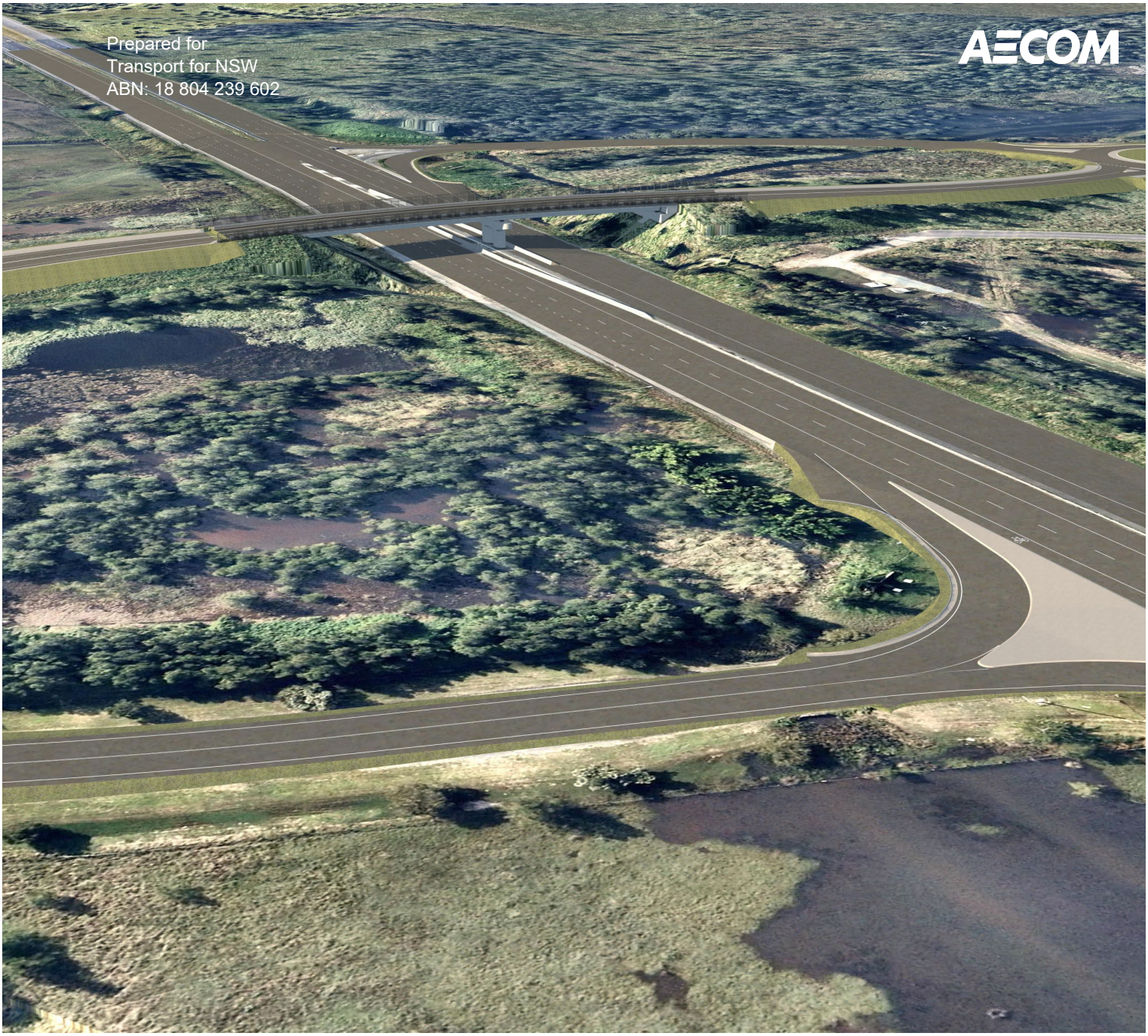


# Noise and Vibration Impact Assessment Report

## HW10 Pacific Highway / Harrington Road Interchange Upgrade

06-Sep-2023
HW10 Pacific Highway / Harrington Road Interchange Upgrade
Doc No. 60684355_REP_EV_010_G_Noise and Vibration Impact Assessment Report

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# Noise and Vibration Impact Assessment Report

HW10 Pacific Highway / Harrington Road Interchange Upgrade

Client: Transport for NSW

ABN: 18 804 239 602

Prepared by

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| G | 06-Sep-2023 | Final | Dan Wyse<br>Project Manager |  |

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# Glossary and abbreviations

| Term | Description |
|---|---|
| A Weighted decibels [dB(A)] | The A weighting is a frequency filter applied to measured noise levels to represent how humans hear sounds. The A-weighting filter emphasises frequencies in the speech range (between 1 kHz and 4 kHz) which the human ear is most sensitive to, and places less emphasis on low frequencies at which the human ear is not so sensitive. When an overall sound level is A-weighted it is expressed in units of dB(A). |
| Ambient noise | The all-encompassing noise at a point composed of sound from all sources near and far. |
| Assessment background level [ABL] | The overall background level for each day, evening and night period for each day of the noise monitoring. |
| Background noise | The underlying level of noise present in the ambient noise when extraneous noise (such as transient traffic and dogs barking) is removed. The $L_{90}$ sound pressure level is used to quantify background noise. |
| Construction ancillary facilities | Dedicated areas of land required for construction amenities, parking, materials/equipment storage, mobile asphalt batch plants and stockpiling. |
| Construction footprint | The area needed to construct the proposal, including for example construction ancillary facilities, access roads, haulage and water quality basins. |
| Day | Construction noise:<br>The period from 0700 to 1800 h Monday to Saturday and 0800 to 1800 h Sundays and Public Holidays.<br>Road traffic noise:<br>The period from 0700 to 2200 h every day of the week. |
| Decibel [dB] | The measurement unit of sound. |
| Decibel scale | The decibel scale is logarithmic in order to produce a better representation of the response of the human ear. A 3 dB(A) increase in the sound pressure level corresponds to a doubling in the sound energy. A 10 dB(A) increase in the sound pressure level corresponds to a perceived doubling in volume. Examples of decibel levels of common sounds are as follows:<br>0 dB(A) Threshold of human hearing<br>30 dB(A) A quiet country park<br>40 dB(A) Whisper in a library<br>50 dB(A) Open office space<br>70 dB(A) Inside a car on a freeway<br>80 dB(A) Outboard motor<br>90 dB(A) Heavy truck pass-by<br>100 dB(A) Jack hammer / subway train<br>110 dB(A) Rock concert<br>115 dB(A) Limit of sound permitted in industry<br>120 dB(A) 747 take off at 250 metres |
| Equivalent continuous sound level [$L_{eq}$] | The constant sound level which, when occurring over the same period of time, would result in the receiver experiencing the same amount of sound energy. |

| Term | Description |
|---|---|
| Evening | Construction noise:<br>The period from 1800 to 2200 h Monday to Sunday and Public Holidays.<br>Road traffic noise:<br>Not applicable. |
| Frequency [f] | The repetition rate of the cycle measured in Hertz (Hz). The frequency corresponds to the pitch of the sound. A high frequency corresponds to a high-pitched sound and a low frequency to a low-pitched sound. |
| $L_{max}$ | The maximum sound pressure level measured over the measurement period. |
| $L_{min}$ | The minimum sound pressure level measured over the measurement period. |
| $L_{10}$ | The sound pressure level exceeded for 10% of the measurement period. For 10% of the measurement period it was louder than the $L_{10}$. |
| $L_{90}$ | The sound pressure level exceeded for 90% of the measurement period. For 90% of the measurement period it was louder than the $L_{90}$. |
| Night | Construction noise:<br>The period from 2200 to 0700 h Monday to Saturday and 2200 to 0800 h Sundays and Public Holidays.<br>Road traffic noise:<br>The period from 2200 to 0700 h every day of the week. |
| Noise management level | The level which represents the point above which there may be some community reaction to noise. |
| Operational footprint | The area needed for the operation of the proposal including the concept design. |
| Proponent | Transport for NSW (“Transport”) |
| Proposal | The upgrade of Harrington Road, Coopernook Road and the Pacific Highway to allow grade separation to traverse the Pacific Highway |
| Proposal area | Area required for construction and operation of the proposal. |
| QA Specifications | Quality assurance specifications developed by Transport for NSW for use with road work and bridge work contracts let by Transport for NSW. |
| Rating background level [RBL] | The overall background level for each day, evening and night period for the entire length of noise monitoring. |
| Sound power level | The total sound emitted by a source. |
| Sound pressure level | The amount of sound at a specified point. |
| Traffic noise | The total noise resulting from road traffic. The $L_{eq}$ sound pressure level is used to quantify traffic noise. |

| Acronym | Definition |
|---|---|
| CEMP | Construction Environmental Management Plan<br>A site-specific plan developed for the construction phase to ensure that all contractors and sub-contractors comply with the environmental conditions of approval and that the environmental risks are properly managed. |
| EP&A Act | *Environmental Planning and Assessment Act 1979* (NSW)<br>Provides the legislative framework for land use planning and development assessment in NSW |
| EPA | NSW Environment Protection Authority |
| km | kilometres |
| LGA | Local Government Area |
| m | metres |
| NATA | National Association of Testing Authorities |
| NCA | Noise catchment area |
| REF | Review of environmental factors |
| Roads and Maritime | NSW Roads and Maritime Services, now known as Transport for NSW |
| SEPP | State Environmental Planning Policy<br>A type of planning instrument made under Part 3 of the EP&A Act. |
| SWL | Sound power level |
| Transport for NSW | Transport for New South Wales |
| VDV | Vibration dose value |

# Executive Summary

Transport for New South Wales (Transport) proposes to upgrade a local connection between the existing communities of Harrington and Coopernook via the Pacific Highway. The upgrade involves changing the existing at-grade arrangement to a grade separated crossing, taking vehicles over the highway. This would achieve a step-change improvement in safety of the intersections and enhanced connectivity of the townships of Harrington and Coopernook.

Construction of the proposal will primarily occur during standard construction hours except for bridge works and tie-ins to existing pavement which would be completed out-of-hours to reduce impacts to the road network. Delivery and removal of over-sized loads would probably also be out of hours.

This technical paper provides a detailed report assessing potential noise and vibration impacts from both the construction and operational phases of the proposal. Relevant guidelines and assessment procedures have been followed so that all applicable state requirements have been considered.

**Construction Impacts**

A construction noise assessment has been conducted in accordance with the *Interim Construction Noise Guideline* and *Construction Noise and Vibration Guideline*. Reasonable worst case construction scenarios have been assessed. Construction would largely be carried out during standard construction work hours in accordance with the *Interim Construction Noise Guideline*, with a small number of activities required to occur out of hours to minimise disruption to road traffic on the Pacific Highway.

The assessment of noise associated with the construction of the proposal indicates some exceedances of the *Interim Construction Noise Guideline* noise management levels at the most affected sensitive receivers. The magnitude and number of exceedances are detailed in Section 5.0. Exceedances of the noise management levels occur during the day and night at the most affected sensitive receivers during certain activities.

Site establishment works are predicted to result in the greatest number of exceedances of the daytime construction noise management levels. Effective noise mitigation and management measures would need to be developed by the contractor to minimise the potential noise impacts from the works. The magnitude of these impacts is consistent with other major works projects and highlights the need for effective noise mitigation and management planning.

Measures have been recommended to mitigate construction noise impacts upon nearby sensitive receivers. The final number, degree and nature of these measures would ultimately be selected by the contractor and be largely dependent on the construction strategy and work undertaken. Specific noise management and mitigation measures would be detailed in the contractor's Construction Noise and Vibration Management Plan. The recommended management and mitigation measures which would be considered in the plan include:

- Effective community consultation
- Training of construction site workers
- Use of noise barriers
- Noise monitoring
- Appropriate selection and maintenance of equipment
- Situating plant in less noise sensitive locations
- Construction traffic management.

Minimum working distances for vibration intensive construction works. Equipment size would be selected by the contractor taking into account the minimum working distances and the distance between the area of construction and the most affected sensitive receiver. If works need to be undertaken within minimum working distances, vibration monitoring would be undertaken.

Construction traffic is not likely to increase measurably compared with existing traffic flows along construction routes. Increases would be considerably less than 2 dB(A). An increase of 2 dB(A) or less is compliant with the traffic noise increase criterion in the *Road Noise Policy*.

**Operational Impacts**

An operational road traffic noise assessment has been completed in accordance with *Road Noise Policy* and the *Road Noise Criteria Guideline* and *Road Noise Mitigation Guideline*.

Analysis of the road traffic noise modelling results has concluded that there are no predicted exceedances of the applicable minor works criteria outlined in the *Road Noise Criteria Guideline*. Therefore, no further consideration of road traffic noise mitigation is required.

# 1.0 Introduction

## 1.1 Context and background

The Pacific Highway (A1/M1) is a 960-kilometre-long route along the central east coast of New South Wales between the Warringah Freeway in North Sydney and the Queensland state border. It is the primary north-south transport corridor that connects two major Australian cities, being Sydney and Brisbane. The Pacific Highway forms the East Coast National Land Transport Network (NLTN) road transport link and is a nationally significant infrastructure link. Along the corridor the highway provides connection to several major regional cities including Newcastle, Port Macquarie, Coffs Harbour, Tweed Heads and many rapidly growing coastal communities.

Over a period of 30 years, the Australian and New South Wales Government have progressively completed duplication of the Pacific Highway between Hexham and the Queensland border. Following completion of the highway's duplication in 2020, for various reasons and particularly in the southern end of the corridor, some intersections remain at-grade.

During 1997, the Coopernook Bypass project planned for approximately 4.5 km of dual carriageway highway bypassing the village of Coopernook with a new bridge over the Lansdowne River. The project considered the option for grade-separation of the then proposed Pacific Highway intersection with Harrington Road. However, the assessment concluded, that although grade-separation would provide increased safety benefits, an at-grade solution was sufficient for the 2026 design year.

In 2002, the Pacific Highway Coopernook Bypass project commenced construction of the highway deviation. The scope of works included implementation of the current at-grade "staggered-T" intersection arrangement, as shown in Figure 1-1. In 2004, the project was delayed for treatment and settlement of soft soils. Later, in 2005 the project scope was amended to address the need for a future grade-separated interchange. As such, a strategic design was prepared, and initial pre-loading was undertaken to accommodate the approaches to a grade-separated overpass. A second stage of pre-loading was placed during 2012.


