criteria	Max Criteria					eVDV Day	eVDV Night	PPV
I301		Residential	4 Macartney Street Ermington		42	37	56	42	40	60	50	80	No	14	35		0.001	0.000	0.002
I302		Residential	40 Macartney Street Ermington		44	40	56	45	43	60	50	80	No	22	35		0.001	0.001	0.003
I303		Residential	41 Macartney Street Ermington		41	37	52	42	40	60	50	80	No	5	35		0.000	0.000	0.001
I304		Residential	42 Macartney Street Ermington		46	41	61	47	45	60	50	80	No	23	35		0.001	0.001	0.003
I305		Residential	43 Macartney Street Ermington		43	38	55	43	41	60	50	80	No	8	35		0.000	0.000	0.001
I306		Residential	43 Macartney Street Ermington		40	35	53	41	39	60	50	80	No	3	35		0.000	0.000	0.001
I307		Residential	5 Macartney Street Ermington		37	33	48	38	36	60	50	80	No	0	35		0.000	0.000	0.001
I308		Residential	6 Macartney Street Ermington		39	35	52	40	38	60	50	80	No	10	35		0.000	0.000	0.001
I309		Residential	7 Macartney Street Ermington		41	36	49	42	40	60	50	80	No	0	35		0.000	0.000	0.001
I310		Residential	8 Macartney Street Ermington		38	33	50	39	37	60	50	80	No	11	35		0.000	0.000	0.001
I311		Residential	9 Macartney Street Ermington		37	33	47	38	36	60	50	80	No	0	35		0.000	0.000	0.001
I392		Residential	53 Marguerette Street Ermington		41	37	52	42	40	60	50	80	No	0	35		0.000	0.000	0.000
I394		Residential	54 Marguerette Street Ermington		40	36	52	41	39	60	50	80	No	0	35		0.000	0.000	0.001
I396		Residential	55 Marguerette Street Ermington		41	37	51	42	40	60	50	80	No	0	35		0.000	0.000	0.000
I399		Residential	57 Marguerette Street Ermington		42	38	52	43	41	60	50	80	No	0	35		0.000	0.000	0.000
I401		Residential	59 Marguerette Street Ermington		43	38	54	43	41	60	50	80	No	0	35		0.000	0.000	0.000
I404		Residential	62 Marguerette Street Ermington		39	34	50	40	37	60	50	80	No	3	35		0.000	0.000	0.001
I405		Residential	64 Marguerette Street Ermington		37	33	46	38	36	60	50	80	No	5	35		0.000	0.000	0.001
I406		Residential	66 Marguerette Street Ermington		44	40	57	45	43	60	50	80	No	8	35		0.000	0.000	0.001
I407		Residential	66 Marguerette Street Ermington		42	37	55	43	40	60	50	80	No	3	35		0.000	0.000	0.001
I408		Residential	68 Marguerette Street Ermington		40	36	55	41	39	60	50	80	No	5	35		0.000	0.000	0.001
I411		Residential	70 Marguerette Street Ermington		42	38	56	43	41	60	50	80	No	8	35		0.000	0.000	0.001
I412		Residential	72 Marguerette Street Ermington		45	40	58	46	44	60	50	80	No	11	35		0.001	0.000	0.001
I413		Residential	74 Marguerette Street Ermington		45	40	56	46	43	60	50	80	No	9	35		0.000	0.000	0.001
I414		Residential	76 Marguerette Street Ermington		45	40	55	45	43	60	50	80	No	9	35		0.000	0.000	0.001
I415		Residential	78 Marguerette Street Ermington		45	41	58	46	44	60	50	80	No	11	35		0.000	0.000	0.001
I418		Residential	1 Massie Street Ermington		47	43	66	48	46	60	50	80	No	30	35		0.002	0.002	0.006
I419		Residential	10 Massie Street Ermington		41	36	53	41	39	60	50	80	No	6	35		0.000	0.000	0.001
I420		Residential	12 Massie Street Ermington		41	37	54	42	40	60	50	80	No	4	35		0.000	0.000	0.001
I421		Residential	14 Massie Street Ermington		39	35	53	40	38	60	50	80	No	0	35		0.000	0.000	0.001
I422		Residential	2 Massie Street Ermington		45	40	58	46	43	60	50	80	No	12	35		0.001	0.000	0.001
I423		Residential	3 Massie Street Ermington		46	41	59	47	44	60	50	80	No	26	35		0.002	0.001	0.004
I424		Residential	4 Massie Street Ermington		37	33	46	38	36	60	50	80	No	4	35		0.000	0.000	0.001
I425		Educational institute	4 Massie Street Ermington	Tiny Scholars Childcare	40	36	51	41	39	50			No	7	40		0.000	0.000	0.001
I426		Residential	5 Massie Street Ermington		45	41	59	46	44	60	50	80	No	26	35		0.002	0.001	0.004
I427		Residential	5 Massie Street Ermington		44	39	59	45	43	60	50	80	No	18	35		0.001	0.001	0.002
I428		Residential	6 Massie Street Ermington		39	35	51	40	38	60	50	80	No	8	35		0.000	0.000	0.001
I429		Residential	8 Massie Street Ermington		40	35	51	40	38	60	50	80	No	7	35		0.000	0.000	0.001
I430		Residential	9 Massie Street Ermington		46	42	60	47	45	60	50	80	No	22	35		0.001	0.001	0.003
I450		Residential	25 Murdoch Street Ermington		44	40	57	45	43	60	50	80	No	31	35		0.002	0.002	0.006
I453		Residential	27 Murdoch Street Ermington		46	42	61	47	45	60	50	80	No	23	35		0.001	0.001	0.003
I456		Residential	29 Murdoch Street Ermington		43	39	55	44	42	60	50	80	No	16	35		0.001	0.001	0.002
I458		Residential	31 Murdoch Street Ermington		42	38	54	43	41	60	50	80	No	11	35		0.001	0.000	0.001
I459		Residential	31 Murdoch Street Ermington		42	38	58	43	41	60	50	80	No	14	35		0.001	0.000	0.001
I460		Residential	32 Murdoch Street Ermington		46	42	61	47	45	60	50	80	No	21	35		0.001	0.001	0.002
I461		Residential	32 Murdoch Street Ermington		48	44	59	49	47	60	50	80	No	20	35		0.001	0.001	0.002
I462		Residential	33 Murdoch Street Ermington		42	38	54	43	41	60	50	80	No	4	35		0.000	0.000	0.001
I463		Residential	34 Murdoch Street Ermington		43	39	57	44	42	60	50	80	No	12	35		0.000	0.000	0.001
I464		Residential	35 Murdoch Street Ermington		40	36	54	41	39	60	50	80	No	0	35		0.000	0.000	0.001
I465		Residential	36 Murdoch Street Ermington		41	36	53	42	39	60	50	80	No	8	35		0.000	0.000	0.001
I466		Residential	37 Murdoch Street Ermington		39	35	52	40	38	60	50	80	No	0	35		0.000	0.000	0.000
I467		Residential	38 Murdoch Street Ermington		41	36	54	41	39	60	50	80	No	3	35		0.000	0.000	0.001
I468		Residential	39 Murdoch Street Ermington		40	36	51	41	39	60	50	80	No	0	35		0.000	0.000	0.000
I471		Residential	42 Murdoch Street Ermington		40	36	53	41	39	60	50	80	No	0	35		0.000	0.000	0.000
I473		Residential	44 Murdoch Street Ermington		40	35	53	41	38	60	50	80	No	0	35		0.000	0.000	0.000
I492		Residential	1 Saunders Road Ermington		44	39	59	44	42	60	50	80	No	16	35		0.001	0.001	0.002
I494		Residential	11 Saunders Road Ermington		38	33	47	38	36	60	50	80	No	0	35		0.000	0.000	0.001
I503		Residential	2 Saunders Road Ermington		41	37	56	42	40	60	50	80	No	5	35		0.000	0.000	0.001
I506		Residential	3 Saunders Road Ermington		44	39	55	45	42	60	50	80	No	7	35		0.000	0.000	0.001
I507		Residential	4 Saunders Road Ermington		40	35	53	41	38	60	50	80	No	0	35		0.000	0.000	0.001
I508		Residential	5 Saunders Road Ermington		39	34	48	39	37	60	50	80	No	5	35		0.000	0.000	0.001
I509		Residential	6 Saunders Road Ermington		39	35	51	40	38	60	50	80	No	0	35		0.000	0.000	0.001