**Figure 1-1 Pacific Highway (A1) intersection with Harrington and Coopernook Road - current at-grade 'Staggered-T' intersection arrangement (Nearmap, 2012)**

In 2016, Transport for NSW (Transport) Regional Planning prepared the draft Pacific Highway Post Duplication Strategy. The strategy includes a thorough investigation of the highway's current performance and future challenges to meet the agreed corridor vision. A key issue identified within this document was for safety at the remaining at-grade intersections along the length of the highway. Urban development has since continued along the coast, with the Pacific Highway remaining the primary access for interstate and inter-regional traffic for Harrington and Coopernook. Therefore, with increased

traffic volumes it is proving more difficult for traffic to enter and exit the highway at this particular location.

The intersections of Harrington and Coopernook Road with the Pacific Highway provide a local connection between the communities of Harrington and Coopernook. Harrington is a coastal centre and popular tourist destination located 22 km north-east of Taree at the northern entrance of the Manning River. Coopernook is a small village township located 17 km north of Taree and 9 km west of Harrington. The two intersections currently operate as staggered at-grade intersections, separated by the highway. Consequently, a contributing factor for the sites high-severity crash history has been attributed to the need for local traffic to complete a weaving manoeuvre across the high-speed high-volume Pacific Highway. There have been ten crashes at this intersection between October 2016 and August 2022, including one fatality recorded in 2021.

Transport is now progressing planning for upgrade of the Harrington and Coopernook Road intersections with the Pacific Highway. Introduction of the grade-separated crossing is a critical element to enable a step-change improvement in safety at the interchange and enhanced connectivity for the townships of Harrington and Coopernook. Respectively, there is strong community advocacy for the proposed grade-separated upgrade and a recently announced Federal Government funding commitment of $48M towards the project, with a further $12M commitment by the State.

Transport has engaged AECOM to complete the Concept Design, REF, Detailed Design, Final Business Case and Economic Appraisal for the Harrington Road Interchange Project. This project involves developing the design for the grade-separated interchange at the junction between the Pacific Highway and roads connecting to Harrington and Coopernook. The solution will seek to provide a safe, constructable design that addresses the safety issues inherent in the existing layout, whilst minimising environmental impacts and improving the lives of the local community.

## 1.2 Proposal area

The project site includes the intersections of Harrington and Coopernook Road with the Pacific Highway. The site is located approximately 12 km north of the Princes Street, Cundletown and Taree interchange, as shown in Figure 1-2.


**Figure 1-2 Regional Location**

As defined in Figure 1-3, the proposal area extent includes the acceleration/deceleration lanes along the Pacific Highway, the proposed overpass and intersections with Harrington and Coopernook Road.

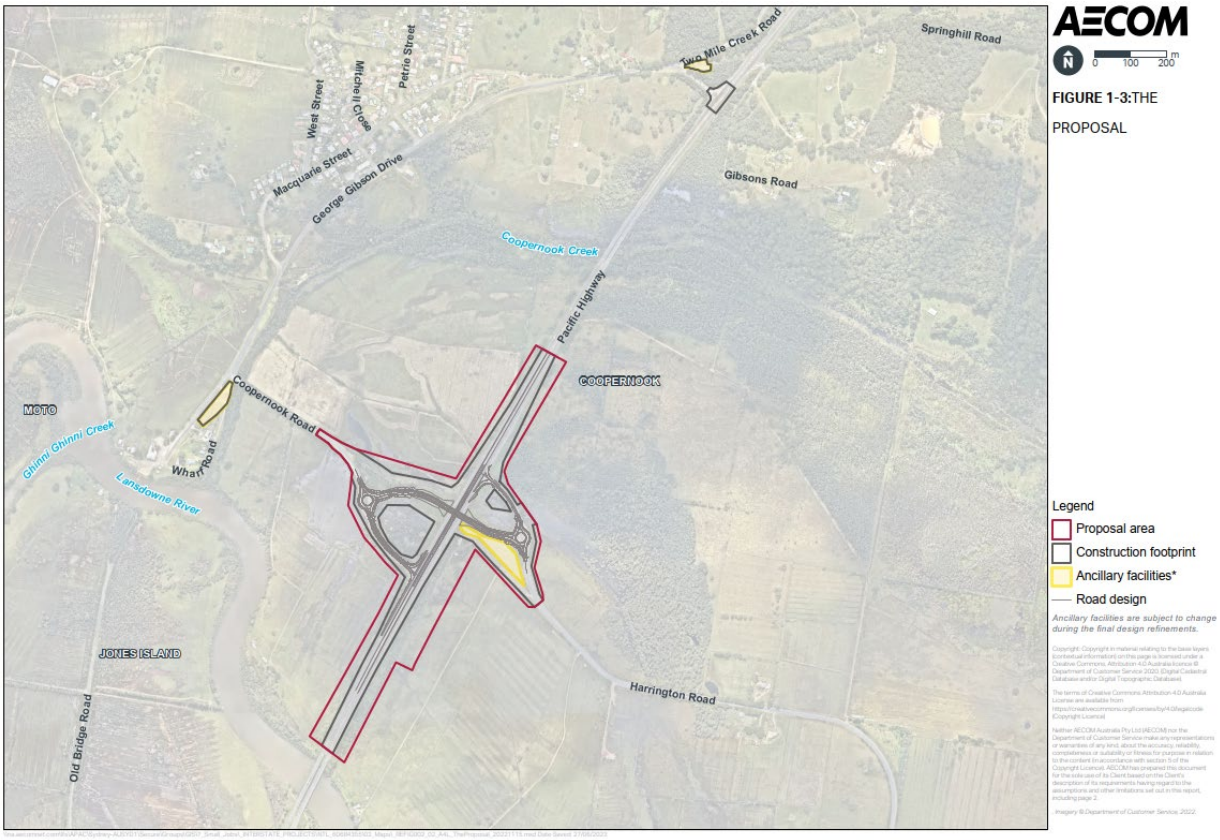



**Figure 1-3 Proposal area extent**

## 1.3 Purpose of this technical report

This noise and vibration assessment report (the assessment) provides an assessment of the potential noise and vibration impacts associated with the proposal and has been prepared to inform the review of environmental factors (REF). It contributes to fulfilling the requirements of Section 5.5 of the Environmental Planning and Assessment Act 1979 (EP&A Act) which requires that Transport for NSW examines and takes into account to the fullest extent possible, all matters affecting or likely to affect the environment by reason of the activity.

# 2.0 Proposal description

## 2.1 Key features

Transport proposes to build a grade-separated crossing at the Harrington Road and Coopernook Road intersections with the Pacific Highway (A15 Pacific Highway).

Key features of the proposal include:

- An approximately 76 metre long bridge over the Pacific Highway, utilising the existing preloaded fill embankments
- A link road with a single lane in each direction connecting Coopernook Road and Harrington Road
- Connection with Coopernook Road via a single-lane roundabout
- Connection with Harrington Road via a single-lane roundabout
- Upgrade of Coopernook Road between the Pacific Highway and the proposed roundabout to improve flood immunity (subject to further investigations in detailed design)
- Adjustments to the Pacific Highway median to remove turning lanes, install wire rope and concrete barriers
- Utilisation of existing at-grade left-in/left-out connections to the Pacific Highway
- A 2.5 metre wide (minimum) concrete shared user path over the bridge.

## 2.2 Overview of construction activities

Construction of the proposal is anticipated to take around 18 months to two years complete. The construction footprint (i.e. area of land required for construction of the proposal), including locations of the two proposed construction ancillary facilities, is shown in Figure 2-1.

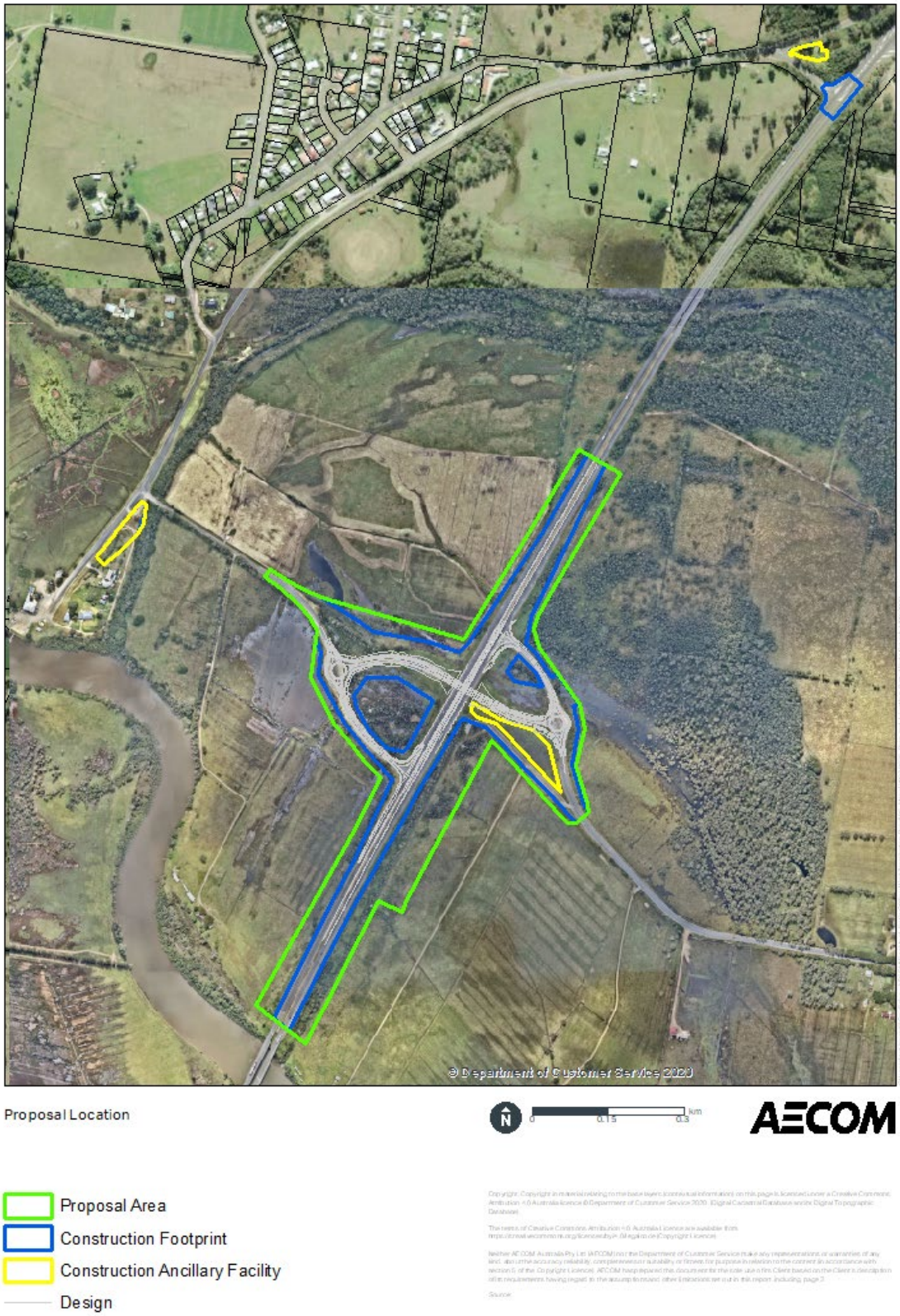



**Figure 2-1 Proposal construction footprint and construction ancillary facilities**

Construction of the proposal would involve the following:

- Notification to relevant authorities and community
- PMP and CEMP prepared by the contractor and reviewed and approved by Transport
- Site establishment (including setting up ancillary facilities and compound areas)
- Preloading / surcharging of approach embankment
- Concrete injected columns in the approach embankment
- Utility relocations
- Vegetation clearing
- Earthworks and drainage
- Bridge construction, including approaches and roundabouts
- Pavement construction, including local roads
- Landscaping and finishing work
- Removal of ancillary facilities and site rehabilitation.

### 2.2.1 Construction ancillary facilities

Three temporary construction ancillary facilities may be established to support construction of the proposal (refer to Figure 2-1), including at:

- construction ancillary facility 1 – located at the south eastern corner of the Harrington Road and the Pacific Highway intersection
- construction ancillary facility 2 – located at the north eastern corner of the George Gibson Drive and Two Mile Creek Road intersection
- construction ancillary facility 3 – located at the southern corner of Coopernook Road and George Gibson Drive.

Construction ancillary facilities may include the following noise-generating activities:

- vegetation clearing
- utility works
- laydown and storage of materials
- crushing
- stockpiling.

# 3.0 Existing environment

## 3.1 Overview and study area

The proposed upgrade is located in the suburb of Coopernook.

The noise and vibration impact assessment has considered two study areas:

- construction noise assessment study area which comprises two noise catchment areas (NCAs) as detailed in Section 4.2.1.
- operational road traffic noise study area which extends to where noise levels are dominated by other roads that are not being assessed as part of this proposal, as detailed in the *Road Noise Criteria Guideline*. This is up to a maximum distance of 600 metres from the centre line of the outermost traffic lane on each side of the road under consideration.

The study areas include a mixture of receivers sensitive to noise and vibration such as, residential properties, a school, agricultural and commercial properties.

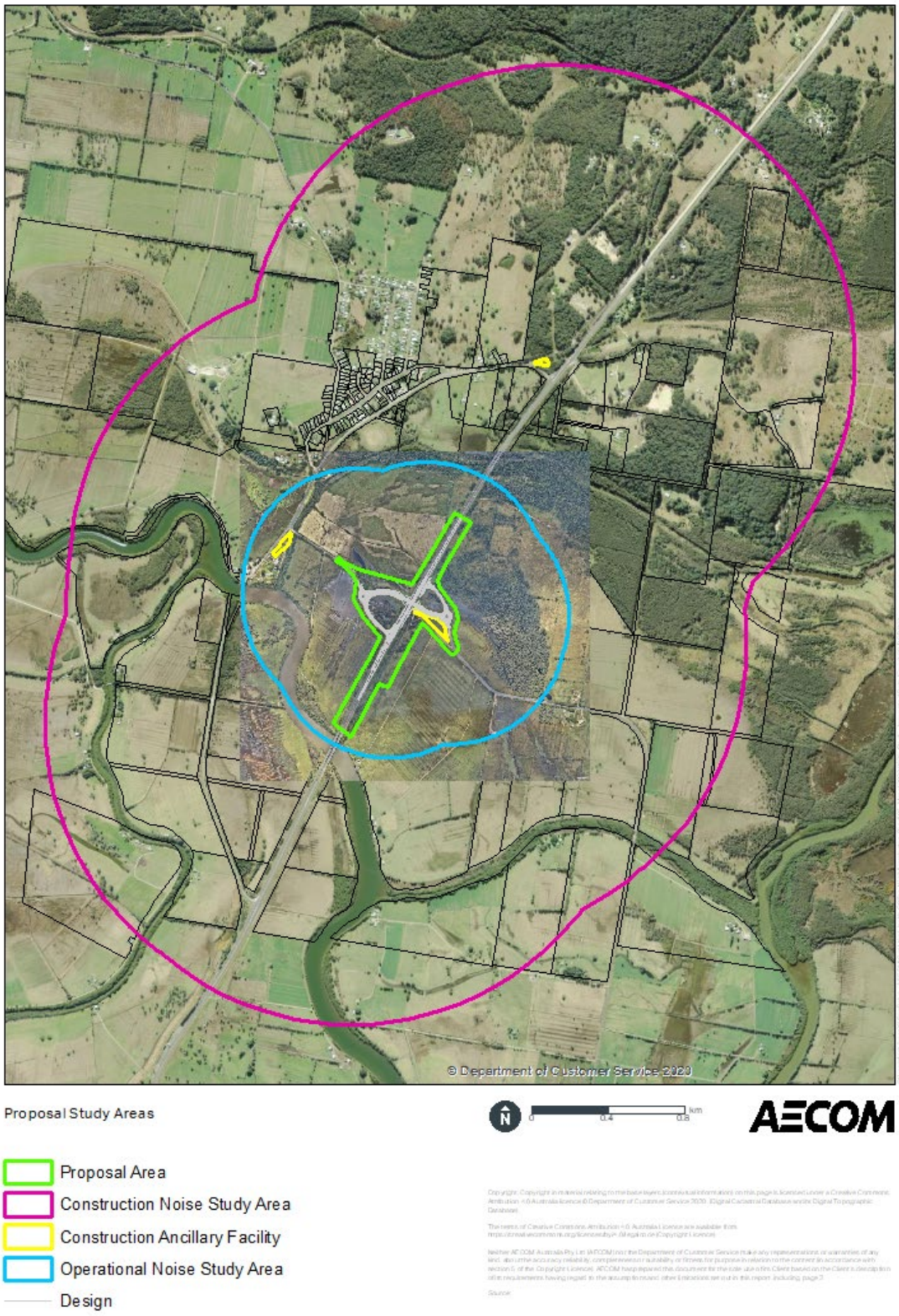



**Figure 3-1 Construction and operational study areas**

## 3.2 Noise sensitive receivers

Receivers surrounding the proposal area are mostly single storey residential dwellings. There is also a commercial receiver – The Coopernook Hotel and a school – Coopernook Public School. NCAs have been determined for the construction noise and vibration assessment (as detailed in Section 4.2.1), where receivers have a similar land use and ambient noise environment. They are used to group receivers affected by the same works to assist with assessment, consultation and mitigation. The NCAs are identified in Figure 4-1 and are also shown in Appendix A along with all receivers.

Noise sensitive receivers other than residential receivers are listed in Table 3-1.

**Table 3-1 Notable sensitive receivers within the construction noise study area (non-residential)**

| Receiver | Receiver Type |
|---|---|
| Coopernook Public School | School |
| Coopernook School of Arts | School |
| The Coopernook Hotel | Commercial |
| Palms Oasis Motel | Commercial |
| Coopernook Service Station | Commercial |
| Coopernook Cemetery | Passive Recreation |
| Coopernook Oval | Active Recreation |

### 3.2.1 Heritage items and other sensitive structures

No state and local heritage items have been identified within a 200 m radius of the proposal. The closest local heritage items are The Coopernook Hotel, Coopernook Public School and Coopernook Wharf, all items are more than 400 m from the proposal and are unlikely to be impacted by vibration from works associated with the proposal.

## 3.3 Ambient noise monitoring

Ambient noise monitoring was undertaken at three locations shown in Table 3-2 between 23 August and 5 September 2022. Concurrent traffic counts were undertaken during the monitoring period.

Noise logging and traffic count locations were identified through examination of aerial photography and site inspections, with the aim of providing good spatial coverage of the proposal corridor and the identified NCAs along it. Attended noise measurements were also undertaken to determine the nature of the local noise environment and confirm road traffic as the controlling noise source (for the validation of the operational noise model).

The noise logging locations are shown in Figure 3-2. The noise logging results are provided graphically in Appendix B.

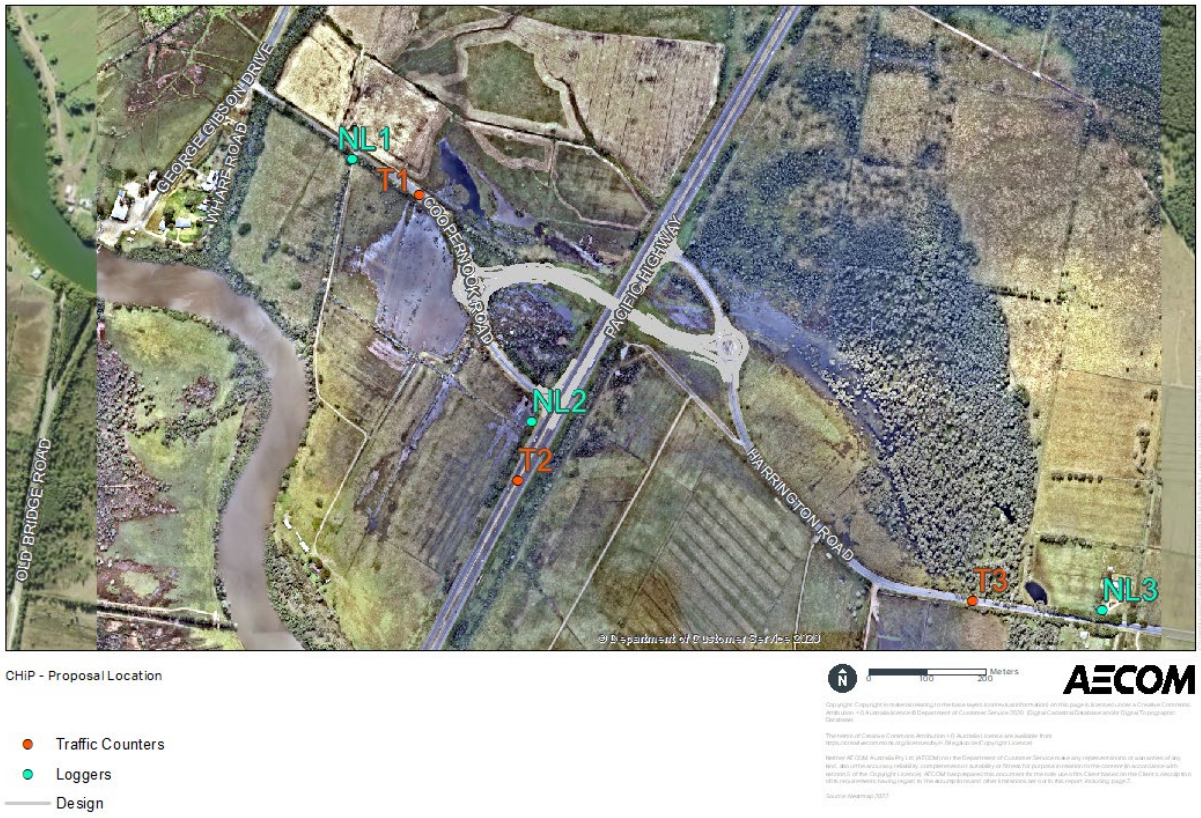



**Figure 3-2 Noise logger and traffic counter measurement locations**

The acoustic instrumentation employed during both unattended and attended noise measurements comply with the requirements of *AS IEC 61672.1-2019 Electroacoustics – Sound level meters Specifications* and were within their current National Association of Testing Authorities, Australia (NATA) certified in-calibration period (i.e. calibration in the last two years).

A noise logger measures the noise level over a 15-minute sample period and then determines $L_{A1}$, $L_{A10}$, $L_{A90}$, $L_{Amax}$ and $L_{Aeq}$ levels of the noise environment. The $L_{A1}$, $L_{A10}$ and $L_{A90}$ levels are the levels exceeded for 1%, 10% and 90% of the sample period respectively. The $L_{Amax}$ level is the maximum noise levels due to individual noise events. The $L_{A90}$ level is taken as the background noise level. The $L_{Aeq}$ level is the energy averaged noise level over the 15-minute period.

The results of the noise monitoring have been processed in accordance with the procedures contained in the *NSW Road Noise Policy* and the *Noise Policy for Industry*. Weather data recorded during the noise monitoring survey periods was obtained from the Bureau of Meteorology weather station, located at Taree Airport (ID060141). Periods which were affected by noise from extraneous wind and rain were omitted from the results, as indicated in Appendix B.

Details of each noise logging location and the purpose of each noise logger are provided in Table 3-2 below. As the operational road traffic noise study area includes receivers up to 600 metres from the alignment of roads, noise loggers have been located at varying distances from the existing road alignments. This allows the accuracy of the model to be confirmed over the extent of the proposal area.

**Table 3-2 Noise logging locations**

| Location ID | Address | Purpose | | Measurement period |
|---|---|---|---|---|
| | | Construction | Operational | |
| NL1 | 20 Coopernook Road, Coopernook | ✓ | ✓ | 23 Aug to 5 Sep 2022 |
| NL2 | 20 Coopernook Road, Coopernook | - | ✓ | 23 Aug to 5 Sep 2022 |
| NL3 | 173 Harrington Road, Coopernook | ✓ | ✓ | 23 Aug to 5 Sep 2022 |

NL2 was not used for the purpose of construction noise as its proximity to the Pacific Highway would mean road traffic would be the dominant source of background noise, in addition to not being close to any receivers.

Noise measurements and traffic count data have been used to validate the operational road traffic noise model. Noise logging data has also been used to establish construction noise management levels and operational noise criteria for the proposal, consistent with applicable guidelines (refer to Section 4.1).

### 3.3.1 Unattended background noise monitoring results

Table 3-3 presents the representative $L_{Aeq}$ ambient noise levels and the $L_{A90}$ rating background noise levels for the existing environment at each noise logging location during the day, evening and night-time periods.

The representative $L_{Aeq}$ noise levels were determined by logarithmically averaging noise measurements in each time period for the entire duration of noise logging. The assessment background levels (ABL) were established by determining the lowest tenth-percentile level of the $L_{A90}$ noise data acquired over each assessment period of interest. The background noise level or rating background levels (RBL) representing the day, evening and night-time assessment periods were based on the median of individual ABLs determined over the entire monitoring duration.

The noise levels presented in Table 3-3 indicate that the noise environment at the measurement locations is typical of those located along transport corridors in suburban areas, with characteristically intermittent traffic flows and/or limited commerce/industry.

**Table 3-3 Ambient and background noise measurements**

| Noise logger | Ambient noise level dB(A) | | | Rating background level, dB(A) | | |
|---|---|---|---|---|---|---|
| | Day (7am to 6pm) $L_{Aeq,11\ hour}$ | Evening (6pm to 10pm) $L_{Aeq,4\ hour}$ | Night (10pm to 7am) $L_{Aeq,9\ hour}$ | Day (7am to 6pm) $L_{A90,15\ min}$ | Evening (6pm to 10pm) $L_{A90,15\ min}$ | Night (10pm to 7am) $L_{A90,15\ min}$ |
| NL1 | 59 | 55 | 53 | 42 | 40 | 35 |
| NL2 | 70 | 68 | 66 | 55 | 47 | 40 |
| NL3 | 60 | 56 | 53 | 41 | 41(42)[1] | 37 |

*Notes:*

1 *Application notes to the Noise Policy for Industry indicate that the community generally expects a greater control of noise during the evening and night as compared to the daytime. Therefore, the rating background level for the evening is set to no more than that for the daytime. Measured RBL noted in brackets.*

## 3.4 Short term attended measurements

Short term attended noise measurements were undertaken to establish the existing ambient noise environment at potentially affected receivers around the proposal. The acoustic instrumentation employed during attended noise measurements comply with the requirements of *AS IEC 61672.1-2019 Electroacoustics – Sound level meters Specifications* and were within their current National Association of Testing Authorities, Australia (NATA) certified in-calibration period (i.e. calibration in the last two years).

Attended noise measurements were conducted at the three unattended noise monitoring locations during both daytime and night-time periods between 18 to 25 October 2021. The measurements were conducted over 15-minute periods. Weather conditions were clear on the days of monitoring, with no wind.

Attended noise measurements were conducted using a Brüel & Kjær Type 2250 sound level meter. The sound level meter used is designated as a Class 1 instrument and has accuracy suitable for laboratory and field use. The sound level meter was calibrated before and after the measurements with no drift in calibration exceeding ±0.5 dB(A).

The results of the 15-minute attended noise monitoring are presented in Table 3-4.

**Table 3-4 Attended noise measurements**

| Location | Date | Time | $L_{Aeq}$ dB(A) | $L_{A90}$ dB(A) | Comments |
|---|---|---|---|---|---|
| NL1 | 17/08/2022 | 15:15 | 57 | 49 | Local road traffic noise on Coopernook Road 69-74 dB(A). Background noise dominated by distant road traffic noise on Pacific Highway 50-53 dB(A). Bird calls and insects audible. |
| | 17/08/2022 | 22:09 | 51 | 44 | |
| NL2 | 17/08/2022 | 16:09 | 73 | 63 | Noise levels dominated by road traffic noise on Pacific Highway 62-78 dB(A). Crickets audible. |
| | 17/08/2022 | 22:29 | 60 | 43 | |
| NL3 | 17/08/2022 | 16:59 | 62 | 46 | Background noise dominated by road traffic noise on Pacific Highway 44-54 dB(A). Local road traffic noise on Harrington Road 69-75 dB(A). Bird calls and insects audible occasionally 51 dB(A). |
| | 17/08/2022 | 22:50 | 54 | 49 | |

## 3.5 Road noise monitoring results

Table 3-5 provides the logarithmically averaged road existing traffic noise levels measured at each of the noise logging locations used for the assessment of road traffic noise. Noise logging data from these locations have been used to validate the road traffic noise model for the proposal.