I510		Residential	7 Saunders Road Ermington		40	35	53	41	38	60	50	80	No	0	35		0.000	0.000	0.001
I513		Residential	9 Saunders Road Ermington		38	33	52	39	36	60	50	80	No	0	35		0.000	0.000	0.001
I514		Residential	1 Spofforth Street Ermington		40	36	54	41	39	60	50	80	No	5	35		0.000	0.000	0.001
I515		Residential	10 Spofforth Street Ermington		45	40	62	45	43	60	50	80	No	19	35		0.001	0.001	0.002
I516		Residential	11 Spofforth Street Ermington		45	41	58	46	44	60	50	80	No	25	35		0.001	0.001	0.004
I517		Residential	12-14 Spofforth Street Ermington		44	39	57	45	43	60	50	80	No	10	35		0.000	0.000	0.001
I518		Residential	12-14 Spofforth Street Ermington		44	39	61	44	42	60	50	80	No	15	35		0.001	0.000	0.002
I519		Residential	12-14 Spofforth Street Ermington		46	41	60	47	45	60	50	80	No	14	35		0.001	0.000	0.001
I520		Residential	13 Spofforth Street Ermington		47	42	63	47	45	60	50	80	No	28	35		0.002	0.001	0.005
I521		Residential	15 Spofforth Street Ermington		45	40	61	46	43	60	50	80	No	23	35		0.001	0.001	0.003
I522		Residential	16 Spofforth Street Ermington		39	34	50	39	37	60	50	80	No	3	35		0.000	0.000	0.001
I524		Residential	18 Spofforth Street Ermington		41	37	55	42	40	60	50	80	No	0	35		0.000	0.000	0.000
I525		Residential	18 Spofforth Street Ermington		39	35	52	40	38	60	50	80	No	0	35		0.000	0.000	0.001
I527		Residential	2 Spofforth Street Ermington		58	54	77	59	57	60	50	80	No	45	35	Yes	0.010	0.007	0.026
I528		Residential	20 Spofforth Street Ermington		41	36	54	41	39	60	50	80	No	0	35		0.000	0.000	0.000
I538		Residential	3 Spofforth Street Ermington		46	41	56	47	44	60	50	80	No	9	35		0.000	0.000	0.001

RID	Acquired	Type	Address	Name	2039 15/9 hour			2039 1 hour		Trigger levels			Qualifies? (Airborne)	GBN LASmax	Trigger level	Qualifies? (GBN)	Future		
					Laeq(15h)	Laeq(9hr)	LAMax	LAeq(1hr)	LAeq(1hr)	Day Criteria	Night Criteria	Max Criteria					eVDV Day	eVDV Night	PPV
I543		Residential	4 Spofforth Street Ermington		51	46	71	51	49	60	50	80	No	39	35		0.005	0.004	0.013
I544		Residential	4 Spofforth Street Ermington		58	54	77	59	57	60	50	80	No	46	35	Yes	0.010	0.007	0.026
I545		Residential	5 Spofforth Street Ermington		41	37	54	42	40	60	50	80	No	12	35		0.001	0.000	0.001
I546		Residential	5 Spofforth Street Ermington		41	37	53	42	40	60	50	80	No	15	35		0.001	0.000	0.002
I547		Residential	6 Spofforth Street Ermington		46	42	65	47	45	60	50	80	No	31	35		0.003	0.002	0.007
I548		Residential	7 Spofforth Street Ermington		41	37	55	42	40	60	50	80	No	16	35		0.001	0.001	0.002
I549		Residential	8 Spofforth Street Ermington		44	40	61	45	43	60	50	80	No	24	35		0.001	0.001	0.003
I550		Residential	9 Spofforth Street Ermington		45	41	55	46	44	60	50	80	No	21	35		0.001	0.001	0.003
I551		Residential	9 Spofforth Street Ermington		44	40	55	45	43	60	50	80	No	19	35		0.001	0.001	0.002
I552		Residential	1 Spurway Street Ermington		58	54	77	59	57	60	50	80	No	47	35	Yes	0.012	0.008	0.032
I553		Residential	3 Spurway Street Ermington		50	46	66	51	49	60	50	80	No	30	35		0.002	0.002	0.006
I554		Educational institute	39 Spurway Street Ermington	Rydalmere East Public School	40	35	54	41	38	50			No	12	40		0.001	0.000	0.002
I557		Educational institute	39 Spurway Street Ermington		39	34	51	39	37	50			No	13	40		0.001	0.000	0.002
I562		Residential	5 Spurway Street Ermington		48	44	63	49	47	60	50	80	No	26	35		0.002	0.001	0.004
I594		Residential	29 Trumble Avenue Ermington		45	40	61	45	43	60	50	80	No	27	35		0.002	0.001	0.005
I597		Residential	31 Trumble Avenue Ermington		42	38	60	43	41	60	50	80	No	23	35		0.001	0.001	0.003
I599		Residential	33 Trumble Avenue Ermington		42	37	58	42	40	60	50	80	No	17	35		0.001	0.001	0.002
I601		Residential	35 Trumble Avenue Ermington		41	36	56	42	39	60	50	80	No	13	35		0.001	0.000	0.001
I602		Residential	36 Trumble Avenue Ermington		39	34	55	40	38	60	50	80	No	0	35		0.000	0.000	0.001
I603		Residential	37 Trumble Avenue Ermington		45	40	55	45	43	60	50	80	No	8	35		0.000	0.000	0.001
I604		Residential	38 Trumble Avenue Ermington		39	35	55	40	38	60	50	80	No	2	35		0.000	0.000	0.001
I605		Residential	39 Trumble Avenue Ermington		40	36	54	41	39	60	50	80	No	5	35		0.000	0.000	0.001
I606		Residential	40 Trumble Avenue Ermington		40	36	56	41	39	60	50	80	No	6	35		0.000	0.000	0.001
I607		Residential	41 Trumble Avenue Ermington		40	36	52	41	39	60	50	80	No	1	35		0.000	0.000	0.001
I608		Residential	42 Trumble Avenue Ermington		43	39	59	44	42	60	50	80	No	11	35		0.000	0.000	0.001
I609		Residential	43 Trumble Avenue Ermington		40	35	52	41	39	60	50	80	No	0	35		0.000	0.000	0.001
I610		Residential	44 Trumble Avenue Ermington		43	38	59	43	41	60	50	80	No	13	35		0.001	0.000	0.001
I612		Residential	46 Trumble Avenue Ermington		45	41	61	46	44	60	50	80	No	19	35		0.001	0.001	0.002
I616		Residential	50 Trumble Avenue Ermington		45	40	62	46	44	60	50	80	No	28	35		0.002	0.001	0.005
I618		Residential	52 Trumble Avenue Ermington		43	39	60	44	42	60	50	80	No	23	35		0.001	0.001	0.003
I620		Residential	54 Trumble Avenue Ermington		44	40	59	45	43	60	50	80	No	16	35		0.001	0.000	0.002
I622		Residential	56 Trumble Avenue Ermington		42	37	57	43	41	60	50	80	No	12	35		0.001	0.000	0.001
I623		Residential	58 Trumble Avenue Ermington		43	38	54	43	41	60	50	80	No	9	35		0.000	0.000	0.001
I625		Residential	60 Trumble Avenue Ermington		39	34	53	40	37	60	50	80	No	5	35		0.000	0.000	0.001
I626		Residential	62 Trumble Avenue Ermington		41	37	53	42	40	60	50	80	No	0	35		0.000	0.000	0.001
I627		Residential	64 Trumble Avenue Ermington		38	33	46	39	36	60	50	80	No	0	35		0.000	0.000	0.001
I639		Residential	10 Trumper Street Ermington		48	44	61	49	47	60	50	80	No	15	35		0.001	0.000	0.002
I641		Residential	12 Trumper Street Ermington		46	42	62	47	45	60	50	80	No	20	35		0.001	0.001	0.002
I643		Residential	14 Trumper Street Ermington		49	45	64	50	48	60	50	80	No	25	35		0.001	0.001	0.004
I645		Residential	16 Trumper Street Ermington		46	42	62	47	45	60	50	80	No	26	35		0.002	0.001	0.004
I647		Residential	18 Trumper Street Ermington		42	38	59	43	41	60	50	80	No	20	35		0.001	0.001	0.002
I650		Residential	20 Trumper Street Ermington		43	38	58	43	41	60	50	80	No	16	35		0.001	0.001	0.002
I651		Residential	20 Trumper Street Ermington		44	40	57	45	43	60	50	80	No	6	35		0.000	0.000	0.001