These measured road traffic noise levels have been compared to the predicted noise levels from the validation noise model. It was found that the measured levels correlated well with the predicted levels. This provides confidence that the future road traffic noise levels can be accurately predicted for the operational noise assessment. Further information on the noise modelling and validation of noise model outputs is provided in Section 6.1.2.

**Table 3-5 Existing road traffic noise levels**

| Noise logging location | Ambient road traffic noise level, dB(A) | |
|---|---|---|
| | Day[1] ($L_{Aeq,15\ hr}$) | Night[1] ($L_{Aeq,9\ hr}$) |
| NL1 | 58 | 53 |
| NL2 | 69 | 66 |
| NL3 | 59 | 53 |

*Notes:*
1. *Day is defined as 7:00 am to 10:00 pm. Night is defined as 10:00pm to 7:00am.*

## 3.6 Road traffic counts

Table 3-6 provides the traffic counts undertaken during the noise measurements.

**Table 3-6 Existing road traffic volumes**

| Location | Direction | Daytime (7am – 10pm) | | | Night-time (10pm – 7am) | | |
|---|---|---|---|---|---|---|---|
| | | Traffic volume | Heavy vehicle ratio | Vehicle speed, km/h | Traffic volume | Heavy vehicle ratio | Vehicle speed, km/h |
| Pacific Highway | Northbound | 8,318 | 18% | 98 | 1,155 | 34% | 99 |
| | Southbound | 8,187 | 18% | 97 | 1,145 | 39% | 98 |
| Coopernook Road | Westbound | 492 | 8% | 62 | 26 | 16% | 59 |
| | Eastbound | 506 | 12% | 60 | 52 | 16% | 59 |
| Harrington Road | Westbound | 1,653 | 11% | 84 | 153 | 14% | 88 |
| | Eastbound | 1,698 | 8% | 83 | 104 | 13% | 84 |

# 4.0 Assessment methodology

## 4.1 Relevant guidelines and standards

The following guidelines have been used for the noise and vibration assessment:

- Construction noise:
  - Construction Noise and Vibration Guideline (Roads and Maritime, 2016)
  - Interim Construction Noise Guideline (DECC, 2009)
- Construction vibration:
  - Assessing Vibration: a technical guideline (DEC, 2006)
  - Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration (Australian and New Zealand Environment Council (ANZEC), 1990)
  - Australian/New Zealand Standard 2107: 2000 – Acoustics – Recommended design sound levels and reverberation times for building interiors, 2000
  - British Standard 7385: Part 2 1993 - Evaluation and Measurement of Vibration in Buildings, 1993
  - British Standard 6472: Part 1 2008 - Evaluation of Human Exposure to Vibration in Buildings, 2008
  - British Standard 5228: Part 1 2009 - Code of Practice for Noise and Vibration Control on Construction and Open Sites Part 1: Noise
  - DIN 4150:Part 3-1999 Structural vibration – Effects of vibration on structures (Deutsches Institut für Normung 1999)
  - Evaluation and Measurement for Vibration in Buildings Part 2, (British Standard (BS) 7385:Part 2-1993) (BS 7385)
- Operational traffic noise:
  - NSW Road Noise Policy (DECCW, 2011)
  - Road Noise Criteria Guideline (Transport, 2022)
  - Road Noise Mitigation Guideline (Transport, 2022)
  - Road Noise Model Validation Guideline (Transport, 2022)
  - Application Notes – Road Noise Criteria Guideline (Transport, 2022)
  - Environmental Noise Management Manual (RTA, 2001)
  - Procedure for Preparing an Operational Noise and Vibration Assessment (RMS, 2011)
  - Draft At-Receiver Noise Treatment Guideline (RMS, 2017)

## 4.2 Construction noise

The potential risk of adverse impact of construction noise on a receiver is determined by the extent of its emergence above the existing background noise level, the duration of the event and the characteristics of the noise.

The *Interim Construction Noise Guideline* is a NSW Government document that identifies ways to manage impacts of construction noise on residences and other sensitive land uses. It is the principal guideline for the assessment and management of construction noise in NSW and is used to establish construction noise management levels.

As the construction stage of the proposal is expected to continue for a period of more than three weeks and are within relatively close proximity to noise sensitive receivers, a quantitative assessment, based on ‘reasonable’ worst case construction scenarios, has been carried out in this technical report.

Noise levels resulting from construction activities are predicted at nearby noise sensitive receivers using environmental noise modelling software and compared to the noise management levels, derived in accordance with the *Interim Construction Noise Guideline*.

Where an exceedance of the noise management levels is predicted, the *Interim Construction Noise Guideline* advises that receivers can be considered 'noise affected' and the proponent should apply all feasible and reasonable work practices to minimise the noise impact. The proponent should also inform all potentially impacted residents of the nature of the works to be carried out, the expected noise level and duration, as well as provide contact details to facilitate feedback from affected residents during construction.

Where construction noise levels at a receiver reach 75 dB(A), residential receivers are considered to be 'highly noise affected' and the proponent should, in consultation with the community, consider restrictions to the hours of construction to provide respite periods.

The *Interim Construction Noise Guideline* defines what is considered to be feasible and reasonable as follows:

- Feasible - a work practice or abatement measure is feasible if it is capable of being put into practice or of being engineered and is practical to build given proposal constraints such as safety and maintenance requirements
- Reasonable - selecting reasonable measures from those that are feasible involves making a judgment to determine whether the overall noise benefits outweigh the overall adverse social, economic and environmental effects, including the cost of the measure.

Additionally, the *Interim Construction Noise Guideline* notes that strong justification is required for work that is proposed outside of standard working hours.

Construction noise management levels for the proposal for residential receivers are derived using the information in Table 4-1.

**Table 4-1 Construction noise management levels – Residential receivers (from the *Interim Construction Noise Guideline*)**

| Time of day | Construction noise management level $L_{Aeq,15min}$ | How to apply |
|---|---|---|
| Recommended standard hours:<br>Monday to Friday 7am to 6pm<br>Saturday 8am to 1pm<br>No work on Sundays or public holidays | Noise affected<br>RBL + 10 dB(A) | The noise affected level represents the point above which there may be some community reaction to noise.<br>• Where the predicted or measured $L_{Aeq,15\ min}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level.<br>• 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<br>75 dB(A) | The highly noise affected level represents the point above which there may be strong community reaction to noise.<br>• 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:<br>1. Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences.<br>2. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times. |
| Outside recommended standard hours | Noise affected<br>RBL + 5 dB(A) | • A strong justification would typically be required for works outside the recommended standard hours.<br>• The proponent should apply all feasible and reasonable work practices to meet the noise affected level.<br>• Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.<br>• For guidance on negotiating agreements see section 7.2.2 of the *Interim Construction Noise Guideline*. |

*Notes:*

*1 Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 metres above ground level. If the property boundary is more than 30 metres from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 metres of the residence. Noise levels may be higher at upper floors of the noise affected residence.*

### 4.2.1 Noise catchment areas

The construction noise and vibration study area has been divided into two distinct NCAs. The noise environment at each of the sensitive receivers within a NCA is considered to have a similar noise environment to the unattended monitoring location within that NCA. As such each of the sensitive receivers within an NCA is assigned the same background noise level and construction noise management level. The location of each NCA is shown in Figure 4-1.

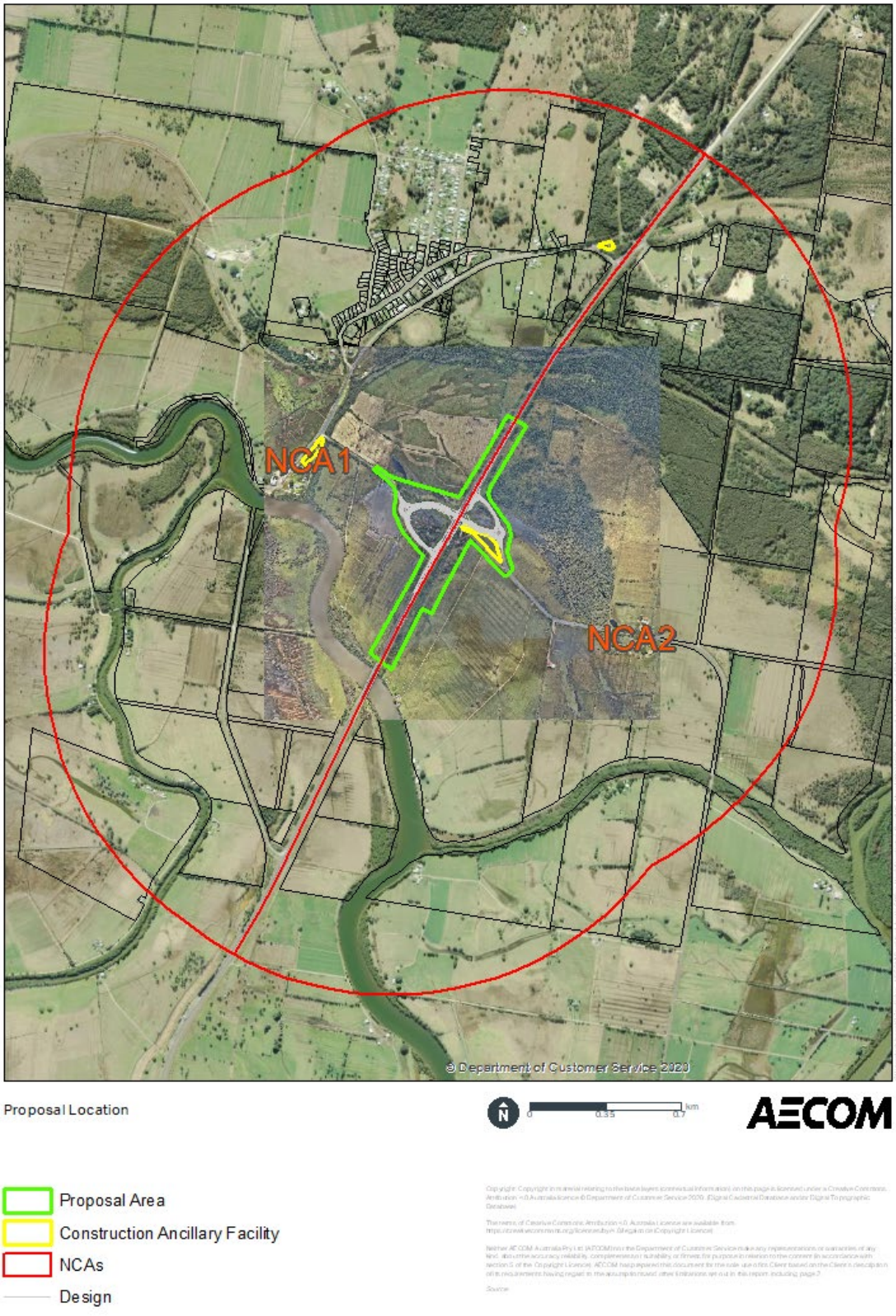



**Figure 4-1 Noise catchment areas**

Details of the construction noise management levels in each NCA are provided in Table 4-2.

**Table 4-2 Noise catchment areas and construction noise management levels**

| NCA | Representative logger | Period | Rating background level, dB(A) | Construction noise management level (NML)[1,2,3] |
|---|---|---|---|---|
| NCA01 | NL1 | Day | 42 | 52 (47) |
| | | Evening | 40 | 45 |
| | | Night | 35 | 40 |
| NCA02 | NL3 | Day | 41 | 51 (46) |
| | | Evening | 41 | 46 |
| | | Night | 37 | 42 |

*Notes:*
*1 Day noise management levels = RBL + 10 dB(A)*
*2 Evening/night noise management levels = RBL + 5 dB(A)*
*3 Day Out of Hours Management level given in brackets = RBL + 5 dB(A)*

### 4.2.2 Non-residential criteria

Relevant construction noise management levels recommended by the *Interim Construction Noise Guideline* for non-residential sensitive land uses, such as schools, hospitals or places of worship are provided in Table 4-3. Noise management levels for commercial and industrial premises are provided in Table 4-4.

**Table 4-3 Construction noise management levels – non-residential sensitive land uses**

| Land use | Construction management level, $L_{Aeq(15\ min)}$ |
|---|---|
| Classrooms at schools and other educational institutions | Internal noise level<br>45 dB(A) |
| Places of worship | Internal noise level<br>45 dB(A) |
| Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion) | External noise level<br>65 dB(A) |
| Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation) | External noise level<br>60 dB(A) |

**Table 4-4 Construction noise management levels – Commercial and industrial land uses**

| Land use | Construction management level, $L_{Aeq(15min)}$ |
|---|---|
| Industrial premises | External noise level<br>75 dB(A) |
| Offices, retail outlets | External noise level<br>70 dB(A) |

### 4.2.3 Sleep disturbance

The *Interim Construction Noise Guideline* requires a sleep disturbance assessment to be undertaken where construction works are planned to extend over more than two consecutive nights. The *Interim Construction Noise Guideline* makes reference to the NSW *Environment Criteria for Road Traffic Noise*, now superseded by the NSW *Road Noise Policy*, for assessment of sleep disturbance. The NSW *Road Noise Policy* references the recommendations in the *Environment Criteria for Road Traffic Noise* as providing the most appropriate assessment guidance.

The guidance provided in the *Road Noise Policy* for assessing the potential for sleep disturbance recommends that to minimise the risk of sleep disturbance during the night-time period (10pm to 7am), the $L_{A1(1\ min)}$ noise level outside a bedroom window should not exceed the $L_{A90(15\ min)}$ background noise level by more than 15 dB(A). The EPA considers it appropriate to use this metric as a screening criterion to assess the likelihood of sleep disturbance. If this screening criterion is found to be exceeded, then a more detailed analysis must be undertaken that should include the extent that the maximum noise level exceeds the background noise level and the number of times this is likely to happen during the night-time period.

The *Road Noise Policy* contains a review of research into sleep disturbance which represents NSW EPA advice on the subject of sleep disturbance due to noise events. It concludes that 'Maximum internal noise levels below 50-55 dB(A) are unlikely to cause awakening reactions'. Therefore, given that an open window provides about 10 dB(A) in noise attenuation from outside to inside, external noise levels of 60-65 dB(A) are unlikely to result in awakening reactions.

Table 4-5 presents the sleep disturbance screening and sleep disturbance awakening reaction criteria.

**Table 4-5 Construction noise sleep disturbance criteria**

| NCA | Night-time rating background level, dB(A) | Sleep disturbance screening $L_{A1(1min)}$ criteria, dB(A) | Sleep disturbance awakening reaction $L_{A1(1min)}$ criteria, dB(A) |
|---|---|---|---|
| NCA01 | 35 | 50 | 65 |
| NCA02 | 37 | 52 | 65 |

### 4.2.4 Construction road traffic noise

Transport's *Construction Noise and Vibration Guideline* (CNVG) refers to the *Interim Construction Noise Guideline* for construction traffic noise impacts. Noise from construction traffic on public roads is not covered by the *Interim Construction Noise Guideline*. However, the *Interim Construction Noise Guideline* does refer to the *Environmental Criteria for Road Traffic Noise*, which is now superseded by the *Road Noise Policy*, for the assessment of noise arising from construction traffic on public roads.

To assess noise impacts from construction traffic, an initial screening test has been undertaken by evaluating whether existing road traffic noise levels would increase by more than 2 dB(A) as a result of the proposal. Where the predicted noise increase is 2 dB(A) or less, then no further assessment is required. However, where the predicted noise level increase is greater than 2 dB(A), and the predicted road traffic noise level exceeds the road category specific criterion, then noise mitigation should be considered for those receivers affected. The *Road Noise Policy* does not require assessment of noise impact to commercial or industrial receivers.

## 4.3 Construction vibration criteria

The relevant standards/guidelines for the assessment of construction vibration are summarised in Table 4-6.

**Table 4-6 Standards/guidelines used for assessing construction vibration**

| Item | Standard/guideline |
|---|---|
| Structural damage | • Heritage structures – *German Standard DIN 4150 – Part 3 – Structural Vibration in Buildings – Effects on Structures (DIN 4150)*<br>• Non-heritage structures – *Evaluation and Measurement for Vibration in Buildings Part 2, (British Standard (BS) 7385:Part 2-1993) (BS 7385)* |
| Human comfort (tactile vibration) | • *Assessing Vibration: A Technical Guideline*[1] |
| Human comfort (ground-borne noise) | • *Interim Construction Noise Guideline* |

*Notes:*

*1 This document is based upon the guidelines contained in British Standard 6472:1992, "Evaluation of human exposure to vibration in buildings (1-80 Hz)". This British Standard was superseded in 2008 with BS 6472-1:2008 "Guide to evaluation of human exposure to vibration in buildings – Part 1: Vibration sources other than blasting" and the 1992 version of the Standard was withdrawn. Although a new version of BS 6472 has been published, the NSW EPA still requires vibration to be assessed in accordance with the 1992 version of the Standard at this point in time.*

Vibration and its associated effects are usually classified as continuous, impulsive or intermittent as follows:

- Continuous vibration continues uninterrupted for a defined period and includes sources such as machinery and continuous construction activities for example, a vibratory roller
- Impulsive vibration is a rapid build up to a peak followed by a damped decay. It may consist of several cycles at around the same amplitude, with a duration of typically less than two seconds and no more than three occurrences in an assessment period. This may include occasional dropping of heavy equipment or loading activities
- Intermittent vibration occurs where there are interrupted periods of continuous vibration, repeated periods of impulsive vibration or continuous vibration that varies significantly in magnitude. This may include intermittent construction activity such as from impact pile driving and jack hammers.

### 4.3.1 Structural damage

At present, no Australian Standards exist for the assessment of building damage caused by vibration. DIN 4150 and BS 7385-2 provide recommended maximum levels of vibration that reduce the likelihood of building damage caused by vibration and are presented in Table 4-7 and Table 4-8. DIN 4150 states that buildings exposed to higher levels of vibration than recommended limits would not necessarily result in damage. Structural damage criteria for heritage items have been taken from DIN 4150, whilst criteria for commercial/residential items have been taken from BS 7385.

**Table 4-7 Structural damage safe criteria (DIN 4150) for building vibration (Peak particle velocity)**

| Group | Type of structure | At foundation – Less than 10 Hz | At foundation – 10 Hz to 50 Hz | At foundation – 50 Hz to 100 Hz[1] | Vibration at the horizontal plane of the highest floor for all frequencies |
|---|---|---|---|---|---|
| 1 | Buildings used for commercial purposes, industrial buildings and buildings of similar design | 20 mm/s | 20 to 40 mm/s | 40 to 50 mm/s | 40 mm/s |
| 2 | Dwellings and buildings of similar design and/or use | 5 mm/s | 5 to 15 mm/s | 15 to 20 mm/s | 15 mm/s |
| 3 | Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Lines 1 or 2 and have intrinsic value (e.g. buildings that are under a preservation order/heritage listed) | 3 mm/s | 3 to 8 mm/s | 8 to 10 mm/s | 8 mm/s |

*Notes:*

*1. At frequencies above 100 Hz, the values given in this column may be used as minimum values*

**Table 4-8 BS 7385-2: Transient vibration guide values for cosmetic damage**

| Group | Type of building | Peak component particle velocity in frequency range of predominant pulse | |
|---|---|---|---|
| | | 4 Hz to 15 Hz | 15 Hz and above |
| 1 | Reinforced or framed structures<br>Industrial and heavy commercial buildings | 50 mm/s at 4 Hz and above | |
| 2 | Unreinforced or light framed structures<br>Residential or light commercial type buildings | 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 |

### 4.3.2 Human comfort

Humans are sensitive to vibration such that they can detect vibration levels well below those required to cause any risk of damage to a building or its contents. Criteria to avoid annoyance are therefore more stringent than those to prevent structural damage.

#### 4.3.2.1 Intermittent vibration

The assessment of intermittent vibration outlined in *Assessing Vibration: A Technical Guideline* is based on Vibration Dose Values (VDVs). The VDV accumulates the vibration energy received over the daytime and night-time periods.

Maximum and preferred VDVs for intermittent vibration arising from construction activities are listed in Table 4-9. The VDV criteria are based on the likelihood that a person would be annoyed by the level of vibration over the entire assessment period.

**Table 4-9 Preferred and maximum vibration dose values for intermittent vibration ($m/s^{1.75}$)**

| Location | Day time | | Night-time | |
|---|---|---|---|---|
| | Preferred | Max | Preferred | Max |
| Critical areas[1] | 0.10 | 0.20 | 0.10 | 0.20 |
| Residences[2] | 0.20 | 0.40 | 0.13 | 0.26 |
| Offices, schools, educational institutions and places of worship | 0.40 | 0.80 | 0.40 | 0.80 |
| Workshops | 0.80 | 1.60 | 0.80 | 1.60 |

*Notes:*

*1 Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria.*

*2 Criteria for residences are lower than schools as people expect to be able to relax/sleep in their homes without annoyance and are generally more concerned about structural damage than would be the case within schools and offices.*

#### 4.3.2.2 Continuous and impulsive vibration

Acceptable levels of human exposure to continuous and impulsive vibration are dependent on the time of day and the activity taking place in the occupied space. *Assessing Vibration: A Technical Guideline* provides the preferred values for continuous and impulsive vibration. These are presented in Table 4-10.

There is low probability of adverse comment or disturbance to building occupants at vibration values below the preferred values in Table 4-10. Situations exist where vibration above the preferred values can be acceptable, particularly for temporary disturbances and infrequent events of short duration. Vibration levels above those indicated in Table 4-10 may be dealt with through negotiation with the regulator of the affected community.

**Table 4-10 Peak particle velocity for continuous and impulsive vibration (mm/s)**

| Location | Assessment period | Preferred | Maximum |
|---|---|---|---|
| **Continuous vibration** | | | |
| Critical areas[1] | When in use | 0.14 | 0.28 |
| Residences[2] | Day<br>Night | 0.28<br>0.20 | 0.56<br>0.40 |
| Offices, schools, educational institutions and places of worship | When in use | 0.56 | 1.10 |
| Workshops | When in use | 1.10 | 2.20 |
| **Impulsive vibration** | | | |
| Critical areas[1] | When in use | 0.14 | 0.28 |
| Residences[2] | Day<br>Night | 8.60<br>2.80 | 17.0<br>5.60 |
| Offices, schools, educational institutions and places of worship | When in use | 18.0 | 36.0 |
| Workshops | When in use | 18.0 | 36.0 |

*Notes:*
1 *Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria.*
2 *Criteria for residences are lower than schools as people expect to be able to relax/sleep in their homes without annoyance and are generally more concerned about structural damage than would be the case within schools and offices.*

## 4.4 Operational road traffic noise criteria

### 4.4.1 Operational road traffic noise criteria – Residential receivers

Noise criteria are assigned to sensitive receivers using the *Road Noise Criteria Guideline*. The *Road Noise Criteria Guideline* provides guidance on how to apply the *Road Noise Policy*.

Redevelopment does not cover minor road works. Minor road works are generally undertaken to improve safety, such as straightening curves, installing traffic control devices, intersection widening and turn bay extensions or making minor road realignments. These works are not considered redeveloped or new as they are not intended to increase the traffic carrying capacity of the overall road or accommodate a significant increase in heavy vehicle traffic.

Transport applies existing road criteria where the minor works increase noise levels by more than 2.0 dB(A) relative to the existing noise levels at the worst affected receiver. The existing road criteria are presented in Table 4-11.

**Table 4-11 Target noise abatement levels for existing roads not subject to redevelopment**

| Existing road category | External target noise levels, dB(A) | |
|---|---|---|
| | Day (7 am – 10 pm) | Night (10 pm – 7 am) |
| Freeway/arterial/sub-arterial road | $L_{Aeq\ (15hr)}$ 60 | $L_{Aeq\ (9hr)}$ 55 |

The *Road Noise Policy* requires the consideration of two scenarios, the 'no build' option (without the proposal) and the 'build' option (with the proposal). The 'no build' option represents the scenario if the proposal was not to proceed. The 'build' option represents the scenario if the proposal was to proceed.

Each of these scenarios must be considered at two points in time, the year of opening and the design year, typically ten years after opening. For this proposal, the year 2028 has been assessed as the year of opening, and 2038 has been assessed as the design year.

For the assessment of minor works the noise catchment should include all receivers where noise levels increase. This may be up to 600 m from the centre line of the outermost traffic lane on each side of the subject road.

The external noise criteria are applied at one metre from the façade that is most exposed to traffic noise and at a height of 1.5 metres from the floor level. The criteria include an allowance for noise reflected from the façade.

Receivers identified for assessment have been assigned ID receiver numbers for the purposes of this assessment.

### 4.4.2 Operational road traffic noise criteria – Non-residential sensitive receivers

The criteria for other sensitive receivers are presented in Table 4-12. For schools, places of worship and childcare facilities, the *Road Noise Criteria Guideline* criteria are based on internal noise levels. A conservative minimum outside-to-inside attenuation of 10 dB(A), on the basis of open windows for natural ventilation, has been assumed to allow for an external noise assessment at the other sensitive receivers. As details are not currently available to allow the building-specific façade noise reduction to be identified, it is recommended that this should be investigated further at detailed design if required (i.e. if receiver qualifies for consideration of feasible and reasonable mitigation measures).

The noise model predicts noise levels for $L_{Aeq(15\ hr)}$ and $L_{Aeq(9\ hr)}$ periods for day and night-time respectively.

**Table 4-12 Road traffic noise assessment criteria for non-residential land use**

| Existing sensitive land use | Assessment criteria | | Additional considerations |
|---|---|---|---|
| | Day (7am – 10pm) | Night (10pm – 7am) | |
| 1. School classrooms | $L_{Aeq(1\ hr)}$ 40 (internal) | - | In the case of buildings used for education or health care, noise level criteria for spaces other than classrooms and wards may be obtained by interpolation from the 'maximum' levels shown in Australian Standard 2107:2000 (Standards Australia 2000) |

### 4.4.3 Guidance for the evaluation of feasible and reasonable noise mitigation measures

As noted above if the $L_{Aeq}$ noise level during the day or the night is predicted to increase by more than 2 dB(A) as a result of works, and the predicted noise level is higher than the guidelines for existing roads set out in Table 4-12, noise treatments should be provided where feasible and reasonable.

Where the *Road Noise Criteria Guideline* criteria are exceeded, the *Road Noise Mitigation Guideline* provides guidance where the provision of additional controls, such as noise barriers, architectural treatments and quieter pavements, would be considered 'feasible and reasonable'. It should be acknowledged that these considerations apply only if it can be demonstrated that all 'feasible and reasonable' traffic management and other road design opportunities for reduction of traffic noise at the source have been exhausted.

The *Road Noise Mitigation Guideline* provides guidance on managing and controlling road traffic generated noise and describes the principles to be applied when reviewing noise mitigation options. The *Road Noise Mitigation Guideline* recognises that the criteria recommended by the *Road Noise Criteria Guideline* are not always practicable and that it is not always feasible and/or reasonable to expect that they should be achieved.

For receivers that qualify for consideration of additional noise mitigation measures, potential noise mitigation measures include:

- Quieter pavement surfaces
- Noise mounds
- Noise walls
- At-receiver treatments.

Where quieter pavement surfaces and noise mounds or walls are shown not to be feasible or reasonable then at-receiver treatments can be considered.

### 4.4.4 Maximum noise levels – road traffic

Maximum noise levels generated by road traffic noise have the potential to cause disturbance to sleep. Although maximum noise goals are not provided in the *Road Noise Policy*, it does include a review of internal sleep arousal research. It concludes that there appears to be insufficient evidence to set new indicators for potential sleep disturbance due to road traffic noise. Nevertheless, Transport for NSW recognises the potential impacts and requires an assessment of maximum noise levels be made where impacts may occur during the night.

Guidance for assessing maximum noise levels are provided in Practice Note iii of the *Environmental Noise Management Manual*. The maximum noise assessment should be used as a tool to help prioritise and rank mitigation strategies, but should not be used as a decisive criterion in itself and should not be used to aid in designing the degree of mitigation required.

The assessment considers the following:

- Calculation of maximum noise levels
- The extent to which the maximum noise levels for individual vehicle pass-bys exceed the $L_{Aeq}$ noise level for each hour of the night (i.e. $L_{Amax}$ noise levels greater than 65 dB(A) where $L_{Amax} – L_{Aeq(1hr)} \geq 15$ dB(A))
- The number of times the maximum noise levels for individual vehicle pass-bys exceed the $L_{Aeq}$ noise level for each hour of the night.