I655		Residential	25 Trumper Street Ermington		43	39	59	44	42	60	50	80	No	20	35		0.001	0.001	0.002
I656		Residential	25 Trumper Street Ermington		43	38	57	43	41	60	50	80	No	12	35		0.001	0.000	0.001
I658		Residential	27 Trumper Street Ermington		58	53	76	59	56	60	50	80	No	46	35	Yes	0.010	0.007	0.027
I659		Residential	27 Trumper Street Ermington		46	42	62	47	45	60	50	80	No	27	35		0.002	0.001	0.004
I673		Residential	8 Trumper Street Ermington		45	41	59	46	44	60	50	80	No	10	35		0.000	0.000	0.001
J014		Residential	39 Atkins Road Ermington		41	36	55	42	40	60	50	80	No	0	35		0.000	0.000	0.000
J015		Residential	41 Atkins Road Ermington		42	37	55	42	40	60	50	80	No	0	35		0.000	0.000	0.000
J016		Residential	43 Atkins Road Ermington		49	44	59	49	47	60	50	80	No	0	35		0.000	0.000	0.000
J017		Residential	45 Atkins Road Ermington		44	39	57	44	42	60	50	80	No	6	35		0.000	0.000	0.001
J018		Residential	47 Atkins Road Ermington		45	40	59	46	43	60	50	80	No	12	35		0.001	0.000	0.001
J019		Residential	49 Atkins Road Ermington		51	46	64	51	49	60	50	80	No	20	35		0.001	0.001	0.002
J020	TRUE	Industrial	61 Atkins Road Ermington		61	57	80	62	60				No	43			0.009	0.007	0.021
J021	TRUE	Industrial	63 Atkins Road Ermington		63	58	81	63	61				No	47			0.013	0.009	0.033
J022	TRUE	Industrial	65 Atkins Road Ermington		58	54	74	59	57				No	39			0.005	0.004	0.014
J023	TRUE	Industrial	65 Atkins Road Ermington		55	50	67	56	53				No	27			0.002	0.001	0.004
J024		Industrial	67 Atkins Road Ermington		53	48	66	53	51				No	22			0.001	0.001	0.003
J025		Industrial	69 Atkins Road Ermington		50	45	64	50	48				No	16			0.001	0.001	0.002
J028		Industrial	71 Atkins Road Ermington		48	44	62	49	47				No	10			0.000	0.000	0.001
J030		Residential	1 Hope Street Ermington		51	47	62	52	50	60	50	80	No	20	35		0.001	0.001	0.002
J031		Residential	11 Hope Street Ermington		54	49	69	54	52	60	50	80	No	24	35		0.002	0.001	0.004
J032		Residential	13 Hope Street Ermington		54	50	69	55	53	60	50	80	No	26	35		0.002	0.001	0.004
J033		Residential	13 Hope Street Ermington		44	40	58	45	43	60	50	80	No	17	35		0.001	0.000	0.002
J034		Residential	15 Hope Street Ermington		55	51	69	56	54	60	50	80	No	29	35		0.002	0.001	0.005
J035		Residential	17 Hope Street Ermington		57	53	74	58	56	60	50	80	No	37	35		0.004	0.003	0.011
J036	TRUE	Industrial	2 Hope Street Ermington		62	57	80	63	60				No	48			0.015	0.011	0.034
J037		Residential	3 Hope Street Ermington		51	47	62	52	50	60	50	80	No	19	35		0.001	0.001	0.002
J038		Residential	5 Hope Street Ermington		52	48	63	53	51	60	50	80	No	20	35		0.001	0.001	0.002
J039		Residential	5 Hope Street Ermington		52	48	65	53	51	60	50	80	No	20	35		0.001	0.001	0.002
J040		Residential	9 Hope Street Ermington		53	49	66	54	52	60	50	80	No	20	35		0.001	0.001	0.002
J041		Residential	9 Hope Street Ermington		41	36	52	41	39	60	50	80	No	12	35		0.001	0.000	0.001
J074		Residential	48 Hughes Avenue Ermington		47	42	63	48	46	60	50	80	No	14	35		0.001	0.000	0.001
J076		Residential	50 Hughes Avenue Ermington		48	44	65	49	47	60	50	80	No	20	35		0.001	0.001	0.002
J077		Residential	52 Hughes Avenue Ermington		49	44	67	50	47	60	50	80	No	25	35		0.001	0.001	0.003
J084		Residential	61 Hughes Avenue Ermington		43	39	57	44	42	60	50	80	No	0	35		0.000	0.000	0.000
J085		Residential	63 Hughes Avenue Ermington		45	40	58	45	43	60	50	80	No	1	35		0.000	0.000	0.001



RID	Acquired	Type	Address	Name	2039 15/9 hour			2039 1 hour		Trigger levels			Qualifies? (Airborne)	GBN LASmax	Trigger level	Qualifies? (GBN)	Future		
					Laeq(15h)	Laeq(9hr)	LAMax	LAeq(1hr)	LAeq(1hr)	Day Criteria	Night Criteria	Max Criteria					eVDV Day	eVDV Night	PPV
J086	TRUE	Industrial	64 Hughes Street Ermington		66	62	84	67	65				No	50			0.023	0.016	0.046
J087	TRUE	Industrial	64 Hughes Avenue Ermington		76	71	96	76	74				No	57			0.042	0.030	0.099
J088	TRUE	Industrial	64 Hughes Avenue Ermington		63	59	83	64	62				No	39			0.006	0.004	0.013
J089		Residential	65 Hughes Avenue Ermington		45	41	59	46	44	60	50	80	No	7	35		0.000	0.000	0.001
J090		Residential	67 Hughes Avenue Ermington		47	43	60	48	46	60	50	80	No	13	35		0.001	0.000	0.001
J091		Residential	71 Hughes Avenue Ermington		48	44	65	49	47	60	50	80	No	26	35		0.002	0.001	0.004
J092		Residential	73 Hughes Avenue Ermington		54	50	72	55	53	60	50	80	No	35	35		0.004	0.003	0.008
J093		Residential	73 Hughes Avenue Ermington		61	57	80	62	60	60	50	80	No	45	35	Yes	0.010	0.007	0.024
J094	TRUE	Residential	77 Hughes Avenue Ermington		69	65	89	70	68	60	50	80	No	55	35		0.033	0.023	0.070
J096		Industrial	80 Hughes Avenue Ermington		53	48	69	54	51				No	16			0.001	0.001	0.002
J098		Residential	1 Jervis Street Ermington		43	38	55	43	41	60	50	80	No	7	35		0.000	0.000	0.001
J099		Residential	10 Jervis Street Ermington		43	38	56	44	41	60	50	80	No	0	35		0.000	0.000	0.000
J112		Residential	2 Jervis Street Ermington		43	38	53	43	41	60	50	80	No	4	35		0.000	0.000	0.001
J113		Residential	2 Jervis Street Ermington		42	38	53	43	41	60	50	80	No	5	35		0.000	0.000	0.001
J115		Residential	3 Jervis Street Ermington		43	39	56	44	42	60	50	80	No	5	35		0.000	0.000	0.001
J116		Residential	4 Jervis Street Ermington		47	42	59	48	45	60	50	80	No	0	35		0.000	0.000	0.000
J117		Residential	6 Jervis Street Ermington		45	40	58	45	43	60	50	80	No	0	35		0.000	0.000	0.000
J118		Residential	7 Jervis Street Ermington		46	42	58	47	45	60	50	80	No	0	35		0.000	0.000	0.000
J119		Residential	8 Jervis Street Ermington		43	39	57	44	42	60	50	80	No	0	35		0.000	0.000	0.000
J120		Residential	9 Jervis Street Ermington		41	37	51	42	40	60	50	80	No	0	35		0.000	0.000	0.000
J158		Industrial	2 Hope Street Melrose Park		56	51	71	56	54				No	26			0.002	0.001	0.004
J159		Industrial	4 Hope Street Melrose Park		45	41	58	46	44				No	12			0.001	0.000	0.001
J160		Industrial	4 Hope Street Melrose Park		51	46	64	52	50				No	25			0.002	0.001	0.004
J161		Industrial	6 Hope Street Melrose Park		44	40	59	45	43				No	5			0.000	0.000	0.001
J162		Industrial	6 Hope Street Melrose Park		58	54	76	59	57				No	36			0.004	0.003	0.010
J163		Industrial	6 Hope Street Melrose Park		55	50	73	56	54				No	41			0.007	0.005	0.017
J174		Industrial	30 Waratah Street Melrose Park		60	56	79	61	59				No	45			0.010	0.007	0.027
J175		Industrial	32 Waratah Street Melrose Park		59	54	76	59	57				No	37			0.005	0.004	0.012