# 5.0 Construction noise and vibration impact assessment

## 5.1 Construction scenarios and equipment

As outlined in Section 2.2, the following works would be undertaken along the length of the proposal alignment:

1. site establishment and enabling works
2. utility works and property adjustments
3. vegetation clearing
4. earthworks and drainage
5. bridge construction
6. pavement construction
7. landscaping and finishing works
8. removal of ancillary facilities and site rehabilitation.

The construction scenarios used in this assessment have been taken from BS5228-2:2009 *Code of practice for noise and vibration control on construction and open sites Noise* where available.

The equipment and associated sound power levels construction phases associated with the minor works are shown in Table 5-1. Works associated with ancillary facilities are shown in Table 5-2.

**Table 5-1 Assessed construction scenarios and equipment – Minor works**

| Construction scenario | Equipment | Sound power level, dB(A) |
|---|---|---|
| C01 – Site Establishment | Excavators | 98 |
| | Backhoes | 97 |
| | Cranes | 104 |
| | Concrete trucks | 106 |
| | Concrete pumps | 106 |
| | Roller/compacters | 105 |
| | Water trucks | 104 |
| | Dump trucks | 105 |
| | Road Trucks, Low Loaders for Floating plant onsite. | 108 |
| | Wacker plate compactor | 106 |
| | **Total** | **115** |

| Construction scenario | Equipment | Sound power level, dB(A) |
|---|---|---|
| C02 – Utility Relocations | Excavators | 98 |
| | Franna | 98 |
| | Cranes | 104 |
| | Jackhammers[1] | 108 |
| | Concrete saws[2] | 115 |
| | Vacuum truck | 103 |
| | Backhoes | 97 |
| | Generator | 99 |
| | **Total** | **113** |
| C03 – Vegetation Clearing | Chainsaws | 110 |
| | Bulldozers | 106 |
| | Mulchers | 120 |
| | Dump trucks | 105 |
| | **Total** | **121** |
| C04 – Earthworks and Drainage | Excavators, backhoes | 98 |
| | Bulldozers | 106 |
| | Dump trucks | 105 |
| | Rollers/compactors | 105 |
| | Graders | 108 |
| | Water trucks | 104 |
| | Scrapers | 108 |
| | Trenching machine | 102 |
| | Under boring rig | 105 |
| | Road trucks delivering materials | 108 |
| | Wacker packers | 106 |
| | Concrete trucks | 106 |
| | **Total** | **117** |
| C05 – Bridge Construction (including approaches and roundabouts) | Excavators | 98 |
| | Backhoes | 97 |
| | Cranes | 104 |
| | Trucks with dolly for transportation of bridge beams | 108 |
| | Road trucks delivering materials | 108 |
| | Concrete trucks | 106 |
| | Concrete pumps | 106 |
| | Piling rig (impact)[2] | 120 |
| | Dump trucks | 105 |
| | **Total** | **118** |

| Construction scenario | Equipment | Sound power level, dB(A) |
|---|---|---|
| C05 Night – Night-time Bridge Construction | Cranes | 104 |
| | Trucks with dolly for transportation of bridge beams | 108 |
| | Road trucks delivering materials | 108 |
| | **Total** | **112** |
| C06 – Pavement Construction | Dump trucks | 105 |
| | Road trucks delivering materials | 108 |
| | Water trucks | 104 |
| | Concrete saws | 115 |
| | Graders | 108 |
| | Roller/compacters | 105 |
| | Backhoes | 97 |
| | Concrete trucks including bitumen sprayers and aggregate spreaders | 106 |
| | Kerb extrusion machine | 104 |
| | Milling machine | 110 |
| | **Total** | **118** |
| C07 – Landscaping and Finishing Work | Line marking truck | 103 |
| | Asphalt pavers | 103 |
| | Cranes | 104 |
| | Dump trucks | 105 |
| | Road sweepers | 104 |
| | Elevated work platform | 98 |
| | Franna | 98 |
| | **Total** | **111** |
| C08 – Removal of Ancillary Facilities and Site Rehabilitation | Dump trucks | 105 |
| | Road trucks, low loaders for floating plant offsite. | 108 |
| | Water trucks | 104 |
| | Hand tools | 94 |
| | Cranes | 104 |
| | Backhoes | 97 |
| | **Total** | **112** |

*Notes:*

1. *Assumed to be in operation for 50% of any 15 minute period.*
2. *Assumed to be in operation for 33% of any 15 minute period.*

**Table 5-2 Assessed construction scenarios and equipment – Ancillary facilities**

| Construction scenario | Equipment | Sound power level, dB(A) |
|---|---|---|
| A01 – Vegetation Clearing | Chainsaws | 110 |
| | Bulldozers | 106 |
| | Mulchers | 120 |
| | Dump trucks | 105 |
| | **Total** | **121** |
| A02 – Utility Works | Excavators | 98 |
| | Franna | 98 |
| | Cranes | 104 |
| | Jackhammers[1] | 108 |
| | Concrete saws[2] | 115 |
| | Vacuum truck | 103 |
| | Backhoes | 97 |
| | Generator | 99 |
| | **Total** | **113** |
| A03 – Laydown, Storage and Delivery of Materials and Equipment | Roads trucks | 108 |
| | **Total** | **108** |
| A04 - Crushing | Crusher plant | 127 |
| | Road trucks | 108 |
| | **Total** | **127** |
| A05 - Stockpiling | Front end loader | 107 |
| | Dump trucks | 105 |
| | Backhoe | 97 |
| | **Total** | **109** |

*Notes:*

1. *Assumed to be in operation for 50% of any 15 minute period.*
2. *Assumed to be in operation for 33% of any 15 minute period.*

## 5.2 Construction hours

Construction would largely be carried out during standard construction work hours in accordance with the *Interim Construction Noise Guideline* (DECC, 2009):

- Monday to Friday: 7am to 6pm
- Saturday: 8am to 1pm
- Sundays and public holidays: no work.

Construction activities that involve impulsive or tonal noise emissions would be limited to the following hours in accordance with the *Construction Noise and Vibration Guideline* (Roads and Maritime, 2016):

- Monday to Friday: 8am to 5pm
- Saturday: 9am to 1pm
- Sundays and public holidays: no work.

To minimise disruption to daily traffic and disturbance to surrounding landowners and businesses, it would be necessary to carry out some work outside of standard construction work hours. The following activities may take place outside standard construction work hours:

- Delivery of construction materials such as precast bridge structures
- Construction of the Bridge over the Pacific Highway
- Intersection and tie-in activities of the bypass to existing roads
- Installation and adjustment of barriers and signage for construction zones during each construction stage.

Any out of hours work would require justification, assessment and more detailed management. This would be completed in accordance with the Construction Noise and Vibration Management Plan (CNVMP) developed for the proposal during detailed design.

## 5.3 Construction noise modelling

Construction noise modelling of the proposed construction scenarios outlined in Section 5.1 was completed using SoundPLAN version 8.2 noise modelling software. The modelling used the ISO 9613-2 algorithm and included ground topography, buildings and structures and representative construction noise sources. Free field point receivers at 1.5 metres high were assumed and source heights are dependent on the equipment.

It can be expected that there may be differences between predicted and measured noise levels due to variations in instantaneous operating conditions, plant in operation during the measurement and also the location of the plant equipment. The acoustic shielding calculated in the model due to localised fixed building structures would also vary as the construction equipment moves around the construction footprint.

In accordance with Section 5.2 all the construction scenarios have been assessed during standard construction hours. In addition, the bridge construction scenario has also been assessed during the out of hours period.

### 5.3.1 Construction noise impacts

#### 5.3.1.1 Residential receivers

Table 5-3 presents the construction noise modelling results for residential properties and shows the number of properties where the construction noise management levels are likely to be exceeded during the daytime and night-time. The tables also present the number of receivers where noise levels are predicted to exceed the highly affected level (75 dB(A)) for each NCA. The community perception of noise is defined as ‘noticeable’, ‘clearly audible’, ‘moderately intrusive’ and ‘highly intrusive’ as defined in Table 7-2 and included in the discussion of noise exceedances set out in Table 5-3.

During standard hours additional noise mitigation measures are required where noise levels are predicted to be ‘moderately intrusive’ or ‘highly intrusive’ or where receivers are considered to be ‘highly affected’ as described in Section 6.1.2. During out of hours periods additional noise mitigation measures are required where noise levels are predicted to be ‘clearly audible’, ‘moderately intrusive’ and ‘highly intrusive’ or where receivers are considered to be ‘highly affected’.

It is important to consider that this assessment is representative of the worst case 15-minute period of construction activity, while the construction equipment is at the nearest location to each sensitive receiver location. The assessed scenario does not represent the ongoing day to day noise impact at noise sensitive receivers for an extended period of time.

Particularly noisy activities, such as rock hammering and use of concrete saws, are likely to persist for only a fraction of the overall construction period. In addition, the predictions use the shortest separation distance to each sensitive receiver, however in reality separation distances would vary between plant and sensitive receivers. For linear works (works that move along the road alignment, rather than works located at a construction ancillary facility) noise exposure at each receiver would reduce due to increases in distance as the works progress along the alignment. Typical noise levels could be 5 to 10 dB(A) lower dependent on the site and nature of works.

The *Interim Construction Noise Guideline* states that where a construction noise impact level of greater than 75 dB(A) is predicted, a receiver is considered to be ‘highly noise affected’ and afforded additional consideration for mitigation. The receivers where noise levels exceed 75 dB(A) are shown on the noise contours provided in Appendix C. The potential for highly noise affected receivers would be confirmed during detailed construction planning. These receivers would receive additional consultation with regards to specific timing and impacts of construction works. Respite periods would also be considered for these receivers in accordance with the *Interim Construction Noise Guideline.*

Feasible and reasonable mitigation measures would be detailed in the Construction Noise and Vibration Management Plan (refer to Section 7.1).

**Table 5-3 Number of residential buildings where noise levels may exceed construction noise management levels for all construction scenarios – Minor Works**

| Scenario | Number of residential buildings where noise levels may exceed construction noise management levels | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Standard construction hours | | | Outside of standard construction hours (night-time) | | | | Highly affected > 75 dB(A) |
| | Clearly audible | Mode-rately intrusive | Highly intrusive | Notice-able | Clearly audible | Mode-rately intrusive | Highly intrusive | |
| | 1-10 dB | 11-20 dB | > 20 dB | 1-5 dB | 6-15 dB | 16-25 dB | > 25 dB | |
| **NCA1** | | | | | | | | |
| C01 | 10 | 4 | 1 | - | - | - | - | 0 |
| C02 | 0 | 0 | 0 | - | - | - | - | 0 |
| C03 | 10 | 1 | 0 | - | - | - | - | 0 |
| C04 | 0 | 0 | 0 | - | - | - | - | 0 |
| C05 | 2 | 0 | 0 | 4 | 0 | 0 | 0 | 0 |
| C06 | 8 | 1 | 0 | - | - | - | - | 0 |
| C07 | 2 | 0 | 0 | - | - | - | - | 0 |
| C08 | 7 | 1 | 1 | - | - | - | - | 0 |
| **NCA2** | | | | | | | | |
| C01 | 3 | 0 | 0 | - | - | - | - | 0 |
| C02 | 0 | 0 | 0 | - | - | - | - | 0 |
| C03 | 3 | 1 | 0 | - | - | - | - | 0 |
| C04 | 0 | 0 | 0 | - | - | - | - | 0 |
| C05 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| C06 | 5 | 2 | 0 | - | - | - | - | 0 |
| C07 | 2 | 0 | 0 | - | - | - | - | 0 |
| C08 | 2 | 0 | 0 | - | - | - | - | 0 |

**Table 5-4 Number of residential buildings where noise levels may exceed construction noise management levels for all construction scenarios – Ancillary Facilities**

| Scenario | Number of residential buildings where noise levels may exceed construction noise management levels | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Standard construction hours | | | Outside of standard construction hours (night-time) | | | | Highly affected > 75 dB(A) |
| | Clearly audible | Mode-rately intrusive | Highly intrusive | Notice-able | Clearly audible | Mode-rately intrusive | Highly intrusive | |
| | 1-10 dB | 11-20 dB | > 20 dB | 1-5 dB | 6-15 dB | 16-25 dB | > 25 dB | |
| **NCA1** | | | | | | | | |
| A01 | 24 | 7 | 2 | - | - | - | - | 0 |
| A02 | 8 | 2 | 1 | - | - | - | - | 0 |
| A03 | 7 | 1 | 0 | - | - | - | - | 0 |
| A04 | 8 | 2 | 1 | - | - | - | - | 0 |
| A05 | 7 | 1 | 0 | - | - | - | - | 0 |
| **NCA2** | | | | | | | | |
| A01 | 7 | 2 | 0 | - | - | - | - | 0 |
| A02 | 2 | 0 | 0 | - | - | - | - | 0 |
| A03 | 0 | 0 | 0 | - | - | - | - | 0 |
| A04 | 2 | 0 | 0 | - | - | - | - | 0 |
| A05 | 0 | 0 | 0 | - | - | - | - | 0 |

The results of the construction noise modelling show that construction works associated with the minor works within the proposal area would exceed the applicable NMLs at some residential receivers. In this instance, Site establishment (C01) is predicted to be the worst-case construction scenario. Up to 15 receivers in NCA1 and three receivers in NCA2 are predicted to exceed the applicable NML, with one receiver in NCA1 predicted to be receive highly intrusive noise levels.

For construction works at ancillary facilities, vegetation clearing (A01) is similarly predicted to have the greatest impact at sensitive receivers. Up to 33 receivers in NCA1 and nine receivers in NCA2 are predicted to exceed the applicable NML during the daytime. Two receivers are considered to be highly affected during this stage of construction works. The number of receivers where noise levels are predicted to exceed the NMLs is predominantly due to the low density of receivers in close proximity to construction activities, in addition to the distances between many receivers and proposed construction activities within the Project area and ancillary facilities.

#### 5.3.1.1.1 Sleep disturbance assessment

Sleep disturbance is assessed using an $L_{A1(1\ min)}$ parameter, which is considered to be the maximum noise level excluding extraneous noise events. A sleep disturbance assessment has been undertaken for the proposed night works with the construction information available to date. The noise modelling results are provided in Table 5-5 with the number of residential buildings where noise levels are predicted to exceed the sleep disturbance screening criteria and the awakening reaction criteria. Appendix D presents the $L_{A1(1min)}$ noise contours.

Results of the construction sleep disturbance assessment shown in Table 5-5 below indicate that there are no exceedances of either the sleep disturbance screening criterion or the awakening reaction level for the proposed night-time works.

However, for the works that would take place outside of standard hours, it is still recommended that an effective communication plan and noise management measures be developed during detailed design to minimise the impacts upon affected sensitive receivers.

**Table 5-5 Number of residential buildings where noise levels may exceed sleep disturbance criteria for night works**

| Scenario | Number of residential buildings where noise levels may exceed the sleep disturbance screening level and/or the awakening reaction level | |
|---|---|---|
| | Sleep disturbance screening level $L_{A1(1\ minute)}$, dB(A) | Awakening reaction level $L_{A1(1\ minute)}$, dB(A) |
| **NCA01** | | |
| C05 Night | 0 | 0 |
| **NCA02** | | |
| C05 Night | 0 | 0 |

#### 5.3.1.2 Other receivers

The construction noise modelling for non-residential properties indicates that there are no additional properties where the construction noise management levels are likely to be exceeded during their hours of use. This assessment is representative of the worst case 15-minute period of construction activity, while the construction equipment is at the nearest location to each receiver location.

## 5.4 Construction vibration

### 5.4.1 Minimum working distances

Construction vibration may be generated due to the vibration intensive equipment that may potentially be used during some stages of work. Multiple equipment sizes are provided for completeness. The minimum working distances for these items of equipment from off-site receivers are shown in Table 5-6.

**Table 5-6 Recommended minimum working distances for vibration intensive plant**

| Plant item | Rating/Description | Minimum working distance | | |
|---|---|---|---|---|
| | | Cosmetic damage (BS 7385) Light-framed structures | Cosmetic damage (DIN 4150) Heritage and other sensitive structures | Human response (EPA's Vibration guideline) |
| Vibratory Roller | < 50 kN (Typically 1-2 t) | 5 m | 14 m | 15 m to 20 m |
| | < 100 kN (Typically 2-4 t) | 6 m | 16 m | 20 m |
| | < 200 kN (Typically 4-6 t) | 12 m | 33 | 40 m |
| | < 300 kN (Typically 7-13 t) | 15 m | 41 | 100 m |
| | > 300 kN (Typically 13-18 t) | 20 m | 54 m | 100 m |
| | > 300 kN (> 18 t) | 25 m | 68 m | 100 m |
| Small Hydraulic Hammer | (300 kg - 5 to 12 t excavator) | 2 m | 5 m | 7 m |
| Medium Hydraulic Hammer | (900 kg – 12 to 18 t excavator) | 7 m | 19 m | 23 m |
| Large Hydraulic Hammer | (1,600 kg – 18 to 34 t excavator) | 22 m | 60 m | 73 m |
| Vibratory Pile Driver | Sheet piles | 20 m | 50 m | 100 m |
| Pile Boring | ≤ 800 mm | 2 m (nominal) | 4 m | 4 m |
| Jackhammer | Handheld | 1 m (nominal) | 2 m | 2 m |

This is based on recommendations of the *Construction Noise and Vibration Guideline* and AECOM's previous project experience. If these minimum working distances are complied with, no adverse impacts from vibration intensive works are likely in terms of human response or cosmetic damage. Equipment size would be selected by the construction contractor and would take into account the minimum working distances and the distance between the area of construction and the nearest receiver. If vibration intensive works are required within these minimum working distances, mitigation measures to control excessive vibration would be implemented as outlined in Section 7.1.

### 5.4.2 Human comfort

Works undertaken within the human comfort minimum working distances may cause some people to experience annoyance and concern for cosmetic damage. Receivers located within the minimum distances for human comfort would be notified of the potential impacts as part of the notification of highly noise affected receivers.

### 5.4.3 Cosmetic damage

Table 5-6 presents minimum working distances to minimise the likelihood of cosmetic damage on buildings and structures, including heritage items. The non-Aboriginal Heritage assessment prepared for the proposal does not identify any heritage items that are likely to be impacted by construction vibration, due to their distance from vibration intensive works.

Works undertaken within minimum working distances for cosmetic damage may cause damage to buildings. However, damage to heritage and other buildings is unlikely to occur when the management measures have been implemented appropriately. These measures include undertaking attended

vibration measurements at the work site when work commences, to determine site specific minimum working distances. These measurements would be made progressively at distances outside the minimum working distances to ensure no structure damage occurs and would provide detailed information regarding the transmission of vibration to allow site specific safe working distances to be determined.

## 5.5 Construction road traffic noise

The numbers of construction vehicle movements have been conservatively estimated to be up to 150 light and 350 heavy vehicles per day (up to 24 per hour) during peak construction periods. Vehicles would access the site primarily by the Pacific Highway. Heavy vehicles would only access the site from approved heavy vehicle routes.

The existing traffic flows on the Pacific Highway have been presented below in Table 5-7, along with the proposed additional construction traffic and resultant relative noise increase.

**Table 5-7 Existing traffic flows and additional traffic flows due to construction traffic**

| Road | Existing daily traffic flow | | Additional daily traffic flow | | Relative noise increase, dB(A) |
|---|---|---|---|---|---|
| | Light | Heavy | Light | Heavy | |
| Pacific Highway | 15,029 | 3,776 | 150 | 350 | 0.1 |

Analysis shows that construction road traffic noise would not noticeably impact existing road traffic noise along the Pacific Highway, with road traffic noise increases expected to be well below the 2 dB(A) threshold. Therefore, no further consideration of construction road traffic noise is required.

# 6.0 Operational impact assessment

## 6.1 Road traffic noise assessment

The assessment of road traffic noise has been completed in accordance with the *Road Noise Policy*, the *Road Noise Criteria Guideline* and the *Road Noise Mitigation Guideline*. The *Road Noise Criteria Guideline* and the *Road Noise Mitigation Guideline* provide details of the practical application of the criteria presented in the *Road Noise Policy*.

To assess the potential impact of the proposal on noise sensitive receivers, the following steps have been completed:

- Existing road traffic noise levels have been modelled with existing (2021) road traffic volumes. This model has been validated with noise measurements and concurrent road traffic surveys. This is discussed further in Section 6.2.1
- Future road traffic noise levels have been modelled for the 'build' (without the proposal) and the 'no build' scenarios for the opening year (2028) and design year (2038). This is discussed further in Section 6.2 and results are presented in Section 6.2.2.

### 6.1.1 Road traffic noise modelling methodology

Road traffic noise levels were calculated using SoundPLAN v8.2 software, which implements the Calculation of Road Traffic Noise (CoRTN) algorithm. The United Kingdom (UK) Department of Transport devised the CoRTN algorithm and with suitable corrections, this method has been shown to give accurate predictions of road traffic noise and has been found to consistently model noise predictions for all Transport's road projects.

CoRTN is the most widely used algorithm for the prediction of road traffic noise within Australia and is an accepted algorithm under the EPA's *Road Noise Policy* (Appendix B4). It is the only algorithm at this point in time which has been evaluated under Australian conditions. Recently in NSW, adjustments have been used to CoRTN predictions to improve accuracy. This includes the use of three source heights for trucks (tyres, engines and exhausts) and the application of a heavy vehicle mix correction to account for the larger heavy vehicle fleet in Australia compared with the UK, where CoRTN was developed.

Where road gradients affect road emissions and speed of vehicles, posted speeds are modelled within CoRTN which are higher than actual speeds on the road gradient and provide a conservative approach. The road design includes optimised grades, there are no locations where grades of significance have any bearing on predicted noise levels.

Whilst road traffic noise levels at receivers may vary at times due to changes in weather conditions such as wind speed and direction and temperature inversions, it is noted that the *Road Noise Policy* does not require road traffic noise criteria to be met under adverse meteorological conditions.

As noted in the *Road Noise Model Validation Guideline* the objective of model validation is to demonstrate that the noise model is an accurate representation of the real world within the limitations of the algorithm. Validation of the existing noise model is presented in Section 4.2.

The modelling parameters which are included in the model are detailed in Table 6-1.

**Table 6-1 Modelling noise parameters**

<table>
<tr><th>Parameter</th><th>Comment</th></tr>
<tr><td>Calculation search radius</td><td>2,000 metres</td></tr>
<tr><td>Assessment area</td><td>600 metres</td></tr>
<tr><td>Source heights and corrections</td><td>Four noise source heights were used in the model as follows:
<table>
<tr><th>Source</th><th>Height (m)</th><th>Correction (dB)</th></tr>
<tr><td>Light vehicles engine and tyres</td><td>0.5</td><td>0.0</td></tr>
<tr><td>Heavy vehicles tyres</td><td>0.5</td><td>-5.4</td></tr>
<tr><td>Heavy vehicles engine</td><td>1.5</td><td>-2.4</td></tr>
<tr><td>Heavy vehicles exhaust</td><td>3.6</td><td>-8.5</td></tr>
</table></td></tr>
<tr><td>Existing road alignment</td><td>The existing roads were modelled using satellite imagery.</td></tr>
<tr><td>Road gradient</td><td>The road gradient was calculated based on elevation information system (ELVIS) data.</td></tr>
<tr><td>Existing pavement</td><td>The road pavements modelled were as dense graded asphalt (DGA).<br>DGA pavement correction = 0 dB.</td></tr>
<tr><td>Calibration corrections</td><td>Day: 0.0 dB</td><td>Night: 0.0 dB</td></tr>
<tr><td>Façade reflection</td><td>+2.5 dB correction for façade reflected receivers.</td></tr>
<tr><td>$L_{10}$ to $L_{eq}$</td><td>-3 dB correction</td></tr>
<tr><td>Receiver heights</td><td>1.5 metres for single storey and 4.5 metres for double storey.</td></tr>
<tr><td>Receiver locations</td><td>1 metre from the façade of receivers.</td></tr>
<tr><td>Buildings, structures and walls</td><td>All buildings and structures were included where acoustically relevant.</td></tr>
<tr><td>Ground absorption</td><td>A ground absorption factor of 0.75 was used for soft ground areas. 1.0 was used in areas of dense vegetation during the validation process, however this was reduced to 0.75 during the design assessment, to take into account that dense vegetation could be cleared in the future.</td></tr>
<tr><td>Topography</td><td>1 metre interval data up to 1 kilometre either side of the proposal.</td></tr>
<tr><td>Traffic volumes and mix</td><td>For model validation, the traffic counting carried out at the time of the noise monitoring was used. Future traffic volumes for the ‘Year of Opening’ 2028 and ‘Design Year’ 2038 were provided by the AECOM traffic modelling team</td></tr>
<tr><td>Traffic speeds</td><td>For model validation, the speed measured during the traffic counting at the time of the noise monitoring was used. For the future scenarios the posted speeds were used.</td></tr>
<tr><td>Temperature and vehicle classification</td><td>Corrections were applied to account for the vehicle classification and temperature in accordance with Peng et al. 2017, Evaluation of Calculation of Road Traffic Noise in Australia.</td></tr>
<tr><td>Noise sensitive receivers</td><td>In accordance with the Road Noise Policy this includes residences, school classrooms, hospital wards, places of worship, open space (active and passive use), mixed use development, childcare facilities and aged facilities.</td></tr>
</table>

### 6.1.2 Validation noise model

An existing road traffic noise model was developed incorporating the existing traffic flows and alignment for validation with road traffic noise measurements. The traffic flows and resulting CoRTN corrections used in the validation model were provided by tube counts that were deployed concurrently with noise logging for the proposal and are provided in Table 6-2 below. Noise logging charts are provided in Appendix B.

**Table 6-2 Validation noise model traffic flows and corrections**

| Location | Direction | Daytime (7am – 10pm) | | | | | Night-time (10pm – 7am) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Traffic volume | Heavy vehicle ratio | Vehicle speed, km/h | LV Correction | HV Correction | Traffic volume | Heavy vehicle ratio | Vehicle speed, km/h | LV Correction | HV Correction |
| Pacific Highway | Northbound | 8,318 | 18% | 98 | -0.3 | 1.3 | 1,155 | 34% | 99 | 0.9 | 3.2 |
| | Southbound | 8,187 | 18% | 97 | -0.3 | 1.4 | 1,145 | 39% | 98 | 0.9 | 3.6 |
| Coopernook Road | Westbound | 492 | 8% | 62 | -0.7 | -3.1 | 26 | 16% | 59 | 0.5 | -2.6 |
| | Eastbound | 506 | 12% | 60 | -0.7 | -3.8 | 52 | 16% | 59 | 0.5 | -2.5 |
| Harrington Road – 90 km/h | Westbound | 1,653 | 11% | 84 | -0.4 | -3.2 | 153 | 14% | 88 | 0.8 | -2.4 |
| | Eastbound | 1,698 | 8% | 83 | -0.4 | -2.9 | 104 | 13% | 84 | 0.8 | -2.4 |
| Harrington Road – 60 km/h[1] | Westbound | 1,653 | 11% | 60 | -0.7 | -4.4 | 153 | 14% | 60 | 0.5 | -4.1 |
| | Eastbound | 1,698 | 8% | 60 | -0.7 | -4.2 | 104 | 13% | 60 | 0.5 | -3.7 |

*Notes:*

1. *This section of Harrington Road contains a speed limit change to 60 km/h where road traffic tube counters were not placed. Vehicle speed has been assumed to reduce to 60 km/h in this section and resulting LV and HV corrections have been changed to suit.*

It can be assumed that if the same road traffic noise model is updated to include the proposal design model parameters (e.g. including alignment, traffic flow etc), then the design noise model would predict to the same level of accuracy.

The model was validated in accordance with the *Road Noise Model Validation Guideline*. The *Road Noise Model Validation Guideline* provides guidance and procedures for validating operational road traffic noise models. The guideline discusses error, which is the difference between measured and predicted noise levels, principles to be applied when completing monitoring and modelling to minimise error and use of calibration adjustments.

After an iterative review process, it was found that calibration factors were not required to result in the best median differences, maintaining a conservative model. A summary of the noise logger validation results is provided in Table 6-3.