J176		Industrial	9 Waratah Street Melrose Park		63	58	82	63	61				No	41			0.007	0.005	0.016
J177		Industrial	100 Wharf Road Melrose Park		43	39	56	44	42				No	6			0.000	0.000	0.001
J179		Educational institute	110 Wharf Road Melrose Park	Melrose Park Public School	42	38	53	43	41	50			No	0	40		0.000	0.000	0.000
J180		Educational institute	110 Wharf Road Melrose Park	Melrose Park Public School	42	38	58	43	41	50			No	0	40		0.000	0.000	0.001
J181		Educational institute	110 Wharf Road Melrose Park	Melrose Park Public School	47	43	61	48	46	50			No	8	40		0.000	0.000	0.001
J183		Educational institute	110 Wharf Road Melrose Park	Melrose Park Public School	46	41	58	46	44	50			No	0	40		0.000	0.000	0.000
J184		Industrial	112 Wharf Road Melrose Park		50	46	63	51	49				No	21			0.001	0.001	0.002
K059		Residential	56 Andrew Street Melrose Park		52	48	66	53	51	60	50	80	No	15	35		0.001	0.000	0.001
K384		Residential	60 Lancaster Avenue Melrose Park		49	44	60	49	47	60	50	80	No	2	35		0.000	0.000	0.001
K386		Residential	62 Lancaster Avenue Melrose Park		43	39	56	44	42	60	50	80	No	0	35		0.000	0.000	0.000
K389		Residential	64 Lancaster Avenue Melrose Park		48	44	59	49	47	60	50	80	No	1	35		0.000	0.000	0.001
K390		Residential	66 Lancaster Avenue Melrose Park		49	44	61	49	47	60	50	80	No	4	35		0.000	0.000	0.001
K392		Residential	68 Lancaster Avenue Melrose Park		47	43	61	48	46	60	50	80	No	5	35		0.000	0.000	0.001
K396		Residential	72 Lancaster Avenue Melrose Park		48	43	61	49	46	60	50	80	No	4	35		0.000	0.000	0.001
K398		Residential	74 Lancaster Avenue Melrose Park		48	44	61	49	47	60	50	80	No	6	35		0.000	0.000	0.001
K400		Residential	76 Lancaster Avenue Melrose Park		48	44	60	49	47	60	50	80	No	5	35		0.000	0.000	0.001
K402		Residential	78 Lancaster Avenue Melrose Park		48	44	60	49	47	60	50	80	No	5	35		0.000	0.000	0.001
K405		Residential	80 Lancaster Avenue Melrose Park		48	43	59	48	46	60	50	80	No	5	35		0.000	0.000	0.001
K407		Residential	82 Lancaster Avenue Melrose Park		48	44	60	49	47	60	50	80	No	7	35		0.000	0.000	0.001
K475		Residential	131 Wharf Road Melrose Park		46	41	57	47	45	60	50	80	No	0	35		0.000	0.000	0.000
K476		Residential	133 Wharf Road Melrose Park		47	43	58	48	46	60	50	80	No	1	35		0.000	0.000	0.000
K477		Residential	135 Wharf Road Melrose Park		48	43	59	48	46	60	50	80	No	3	35		0.000	0.000	0.001
K478		Residential	137 Wharf Road Melrose Park		49	44	60	49	47	60	50	80	No	7	35		0.000	0.000	0.001
K479		Residential	139 Wharf Road Melrose Park		50	46	62	51	49	60	50	80	No	11	35		0.000	0.000	0.001
K480		Residential	141 Wharf Road Melrose Park		51	47	64	52	50	60	50	80	No	13	35		0.001	0.000	0.001
K481		Residential	143 Wharf Road Melrose Park		52	48	67	53	51	60	50	80	No	22	35		0.001	0.001	0.003
K482		Residential	145 Wharf Road Melrose Park		54	50	70	55	53	60	50	80	No	26	35		0.002	0.001	0.004
K483		Residential	147 Wharf Road Melrose Park		55	50	70	56	53	60	50	80	No	27	35		0.002	0.001	0.004
K484		Residential	149 Wharf Road Melrose Park		55	50	70	55	53	60	50	80	No	32	35		0.003	0.002	0.006
K486	TRUE	Residential	151 Wharf Road Melrose Park		55	50	71	55	53	60	50	80	No	36	35		0.004	0.003	0.009
K487	TRUE	Residential	153 Wharf Road Melrose Park		54	49	71	55	53	60	50	80	No	39	35		0.006	0.004	0.013
K488	TRUE	Residential	155 Wharf Road Melrose Park		53	48	70	54	51	60	50	80	No	38	35		0.005	0.004	0.011
K489	TRUE	Residential	157 Wharf Road Melrose Park		50	45	63	51	48	60	50	80	No	22	35		0.001	0.001	0.002
K490	TRUE	Residential	159 Wharf Road Melrose Park		52	47	69	53	50	60	50	80	No	36	35		0.004	0.003	0.009
K491	TRUE	Residential	161 Wharf Road Melrose Park		71	66	90	72	70	60	50	80	No	58	35		0.037	0.027	0.092
L005		Mixed use	1 Burroway Road Sydney Olympic Park		36	32	46	37	35	60	50	80	No	0			0.000	0.000	0.000
L006		Mixed use	1 Burroway Road Sydney Olympic Park		37	33	47	38	36	60	50	80	No	0			0.000	0.000	0.000
L007		Mixed use	1 Burroway Road Sydney Olympic Park		43	38	54	44	41	60	50	80	No	0			0.000	0.000	0.000
L012		Residential	14-16 Hill Road Wentworth Point		59	54	78	60	57	60	50	80	No	43	35	Yes	0.008	0.006	0.021
L013		Residential	14-16 Hill Road Wentworth Point		48	43	62	48	46	60	50	80	No	18	35		0.001	0.001	0.002
L014		Residential	14-16 Hill Road Wentworth Point		56	51	74	57	54	60	50	80	No	46	35	Yes	0.011	0.008	0.028
L015		Residential	14-16 Hill Road Wentworth Point		57	53	76	58	56	60	50	80	No	42	35	Yes	0.007	0.005	0.016
L016		Residential	14-16 Hill Road Wentworth Point		51	47	66	52	50	60	50	80	No	22	35		0.001	0.001	0.002
L017		Residential	14-16 Hill Road Wentworth Point		45	41	62	46	44	60	50	80	No	23	35		0.001	0.001	0.003
L018		Residential	14-16 Hill Road Wentworth Point		41	36	56	42	40	60	50	80	No	1	35		0.000	0.000	0.001
L019		Residential	14-16 Hill Road Wentworth Point		52	48	71	53	51	60	50	80	No	25	35		0.002	0.001	0.004
L020		Residential	14-16 Hill Road Wentworth Point		42	37	56	43	40	60	50	80	No	3	35		0.000	0.000	0.001
L021		Residential	14-16 Hill Road Wentworth Point		41	36	52	42	39	60	50	80	No	0	35		0.000	0.000	0.000
L022		Residential	14-16 Hill Road Wentworth Point		45	40	59	46	44	60	50	80	No	9	35		0.000	0.000	0.001
L023		Residential	14-16 Hill Road Wentworth Point		43	38	55	43	41	60	50	80	No	0	35		0.000	0.000	0.000

RID	Acquired	Type	Address	Name	2039 15/9 hour			2039 1 hour		Trigger levels			Qualifies? (Airborne)	GBN LASmax	Trigger level	Qualifies? (GBN)	Future		
					Laeq(15h)	Laeq(9hr)	LAMax	LAeq(1hr)	LAeq(1hr)	Day Criteria	Night Criteria	Max Criteria					eVDV Day	eVDV Night	PPV
L024		Residential	14-16 Hill Road Wentworth Point		45	40	57	45	43	60	50	80	No	0	35		0.000	0.000	0.000
L025		Residential	14-16 Hill Road Wentworth Point		50	45	63	51	48	60	50	80	No	15	35		0.001	0.000	0.001
L026		Residential	14-16 Hill Road Wentworth Point		52	48	66	53	51	60	50	80	No	28	35		0.002	0.001	0.005
L027		Residential	51 Hill Road Wentworth Point		49	44	61	49	47	60	50	80	No	13	35		0.001	0.000	0.001
L028		Residential	57 Hill Road Wentworth Point		46	41	57	47	44	60	50	80	No	0	35		0.000	0.000	0.000
L029		Residential	7 Waterways Street Wentworth Point		51	47	66	52	50	60	50	80	No	21	35		0.001	0.001	0.002
M003		Residential	37 Amalfi Drive Wentworth Point		54	49	68	55	53	60	50	80	No	34	35		0.003	0.002	0.008
M004		Residential	45 Amalfi Drive Wentworth Point		45	41	64	46	44	60	50	80	No	23	35		0.001	0.001	0.003
M005		Residential	46 Amalfi Drive Wentworth Point		41	36	59	42	39	60	50	80	No	6	35		0.000	0.000	0.001
M006		Residential	48 Amalfi Drive Wentworth Point		40	36	59	41	39	60	50	80	No	7	35		0.000	0.000	0.001
M008		Residential	3 Baywater Drive Wentworth Point		57	53	75	58	56	60	50	80	No	42	35		0.007	0.005	0.019
M010		Residential	5 Baywater Drive Wentworth Point		54	49	71	54	52	60	50	80	No	32	35		0.003	0.002	0.008
M011		Residential	6 Baywater Drive Wentworth Point		56	52	73	57	55	60	50	80	No	38	35		0.005	0.004	0.014
M013		Residential	8 Baywater Drive Wentworth Point		42	38	59	43	41	60	50	80	No	7	35		0.000	0.000	0.001
M014		Residential	9 Baywater Drive Wentworth Point		40	35	58	41	38	60	50	80	No	3	35		0.000	0.000	0.001
M015		Residential	9 Baywater Drive Wentworth Point		37	33	55	38	36	60	50	80	No	3	35		0.000	0.000	0.001
M016		Residential	1 Bennelong Parkway Wentworth Point		54	49	68	54	52	60	50	80	No	34	35		0.004	0.003	0.009
M017		Residential	11 Bennelong Parkway Wentworth Point		45	41	58	46	44	60	50	80	No	3	35		0.000	0.000	0.001
M021		Residential	5 Bennelong Parkway Wentworth Point		49	45	60	50	48	60	50	80	No	9	35		0.000	0.000	0.001
M022		Residential	5 Bennelong Parkway Wentworth Point		52	48	66	53	51	60	50	80	No	26	35		0.002	0.001	0.004
M030		Residential	1 Half Street Wentworth Point		40	36	53	41	39	60	50	80	No	18	35		0.001	0.001	0.002
M033		Residential	21 Hill Road Wentworth Point		55	51	74	56	54	60	50	80	No	37	35		0.005	0.003	0.012
M034		Residential	27 Hill Road Wentworth Point		57	52	75	58	55	60	50	80	No	41	35	Yes	0.006	0.005	0.018
M035		Residential	33 Hill Road Wentworth Point		57	52	74	57	55	60	50	80	No	40	35		0.006	0.004	0.016
M039		Residential	37-39 Hill Road Wentworth Point		40	36	58	41	39	60	50	80	No	2	35		0.000	0.000	0.001
M040		Residential	37-39 Hill Road Wentworth Point		58	53	77	58	56	60	50	80	No	45	35		0.009	0.007	0.026
M042		Residential	37-39 Hill Road Wentworth Point		56	52	74	57	55	60	50	80	No	43	35		0.007	0.005	0.021
M043		Residential	37-39 Hill Road Wentworth Point		36	31	53	37	35	60	50	80	No	0	35		0.000	0.000	0.001
M046		Residential	47 Hill Road Wentworth Point		55	50	71	56	54	60	50	80	No	32	35		0.003	0.002	0.006
M050		Residential	12 Nuvolari Place Wentworth Point		41	37	59	42	40	60	50	80	No	3	35		0.000	0.000	0.001
M051		Residential	13 Savona Drive Wentworth Point		43	38	61	44	42	60	50	80	No	15	35		0.001	0.001	0.002
M052		Residential	46 Savona Drive Wentworth Point		53	48	66	54	51	60	50	80	No	34	35		0.003	0.002	0.008
M053		Residential	46 Savona Drive Wentworth Point		42	38	56	43	41	60	50	80	No	17	35		0.001	0.001	0.002
M056		Residential	46 Savona Drive Wentworth Point		37	32	53	38	35	60	50	80	No	0	35		0.000	0.000	0.000
M057		Residential	3 Stromboli Strait Wentworth Point		40	36	57	41	39	60	50	80	No	5	35		0.000	0.000	0.001
M058		Residential	3 Stromboli Strait Wentworth Point		37	32	55	37	35	60	50	80	No	0	35		0.000	0.000	0.001
M059		Residential	4 Stromboli Strait Wentworth Point		40	35	57	40	38	60	50	80	No	2	35		0.000	0.000	0.001
M077		Mixed use	2 Waterways Street Wentworth Point		29	25	39	30	28	60	50	80	No	0			0.000	0.000	0.000
Q007		Non-sensitive		0	61	56	81	62	59				No	47			0.011	0.008	0.032
Q008		Non-sensitive		0	46	42	55	47	45				No	8			0.000	0.000	0.001
Q011		Commercial		0 Sydney Olympic Park Athletic Centre	49	44	63	50	47	60			No	16			0.001	0.001	0.002
Q012		Commercial		0 NSW Rugby League Centre	61	57	81	62	60	60			No	47			0.012	0.008	0.033
Q013		Mixed use	11 Australia Avenue Sydney Olympic Park		47	42	61	48	46	60	50	80	No	2			0.000	0.000	0.001
Q014		Commercial	2 Australia Avenue Sydney Olympic Park		36	32	48	37	35	60			No	1			0.000	0.000	0.001
Q022		Commercial	10 Dawn Fraser Avenue Sydney Olympic Park		57	52	73	58	55	60			No	39			0.006	0.004	0.014
Q023		Commercial	4 Dawn Fraser Avenue Sydney Olympic Park		64	59	83	64	62	60			No	47			0.015	0.010	0.033
Q024		Commercial	15 Edwin Flack Avenue Sydney Olympic Park	Stadium Australia	54	50	70	55	53	60			No	29			0.002	0.002	0.006
Q034		Commercial	1 Herb Elliott Avenue Sydney Olympic Park		47	43	60	48	46	60			No	22			0.001	0.001	0.003
Q035		Commercial	1 Herb Elliott Avenue Sydney Olympic Park		54	49	68	54	52	60			No	34			0.004	0.003	0.008
Q036		Commercial	1 Herb Elliott Avenue Sydney Olympic Park		39	34	53	39	37	60			No	13			0.001	0.000	0.001
Q037		Commercial	1 Herb Elliott Avenue Sydney Olympic Park		46	41	61	47	45	60			No	23			0.001	0.001	0.003
Q038		Commercial	1 Herb Elliott Avenue Sydney Olympic Park		41	36	53	42	40	60			No	5			0.000	0.000	0.001
Q039		Commercial	10 Herb Elliott Avenue Sydney Olympic Park		37	32	49	37	35	60			No	0			0.000	0.000	0.000
Q040		Commercial	4 Herb Elliott Avenue Sydney Olympic Park		41	37	54	42	40	60			No	3			0.000	0.000	0.001
Q041		Commercial	6 Herb Elliott Avenue Sydney Olympic Park		35	31	46	36	34	60			No	0			0.000	0.000	0.000
Q042		Commercial	8 Herb Elliott Avenue Sydney Olympic Park		37	32	47	37	35	60			No	0			0.000	0.000	0.000
Q053		Commercial	7 Murray Rose Avenue Sydney Olympic Park		59	55	79	60	58	60			No	45			0.009	0.007	0.027
Q055		Hotel	11 Olympic Boulevard Sydney Olympic Park	Novotel Sydney Olympic Park	55	51	71	56	54	60	50	80	No	38			0.005	0.004	0.012
Q056		Hotel	11 Olympic Boulevard Sydney Olympic Park	Novotel Sydney Olympic Park	55	50	70	56	53	60	50	80	No	37			0.005	0.004	0.011
Q057		Hotel	11 Olympic Boulevard Sydney Olympic Park	Ibis Hotel	46	41	56	47	44	60	50	80	No	18			0.001	0.001	0.002
Q061		Hotel	9 Olympic Boulevard Sydney Olympic Park	Pullman At Sydney Olympic Park	43	38	53	43	41	60	50	80	No	0			0.000	0.000	0.000
Q062		Non-sensitive	1 Park Street Sydney Olympic Park	Olympic Park Station	59	54	75	60	57				No	41			0.008	0.006	0.018
Q067		Commercial	3 Parkview Drive Sydney Olympic Park		48	44	58	49	47	60			No	0			0.000	0.000	0.000
Q074		Commercial	1 Showground Road Sydney Olympic Park	Sydney Showground	41	37	57	42	40	60			No	3			0.000	0.000	0.001
Q075		Commercial	1 Showground Road Sydney Olympic Park	Exhibition Hall	54	50	71	55	53	60			No	32			0.003	0.002	0.008
Q081		Commercial	1 Showground Road Sydney Olympic Park		56	52	74	57	55	60			No	36			0.004	0.003	0.011
Q082		Commercial	1 Showground Road Sydney Olympic Park		58	54	77	59	57	60			No	41			0.007	0.005	0.019
Q083		Commercial	1 Showground Road Sydney Olympic Park		41	36	56	41	39	60			No	0			0.000	0.000	0.001
Q085		Commercial	1 Showground Road Sydney Olympic Park		40	36	58	41	39	60			No	10			0.001	0.000	0.001
Q088		Commercial	1 Showground Road Sydney Olympic Park		56	51	73	56	54	60			No	35			0.004	0.003	0.010
Q089		Commercial	1 Showground Road Sydney Olympic Park		45	40	53	45	43	60			No	6			0.000	0.000	0.001
Q090		Commercial	1 Showground Road Sydney Olympic Park		43	39	60	44	42	60			No	11			0.001	0.000	0.001
Q091		Commercial	1 Showground Road Sydney Olympic Park	Sydney Showground	35	30	49	35	33	60			No	0			0.000	0.000	0.000
Q092		Commercial	1 Showground Road Sydney Olympic Park		56	52	74	57	55	60			No	35			0.004	0.003	0.011
Q093		Commercial	1 Showground Road Sydney Olympic Park		43	38	59	44	42	60			No	6			0.000	0.000	0.001
Q095		Commercial	1 Showground Road Sydney Olympic Park		57	53	75	58	56	60			No	39			0.006	0.004	0.015
Q096		Commercial	1 Showground Road Sydney Olympic Park		55	50	72	56	54	60			No	33			0.003	0.002	0.009
Q097		Commercial	1 Showground Road Sydney Olympic Park		57	53	76	58	56	60			No	39			0.006	0.004	0.016



RID	Acquired	Type	Address	Name	2039 15/9 hour			2039 1 hour		Trigger levels			Qualifies? (Airborne)	GBN LASmax	Trigger level	Qualifies? (GBN)	Future		
					Laeq(15h)	Laeq(9hr)	LAMax	LAeq(1hr)	LAeq(1hr)	Day Criteria	Night Criteria	Max Criteria					eVDV Day	eVDV Night	PPV
R004		Residential	11 Canning Street Lidcombe		37	33	56	38	36	60	50	80	No	0	35		0.000	0.000	0.000
R009		Residential	13 Carter Street Lidcombe		48	44	63	49	47	60	50	80	No	0	35				
R010		Residential	13 Carter Street Lidcombe		32	27	49	33	30	60	50	80	No	0	35				
R028		Residential	7 Flock Street Lidcombe		32	28	49	33	31	60	50	80	No	4	35		0.000	0.000	0.001
R029		Residential	9 Grazier Street Lidcombe		48	43	67	49	46	60	50	80	No	21	35		0.001	0.001	0.003
R032		Residential	4-6 Uhrig Street Lidcombe		58	53	78	58	56	60	50	80	No	0	35				
R033		Residential	4-6 Uhrig Street Lidcombe		49	44	66	50	47	60	50	80	No	0	35				
R034		Residential	4-6 Uhrig Street Lidcombe		58	53	78	58	56	60	50	80	No	46	35		0.011	0.008	0.030
R036		Residential	5 Uhrig Road Lidcombe		37	33	51	38	36	60	50	80	No	9	35		0.000	0.000	0.001
R037		Residential	5 Uhrig Road Lidcombe		43	39	60	44	42	60	50	80	No	14	35		0.001	0.000	0.001
R038		Residential	5 Uhrig Road Lidcombe		46	41	60	47	44	60	50	80	No	22	35		0.001	0.001	0.003
R039		Residential	5 Uhrig Road Lidcombe		59	55	80	60	58	60	50	80	No	52	35	Yes	0.018	0.013	0.053
R040		Residential	5 Uhrig Road Lidcombe		36	32	54	37	35	60	50	80	No	31	35		0.003	0.002	0.006
R041		Commercial	5 Uhrig Road Lidcombe		56	52	73	57	55	60			No	39			0.005	0.004	0.014
R046		Hotel	6 Edwin Flack Avenue Sydney Olympic Park	Quest At Sydney Olympic Park	47	42	61	47	45	60	50	80	No	9			0.000	0.000	0.001
R047		Hotel	8 Edwin Flack Avenue Sydney Olympic Park	Ibis Budget Sydney Olympic Park	58	53	76	59	57	60	50	80	No	39			0.006	0.004	0.015

## **G-5    Operational road traffic noise results – South Street and Boronia Street**

RID	North or south of road	Address	Type	NCA	2031 No Build - 15 hour	2031 No Build - 9 hour	2031 No Build - LAFmax	2031 Build 15 hour	2031 Build 9 hour	2031 Build LAFmax	Difference in noise level, 15 hour	Difference in noise level, 9 hour	Difference in noise level, LAFmax	LAFmax - Vehicle crossing track	LAFmax - Vehicle truck passby	Dominant Noise source	>2 dBA Day and Even(15hr) > 60	>2 dBA Night and Even(9hr) > 55	Lmax > 65- No Build	Lmax > 65- Build
E093	North	10 Dorothy Street Rydalmere	Residential	E	59	54	69	60	55	71	1.3	1.4	1.8	67	71	Passby	No	No	Yes	Yes
E094	North	10 Dorothy Street Rydalmere	Residential	E	60	55	70	61	56	72	1.5	1.5	2.2	70	72	Passby	No	No	Yes	Yes
E097	North	14 Dorothy Street Rydalmere	Residential	E	59	54	70	60	55	72	1.3	1.3	2	66	72	Passby	No	No	Yes	Yes
E099	North	16 Dorothy Street Rydalmere	Residential	E	62	57	72	63	58	75	1.5	1.4	3	63	75	Passby	No	No	Yes	Yes
E101	North	18 Dorothy Street Rydalmere	Residential	E	59	55	69	60	55	71	0.8	0.8	2	54	71	Passby	No	No	Yes	Yes
E103	North	2 Dorothy Street Rydalmere	Residential	E	55	50	69	59	54	75	4.1	4.2	6.5	75	72	Crossing	No	No	Yes	Yes
E104	North	20 Dorothy Street Rydalmere	Residential	E	60	55	69	61	56	71	0.8	0.8	2.1	60	71	Passby	No	No	Yes	Yes
E106	North	22 Dorothy Street Rydalmere	Residential	E	60	56	70	61	57	72	1	1.1	2.2	60	72	Passby	No	No	Yes	Yes
E108	North	24 Dorothy Street Rydalmere	Residential	E	61	56	70	62	57	72	1	1.1	2.3	59	72	Passby	No	No	Yes	Yes
E110	North	26 Dorothy Street Rydalmere	Residential	E	60	55	69	61	56	71	1	0.9	2	58	71	Passby	No	No	Yes	Yes
E112	North	28 Dorothy Street Rydalmere	Residential	E	60	56	70	61	56	72	0.9	0.9	2.1	57	72	Passby	No	No	Yes	Yes
E115	North	30 Dorothy Street Rydalmere	Residential	E	60	55	69	61	56	71	1	0.9	2	57	71	Passby	No	No	Yes	Yes
E116	North	4 Dorothy Street Rydalmere	Residential	E	60	55	72	63	58	76	2.8	2.8	4.5	76	75	Crossing	Yes	Yes	Yes	Yes
E117	North	4 Dorothy Street Rydalmere	Residential	E	58	53	69	59	54	71	0.9	0.8	2	66	71	Passby	No	No	Yes	Yes
E120	North	8 Dorothy Street Rydalmere	Residential	E	59	54	69	61	56	71	1.7	1.7	2.2	70	71	Passby	No	No	Yes	Yes
E260	South	102 South Street Rydalmere	Residential	E	63	59	75	63	59	75	-0.1	-0.2	0	73	75	Passby	No	No	Yes	Yes
E261	South	104 South Street Rydalmere	Residential	E	64	59	76	63	59	76	-0.5	-0.4	0	68	76	Passby	No	No	Yes	Yes
E262	South	104 South Street Rydalmere	Residential	E	63	58	75	63	58	75	-0.3	-0.3	0.1	70	75	Passby	No	No	Yes	Yes
E263	South	108 South Street Rydalmere	Residential	E	64	59	75	63	59	75	-0.5	-0.4	0	66	75	Passby	No	No	Yes	Yes
E264	South	110 South Street Rydalmere	Residential	E	64	60	76	64	59	76	-0.5	-0.5	0.1	66	76	Passby	No	No	Yes	Yes
E265	South	112 South Street Rydalmere	Residential	E	64	60	76	64	59	77	-0.5	-0.6	0.1	63	77	Passby	No	No	Yes	Yes
E266	South	114 South Street Rydalmere	Residential	E	64	60	76	64	59	76	-0.5	-0.5	0.1	61	76	Passby	No	No	Yes	Yes
E267	South	116 South Street Rydalmere	Residential	E	64	59	75	63	59	75	-0.4	-0.5	0.1	60	75	Passby	No	No	Yes	Yes
E268	South	116 South Street Rydalmere	Residential	E	64	59	75	63	59	76	-0.4	-0.5	0.1	60	76	Passby	No	No	Yes	Yes
E269	South	120 South Street Rydalmere	Residential	E	65	60	76	64	59	76	-0.5	-0.5	0.1	58	76	Passby	No	No	Yes	Yes
E270	South	122 South Street Rydalmere	Residential	E	63	59	75	63	58	75	-0.5	-0.4	0	53	75	Passby	No	No	Yes	Yes
E271	South	124 South Street Rydalmere	Residential	E	64	59	75	63	59	75	-0.4	-0.5	0.1	56	75	Passby	No	No	Yes	Yes
E301	South	98 South Street Rydalmere	Residential	E	63	58	76	64	59	77	0.6	0.6	1.5	77	76	Crossing	No	No	Yes	Yes
E302	South	98 South Street Rydalmere	Residential	E	63	58	75	63	58	75	0.1	0.2	0	75	75	Passby	No	No	Yes	Yes
F085	North	47 Fallon Street Rydalmere	Residential	F	62	57	73	64	59	78	2.3	2.3	5	61	78	Passby	Yes	Yes	Yes	Yes
F091	South	53 Fallon Street Rydalmere	Residential	F	53	48	66	53	48	67	0.1	0.1	0.6	61	67	Passby	No	No	Yes	Yes
F301	South	25 Primrose Avenue Rydalmere	Residential	F	56	51	69	56	51	72	0.3	0.3	2.7	72	69	Crossing	No	No	Yes	Yes
F316	North	42 Primrose Avenue Rydalmere	Residential	F	58	53	68	59	55	72	1.7	1.7	4.2	72	70	Crossing	No	No	Yes	Yes
F345	South	126 South Street Rydalmere	Residential	F	64	59	75	63	59	75	-0.5	-0.4	0	55	75	Passby	No	No	Yes	Yes
F346	South	128 South Street Rydalmere	Residential	F	64	60	76	64	59	76	-0.5	-0.5	0	54	76	Passby	No	No	Yes	Yes
F347	South	130 South Street Rydalmere	Residential	F	64	60	76	64	59	76	-0.4	-0.4	0.2	54	76	Passby	No	No	Yes	Yes
F348	South	130 South Street Rydalmere	Residential	F	64	59	75	64	59	76	-0.3	-0.3	0.4	53	76	Passby	No	No	Yes	Yes
F349	South	134 South Street Rydalmere	Residential	F	64	59	75	63	59	76	-0.2	-0.1	1.1	54	76	Passby	No	No	Yes	Yes
F350	South	136 South Street Rydalmere	Residential	F	64	59	75	64	59	76	0	0	1.2	54	76	Passby	No	No	Yes	Yes
F351	South	138 South Street Rydalmere	Residential	F	64	59	75	64	59	77	0.1	0.1	1.6	52	77	Passby	No	No	Yes	Yes
F352	South	140 South Street Rydalmere	Residential	F	65	60	76	65	60	78	0.2	0.3	2.1	55	78	Passby	No	No	Yes	Yes
F353	South	142 South Street Rydalmere	Residential	F	64	60	76	65	60	78	0.1	0.1	1.6	57	78	Passby	No	No	Yes	Yes
F354	South	144 South Street Rydalmere	Residential	F	64	60	76	64	60	77	0.1	0	1.5	58	77	Passby	No	No	Yes	Yes
F355	South	146 South Street Rydalmere	Residential	F	65	60	77	65	61	79	0.1	0.1	1.7	58	79	Passby	No	No	Yes	Yes
F356	South	148 South Street Rydalmere	Residential	F	65	60	76	65	60	78	0.1	0	1.6	59	78	Passby	No	No	Yes	Yes
F357	South	148 South Street Rydalmere	Residential	F	65	60	76	65	60	78	0	0	1.5	61	78	Passby	No	No	Yes	Yes
F358	South	152 South Street Rydalmere	Residential	F	65	60	76	65	60	78	0	0	1.4	61	78	Passby	No	No	Yes	Yes
F359	South	154 South Street Rydalmere	Residential	F	64	60	76	64	60	77	0	0	1.3	62	77	Passby	No	No	Yes	Yes
F360	South	156 South Street Rydalmere	Residential	F	65	60	77	65	60	78	-0.1	-0.1	1.2	64	78	Passby	No	No	Yes	Yes
F361	South	158 South Street Rydalmere	Residential	F	65	60	77	65	60	78	-0.2	-0.1	0.9	67	78	Passby	No	No	Yes	Yes
F362	South	160 South Street Rydalmere	Residential	F	64	59	76	64	59	76	-0.2	-0.2	0.7	69	76	Passby	No	No	Yes	Yes
F363	South	162 South Street Rydalmere	Residential	F	64	60	76	64	60	76	-0.2	-0.2	0.3	74	76	Passby	No	No	Yes	Yes
F364	South	164 South Street Rydalmere	Residential	F	65	60	77	65	60	77	-0.1	-0.1	0	76	77	Passby	No	No	Yes	Yes
F365	South	166 South Street Rydalmere	Residential	F	66	61	79	66	61	79	-0.2	-0.2	0.4	74	79	Passby	No	No	Yes	Yes
F366	South	168 South Street Rydalmere	Residential	F	66	61	79	66	61	79	-0.3	-0.3	0.5	70	79	Passby	No	No	Yes	Yes
F367	South	170 South Street Rydalmere	Residential	F	64	60	77	64	59	77	-0.3	-0.3	0.5	66	77	Passby	No	No	Yes	Yes
F368	North	61 South Street Rydalmere	Residential	F	63	58	73	65	60	78	1.9	1.9	4.5	53	78	Passby	No	No	Yes	Yes
F369	North	61 South Street Rydalmere	Residential	F	61	57	72	63	58	75	1.3	1.3	3	58	75	Passby	No	No	Yes	Yes
F373	North	63 South Street Rydalmere	Residential	F	63	58	73	65	61	79	2.4	2.3	5.5	54	79	Passby	Yes	Yes	Yes	Yes
F374	North	65 South Street Rydalmere	Residential	F	63	59	74	65	62	81	3	2.9	6.6	54	81	Passby	Yes	Yes	Yes	Yes
F375	North	67 South Street Rydalmere	Residential	F	62	58	73	65	60	79	2.5	2.4	5.7	54	79	Passby	Yes	Yes	Yes	Yes
F376	North	69 South Street Rydalmere	Residential	F	63	58	73	65	61	79	2.5	2.5	6	52	79	Passby	Yes	Yes	Yes	Yes
F377	North	71 South Street Rydalmere	Residential	F	63	58	73	66	61	80	2.8	2.9	6.7	56	80	Passby	Yes	Yes	Yes	Yes
F378	North	73 South Street Rydalmere	Residential	F	63	58	73	66	61	80	2.8	2.7	6.4	56	80	Passby	Yes	Yes	Yes	Yes
F379	North	75 South Street Rydalmere	Residential	F	63	58	73	66	61	80	2.8	2.8	6.5	57	80	Passby	Yes	Yes	Yes	Yes
F380	North	77 South Street Rydalmere	Residential	F	63	58	73	65	61	79	2.6	2.7	6.4	58	79	Passby	Yes	Yes	Yes	Yes
F381	North	79 South Street Rydalmere	Residential	F	63	58	73	66	61	80	2.9	3	6.6	59	80	Passby	Yes	Yes	Yes	Yes
F382	North	81 South Street Rydalmere	Residential	F	63	58	73	65	61	79	2.7	2.8	6.6	59	79	Passby	Yes	Yes	Yes	Yes
F383	North	83 South Street Rydalmere	Residential	F	63	58	73	66	61	80	3	3.1	6.9	61	80	Passby	Yes	Yes	Yes	Yes
F384	North	85 South Street Rydalmere	Residential	F	62	58	73	65	61	79	2.8	2.7	6.2	62	79	Passby	Yes	Yes	Yes	Yes
F385	North	85 South Street Rydalmere	Residential	F	60	56	71	62	58	75	1.8	1.8	4.4	62	75	Passby	No	No	Yes	Yes
F386	North	89 South Street Rydalmere	Residential	F	63	58	73	65	61	79	2.9	2.9	6.4	64	79	Passby	Yes	Yes	Yes	Yes
F387	North	91 South Street Rydalmere	Residential	F	58	54	70	60	56	74	1.9	1.9	4.2	68	74	Passby	No	No	Yes	Yes
F389	North	93 South Street Rydalmere	Residential	F	63	58	73	66	62	80	3.4	3.5	6.7	76	80	Passby	Yes	Yes	Yes	Yes
F390	North	95 South Street Rydalmere	Residential	F	63	59	74	67	62	82	3.7	3.7	7.4	74	82	Passby	Yes	Yes	Yes	Yes
F391	North	97 South Street Rydalmere	Residential	F	62	57	73	64	60	78	2.4	2.5	5.3	70	78	Passby	Yes	Yes	Yes	Yes
F393	North	99 South Street Rydalmere	Residential	F	62	58	73	65	60	79	2.6	2.6	5.7	67	79	Passby	Yes	Yes	Yes	Yes
I052	North	1 Boronia Street Ermington	Residential	I	66	61	73	68	63	78	2.1	2.1	4.5	71	78	Passby	Yes	Yes	Yes	Yes
I053	North	1 Boronia Street Ermington	Residential	I	65	61	72	67	62	76	1.5	1.5	3.7	66	76	Passby	No	No	Yes	Yes
I054	South	10 Boronia Street Ermington	Residential	I	69	64	78	69	64											

RID	North or south of road	Address	Type	NCA	2031 No Build - 15 hour	2031 No Build - 9 hour	2031 No Build - LAFmax	2031 Build 15 hour	2031 Build 9 hour	2031 Build LAFmax	Difference in noise level, 15 hour	Difference in noise level, 9 hour	Difference in noise level, LAFmax	LAFmax - Vehicle crossing track	LAFmax - Vehicle truck passby	Dominant Noise source	>2 dBA Day and L <sub>eq</sub> (15hr) > 60	>2 dBA Night and L <sub>eq</sub> (9hr) > 55	Lmax > 65- No Build	Lmax > 65- Build
I089	South	38 Boronia Street Ermington	Residential	I	68	64	77	69	65	79	0.7	0.7	1.5	77	79	Passby	No	No	Yes	Yes
I090	North	39 Boronia Street Ermington	Residential	I	65	61	72	67	63	77	1.9	1.9	4.7	69	77	Passby	No	No	Yes	Yes
I091	South	4 Boronia Street Ermington	Residential	I	68	64	77	68	63	78	-0.2	-0.2	0.9	64	78	Passby	No	No	Yes	Yes
I093	North	41 Boronia Street Ermington	Residential	I	65	61	72	67	63	77	1.9	1.9	4.6	72	77	Passby	No	No	Yes	Yes
I094	North	41 Boronia Street Ermington	Residential	I	65	60	72	67	63	76	2	2.1	4.2	74	76	Passby	No	Yes	Yes	Yes
I095	South	42 Boronia Street Ermington	Residential	I	68	63	76	68	64	77	0.2	0.3	1.1	74	77	Passby	No	No	Yes	Yes
I096	South	44 Boronia Street Ermington	Residential	I	67	62	75	66	62	75	-0.3	-0.3	0.2	71	75	Passby	No	No	Yes	Yes
I097	North	45 Boronia Street Ermington	Residential	I	65	61	72	67	63	76	2.3	2.3	4.4	76	76	Passby	Yes	Yes	Yes	Yes
I098	South	46 Boronia Street Ermington	Residential	I	67	63	77	67	62	76	-0.8	-0.8	-0.7	68	76	Passby	No	No	Yes	Yes
I099	North	47 Boronia Street Ermington	Commercial	I	66	62	74	70	66	80	3.5	3.5	5.9	77	80	Passby	Yes	Yes	Yes	Yes
I100	South	48 Boronia Street Ermington	Residential	I	67	63	76	67	63	76	-0.2	-0.2	0.5	76	75	Crossing	No	No	Yes	Yes
I101	North	49 Boronia Street Ermington	Residential	I	66	62	73	69	64	79	2.8	2.9	5.7	75	79	Passby	Yes	Yes	Yes	Yes
I102	North	5 Boronia Street Ermington	Residential	I	66	62	73	68	64	78	1.8	1.9	4.7	62	78	Passby	No	No	Yes	Yes
I103	South	50 Boronia Street Ermington	Residential	I	68	63	77	67	63	76	-0.4	-0.4	-0.2	73	76	Passby	No	No	Yes	Yes
I104	North	51 Boronia Street Ermington	Residential	I	66	61	73	68	64	78	2.5	2.4	5.4	71	78	Passby	Yes	Yes	Yes	Yes
I105	South	52 Boronia Street Ermington	Residential	I	69	64	78	68	64	78	-0.3	-0.3	0.6	69	78	Passby	No	No	Yes	Yes
I106	North	53 Boronia Street Ermington	Residential	I	66	61	72	68	63	77	2.1	2.1	5.3	69	77	Passby	Yes	Yes	Yes	Yes
I107	South	54 Boronia Street Ermington	Residential	I	67	63	76	67	63	77	-0.1	-0.1	0.8	70	77	Passby	No	No	Yes	Yes
I108	North	55 Boronia Street Ermington	Residential	I	65	60	72	66	62	75	1.5	1.5	3.4	70	75	Passby	No	No	Yes	Yes
I109	South	56 Boronia Street Ermington	Residential	I	68	64	77	68	64	79	0.2	0.3	1.6	73	79	Passby	No	No	Yes	Yes
I110	North	57 Boronia Street Ermington	Residential	I	65	61	72	67	62	75	1.7	1.6	2.7	74	75	Passby	No	No	Yes	Yes
I111	South	58 Boronia Street Ermington	Residential	I	67	63	76	68	63	77	0.3	0.3	1.1	74	77	Passby	No	No	Yes	Yes
I112	North	59 Boronia Street Ermington	Residential	I	65	60	72	67	62	75	1.9	1.9	3.2	75	75	Crossing	No	No	Yes	Yes
I113	South	6 Boronia Street Ermington	Residential	I	69	65	79	69	65	80	-0.2	-0.1	1	64	80	Passby	No	No	Yes	Yes
I114	North	61 Boronia Street Ermington	Residential	I	64	60	71	66	62	74	1.5	1.6	2.9	74	74	Crossing	No	No	Yes	Yes
I115	South	62 Boronia Street Ermington	Residential	I	66	62	75	66	62	76	0	0	1.1	72	76	Passby	No	No	Yes	Yes
I116	North	63 Boronia Street Ermington	Residential	I	65	60	72	66	62	75	1.5	1.4	3	72	75	Passby	No	No	Yes	Yes
I117	South	64 Boronia Street Ermington	Residential	I	67	63	76	67	63	78	0	-0.1	1.1	67	78	Passby	No	No	Yes	Yes
I118	North	65 Boronia Street Ermington	Residential	I	65	61	72	67	62	75	1.5	1.5	3.2	70	75	Passby	No	No	Yes	Yes
I119	South	66 Boronia Street Ermington	Residential	I	66	62	76	67	62	77	0.2	0.1	1.1	64	77	Passby	No	No	Yes	Yes
I120	North	67 Boronia Street Ermington	Residential	I	64	60	72	65	61	74	1.2	1.2	2.8	69	74	Passby	No	No	Yes	Yes
I121	North	69 Boronia Street Ermington	Residential	I	65	61	72	66	62	75	1.4	1.5	3	72	75	Passby	No	No	Yes	Yes
I122	North	7 Boronia Street Ermington	Residential	I	66	62	73	68	64	78	1.8	1.8	4.5	65	78	Passby	No	No	Yes	Yes
I123	North	7 Boronia Street Ermington	Residential	I	51	46	63	51	47	65	0.3	0.3	2	60	65	Passby	No	No	No	Yes
I124	North	71 Boronia Street Ermington	Residential	I	65	61	72	67	62	75	1.7	1.7	2.9	74	75	Passby	No	No	Yes	Yes
I125	North	73 Boronia Street Ermington	Residential	I	65	60	72	67	62	76	1.8	1.8	4.4	76	75	Crossing	No	No	Yes	Yes
I126	North	75 Boronia Street Ermington	Residential	I	65	61	72	67	62	76	1.8	1.7	3.4	74	76	Passby	No	No	Yes	Yes
I127	North	75 Boronia Street Ermington	Residential	I	62	58	71	64	59	73	1.2	1.1	2.6	70	73	Passby	No	No	Yes	Yes
I128	North	79 Boronia Street Ermington	Residential	I	64	59	71	65	61	74	1.5	1.5	3	67	74	Passby	No	No	Yes	Yes
I129	South	8 Boronia Street Ermington	Residential	I	69	64	78	68	64	79	-0.2	-0.2	0.8	66	79	Passby	No	No	Yes	Yes
I130	North	81 Boronia Street Ermington	Residential	I	64	60	72	66	62	77	2.2	2.1	4.1	65	77	Passby	Yes	Yes	Yes	Yes
I131	North	83 Boronia Street Ermington	Residential	I	62	58	71	64	60	76	2.2	2.2	4.3	63	76	Passby	Yes	Yes	Yes	Yes
I132	North	9 Boronia Street Ermington	Residential	I	54	49	66	54	50	69	0.4	0.3	2.3	63	69	Passby	No	No	Yes	Yes
I175	South	29 Broadoaks Street Ermington	Residential	I	58	54	71	60	55	73	1.5	1.5	1.8	73	71	Crossing	No	No	Yes	Yes
I450	North	25 Murdoch Street Ermington	Residential	I	55	50	65	55	51	70	0.7	0.7	4.9	70	67	Crossing	No	No	No	Yes
I527	South	2 Spofforth Street Ermington	Residential	I	69	65	79	68	64	78	-0.7	-0.7	-1	76	78	Passby	No	No	Yes	Yes
I543	South	4 Spofforth Street Ermington	Residential	I	57	53	73	57	52	72	-0.7	-0.7	-0.5	64	72	Passby	No	No	Yes	Yes
I544	South	4 Spofforth Street Ermington	Residential	I	69	65	79	68	64	78	-1.1	-1.1	-1.1	72	78	Passby	No	No	Yes	Yes
I552	North	1 Spurway Street Ermington	Residential	I	66	62	75	70	65	81	3.3	3.4	5.7	76	81	Passby	Yes	Yes	Yes	Yes
I553	North	3 Spurway Street Ermington	Residential	I	53	48	66	57	52	71	3.8	3.9	5.3	71	67	Crossing	No	No	Yes	Yes
I562	North	5 Spurway Street Ermington	Residential	I	50	45	63	50	46	64	0.3	0.3	1.2	59	64	Passby	No	No	No	No
I658	South	27 Trumper Street Ermington	Residential	I	68	64	78	69	65	80	0.6	0.6	1.8	76	80	Passby	No	No	Yes	Yes





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