**Table 6-3 Noise logger validation**

| Logger ID | Address | Approx. distance to Hwy | Daytime $L_{Aeq,15hr}$, dB(A) | | | Night-time $L_{Aeq,9hr}$, dB(A) | | |
|---|---|---|---|---|---|---|---|---|
| | | | Predicted | Measured | Difference | Predicted | Measured | Difference |
| NL1 | 20 Coopernook Road, Coopernook | 500 m | 57.1 | 57.8 | -0.7 | 52.5 | 52.6 | -0.1 |
| NL2 | 20 Coopernook Road, Coopernook | 15 m | 69.9 | 69.1 | 0.8 | 67.6 | 66.4 | 1.2 |
| NL3 | 173 Harrington Road, Coopernook | 950 m | 60.1 | 58.7 | 1.4 | 53.4 | 53.4 | 0.0 |
| | | | Median difference | | 0.8 | Median difference | | 0.0 |
| | | | Standard deviation | | 0.9 | Standard deviation | | 0.6 |

It can be seen from Table 6-3 that the median difference is 0.8 and 0.0 for daytime and night-time respectively. Therefore, the model is considered to be predicting road traffic noise levels with acceptable accuracy and is slightly conservative overall, predicting slightly higher noise levels than those measured for both the daytime and the night-time periods.

## 6.2 Noise modelling scenarios

As previously noted, the *Road Noise Policy* requires the assessment of road traffic noise at the year of opening and at the design year. To determine the appropriate noise mitigation, results from the more stringent year (Design year 2038) have been discussed within this report.

Noise levels for both the daytime and night-time periods have been assessed, however the night-time was found to be the controlling period. The assessed situations are:

- **No build –**This scenario is assessed for the design year (2038) and incorporates the existing alignment and traffic flows for the applicable year. All major existing arterial roads have been included in the noise modelling. It represents the design if the proposal was not to be built.
- **Build** – This scenario incorporates the proposal design alignment in addition to the Pacific Highway.

It should be noted that the construction of the Project is not anticipated to generate any new traffic growth, but instead facilitate safer vehicle movements across the Pacific Highway.

### 6.2.1 Traffic noise model

The 'Year of Opening' (2028) and 'Design Year' (2038) traffic flows are presented in Table 6-4 and Table 6-5 respectively and were used in the validated road traffic noise model to provide the 'Year of Opening' and 'Design Year' road traffic noise models for the 'No build' and 'Build' scenarios. These models are used to assess the potential road noise impacts and to identify mitigation requirements.

**Table 6-4 'Year of Opening' (2028) 'No build' and 'Build' predicted traffic flows**

| Location | Direction | Daytime (7 am to 10 pm) | | Night-time (10 pm to 7 am) | | Vehicle speed, km/h |
|---|---|---|---|---|---|---|
| | | Traffic Volume | Heavy vehicle ratio | Traffic Volume | Heavy vehicle ratio | |
| Pacific Highway – North of Coopernook Road | Northbound | 9,122 | 25% | 1,359 | 41% | 100 |
| | Southbound | 7,669 | 28% | 1,248 | 52% | 100 |
| Pacific Highway – South of Coopernook Road | Northbound | 10,499 | 23% | 1,539 | 39% | 100 |
| | Southbound | 9,233 | 25% | 1,439 | 48% | 100 |
| Coopernook Road | Westbound | 801 | 11% | 44 | 23% | 60 |
| | Eastbound | 611 | 9% | 66 | 11% | 60 |
| Harrington Road | Westbound | 2,086 | 7% | 186 | 9% | 60/90 |
| | Eastbound | 2,227 | 7% | 137 | 10% | 60/90 |
| Overpass | Westbound | 598 | 23% | 87 | 46% | 60 |
| | Eastbound | 2,425 | 22% | 348 | 37% | 60 |

**Table 6-5 'Design Year' (2038) 'No build' and 'Build' predicted traffic flows**

| Location | Direction | Daytime (7 am to 10 pm) | | Night-time (10 pm to 7 am) | | Vehicle speed, km/h |
|---|---|---|---|---|---|---|
| | | Traffic Volume | Heavy vehicle ratio | Traffic Volume | Heavy vehicle ratio | |
| Pacific Highway – North of Coopernook Road | Northbound | 10,511 | 25% | 1,564 | 41% | 100 |
| | Southbound | 8,770 | 28% | 1,420 | 52% | 100 |
| Pacific Highway – South of Coopernook Road | Northbound | 12,286 | 23% | 1,793 | 38% | 100 |
| | Southbound | 10,992 | 23% | 1,686 | 46% | 100 |
| Coopernook Road | Westbound | 1,173 | 8% | 62 | 17% | 60 |
| | Eastbound | 990 | 7% | 107 | 8% | 60 |
| Harrington Road | Westbound | 2,937 | 6% | 261 | 8% | 60/90 |
| | Eastbound | 3,051 | 6% | 187 | 9% | 60/90 |
| Overpass | Westbound | 714 | 22% | 102 | 44% | 60 |
| | Eastbound | 2,919 | 21% | 415 | 35% | 60 |

### 6.2.2 Proposal impact

Noise sensitive receivers within the operational road traffic noise study area of the proposal were assessed against the minor works criteria outlined in Section 4.4.1. Considering the impacts in both the 'Year of Opening' 2028 and the 'Design Year' 2038 during the daytime and night-time periods, noise levels are not predicted to increase by more than 2 dB(A) at any assessed sensitive receiver. As a result, no operational road traffic noise mitigation is proposed for this proposal. An overall summary of noise levels at each receiver is included in Table 6-6. A detailed summary of noise levels at each façade for assessed receivers is included in Appendix E. Noise contour maps are provided in Appendix F.

**Table 6-6 Road traffic noise level summary**

| Receiver ID | Address | Use | Predicted noise level Opening Year 2028 | | | | Predicted noise level Design Year 2038 | | | | Change in noise level (Build - No Build) | | | | Do noise levels increase by 2dB or more? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | No Build | | Build | | No Build | | Build | | Opening Year 2028 | | Design Year 2038 | | |
| | | | Day | Night | Day | Night | Day | Night | Day | Night | Day | Night | Day | Night | |
| 1 | 173 Harrington Road, Coopernook | Residential | 60 | 51 | 60 | 51 | 61 | 53 | 61 | 53 | 0.0 | 0.0 | 0.0 | 0.1 | No |
| 2 | 172 Harrington Road, Coopernook | Residential | 65 | 56 | 65 | 56 | 66 | 58 | 66 | 58 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 3 | 180 Harrington Road, Coopernook | Residential | 59 | 51 | 59 | 51 | 60 | 52 | 60 | 52 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 4 | 20 Coopernook Road, Coopernook | Residential | 62 | 58 | 61 | 58 | 62 | 59 | 62 | 58 | -0.2 | -0.2 | -0.2 | -0.1 | No |
| 5 | 3 Wharf Road, Coopernook | Residential | 54 | 51 | 54 | 51 | 55 | 51 | 55 | 51 | 0.0 | 0.1 | 0.1 | 0.1 | No |
| 6 | 3 Wharf Road, Coopernook | Residential | 53 | 49 | 53 | 49 | 54 | 50 | 54 | 50 | 0.1 | 0.0 | 0.0 | 0.0 | No |
| 7 | 3 Wharf Road, Coopernook | Residential | 54 | 50 | 54 | 50 | 55 | 51 | 55 | 51 | 0.1 | 0.1 | 0.0 | 0.0 | No |
| 8 | 3 Wharf Road, Coopernook | Residential | 54 | 50 | 54 | 50 | 55 | 51 | 55 | 51 | 0.1 | 0.1 | 0.0 | 0.0 | No |
| 9 | 189 George Gibson Drive, Coopernook | Residential | 55 | 51 | 55 | 51 | 56 | 52 | 56 | 52 | 0.1 | 0.1 | 0.1 | 0.1 | No |
| 10 | 240 George Gibson Drive, Coopernook | Commercial | 54 | 50 | 54 | 50 | 54 | 51 | 54 | 50 | -0.1 | -0.1 | -0.1 | -0.1 | No |

| Receiver ID | Address | Use | Predicted noise level Opening Year 2028 | | | | Predicted noise level Design Year 2038 | | | | Change in noise level (Build - No Build) | | | | Do noise levels increase by 2dB or more? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | No Build | | Build | | No Build | | Build | | Opening Year 2028 | | Design Year 2038 | | |
| | | | Day | Night | Day | Night | Day | Night | Day | Night | Day | Night | Day | Night | |
| 11 | 90 Harrington Road, Coopernook | Residential | 63 | 60 | 63 | 60 | 64 | 60 | 64 | 60 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 12 | 61 Macquarie Street, Coopernook | School | 55 | 50 | 55 | 50 | 55 | 51 | 55 | 51 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 13 | 50 Macquarie Street, Coopernook | Residential | 57 | 51 | 57 | 51 | 58 | 52 | 58 | 52 | 0.0 | 0.1 | 0.0 | 0.0 | No |
| 14 | 145 George Gibson Drive, Coopernook | Residential | 54 | 50 | 54 | 50 | 55 | 51 | 55 | 51 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 15 | 140 Harrington Road, Coopernook | Residential | 54 | 50 | 54 | 50 | 55 | 51 | 55 | 51 | 0.1 | 0.1 | 0.1 | 0.1 | No |

## 6.3 Maximum noise levels

The overall level associated with maximum noise events is driven by the type of truck, operating conditions, and speed to a lesser degree. With the existing design of Harrington Road and Coopernook Road, it is likely that maximum noise events already exist due to the deceleration and acceleration of vehicles attempting to traverse the Pacific Highway. With the proposed design, vehicles would still be required to slow down or stop for the nearby roundabout, and therefore the location of any maximum noise level events may change to reflect this. In addition, heavy vehicles travelling over the proposed bridge may be required to brake on the decline on either side. However, it is noted that the proposed design would likely result in less aggressive accelerating and braking events as vehicles are generally able to travel at a more constant speed of 60 km/h. As a result, while it is likely that the location of maximum noise events may change, the magnitude and frequency of these events is not expected to increase at receivers.

Transport does not provide any requirements to provide noise mitigation options on the basis of the maximum noise level assessment. Rather, maximum noise level assessments can be used to prioritise the application of noise mitigation measures. Transport has long term strategies which are being employed to ensure noise levels from trucks are reduced across the entire network.

# 7.0 Safeguards and management measures

This section describes safeguards and management measures to address the potential impacts of the proposal identified in this assessment. These measures would be incorporated into the construction stage of the proposal where relevant.

## 7.1 Management of construction impacts

The construction noise and vibration assessment presented in Section 5.0 detailed some exceedances of the noise management levels due to this proposal. These were predicted as a result of various construction activities. As a result of these exceedances, noise and vibration safeguards have been identified in Table 7-1 below. It is noted that no exceedances of the 'highly noise affected' criteria were predicted within the construction noise assessment study area.

Transport's *Construction Noise and Vibration Guideline* lists a number of standard actions and mitigation measures which should be implemented on all construction projects. The strategies are centred on management, training and the attenuation of noise at the source. These are documented in Appendix B of the *Construction Noise and Vibration Guideline*. Appendix C of the *Construction Noise and Vibration Guideline* also details additional noise mitigation measures to be implemented after all standard noise mitigation measures are applied and where the noise levels are still exceeding the noise management levels. Both standard and additional mitigation measures have been included in Table 7-1.

## 7.2 Noise and vibration safeguards

**Table 7-1 Receivers eligible for consideration of additional mitigation measures**

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| Noise and vibration | A Construction Noise and Vibration Management Plan (CNVMP) would be prepared as part of the Construction Environmental Management Plan. The CNVMP would identify:<br>All potential significant noise and vibration generating activities associated with the activity<br>Noise and vibration sensitive receivers<br>Measures to be implemented during construction to minimise noise and vibration impacts, such as restrictions on working hours, staging, placement and operation of work compounds, parking and storage areas, temporary noise barriers, haul road maintenance and controlling the location and use of vibration generating equipment.<br>Feasible and reasonable mitigation measures to be implemented.<br>A monitoring program to assess performance against relevant noise and vibration criteria<br>Arrangements for consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures<br>An out of hours works procedure, including approval process and proposed mitigation measures. | Contractor | Pre-construction and construction |
| Noise and vibration | All sensitive receivers likely to be affected would be notified at least five days prior to commencement of any works associated with the scenario that may have an adverse noise or vibration impact (based on Table 7-2). The notification would include details of:<br>The proposal<br>Construction period and construction hours<br>Contact information for project management staff<br>Complaint and incident reporting and how to obtain further information. | Contractor | Construction |
| Noise and vibration | All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include:<br>All relevant proposed specific and standard noise and vibration mitigation measures<br>Relevant licence and approval conditions<br>Permissible hours of work<br>Any limitations on high noise generating activities<br>Location of nearest sensitive receivers<br>Construction employee parking areas<br>Designated loading/unloading areas and procedures<br>Site opening/closing times (including deliveries)<br>Environmental incident procedures. | Contractor | Construction |
| Noise and vibration | Construction would generally be carried out during the standard daytime working hours. Works generating high noise and/or vibration levels should be scheduled during less sensitive time periods. Any variations to the standard construction hours would follow the approach in Practice Note VII of the | Contractor | Construction |

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| | *Environmental Noise Management Manual* (RTA 2001) and the *Environmental Fact Sheet 02 – Noise Management and Night Works* (RTA 2007), which aim to provide guidance to Transport staff, contractors and consultants on Transport's principles in managing noise from the maintenance or upgrading of existing roads, as well as the construction of new roads in NSW, including consultation with the affected local community. | | |
| Noise and vibration | Where feasible and reasonable, high noise generating activities (75 dB(A) $L_{Aeq}$ at receiver) be used during standard construction hours and in continuous blocks of no more than three hours with at least one hour respite between each block of work generating high noise impact, where the location of the work is likely to impact the same receiver. | Contractor | Construction |
| Noise | The following would be implemented for deliveries to and from the proposal:<br>Loading and unloading of materials/deliveries is to occur as far as possible from sensitive receivers.<br>Dedicated loading/unloading areas are to be shielded if close to sensitive receivers.<br>Delivery vehicles are to be fitted with straps rather than chains for unloading, wherever possible<br>The construction site is to be arranged to limit the need for reversing associated with regular/repeatable movements. | Contractor | Construction |
| 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. | Contractor | Construction |
| Noise and vibration | The noise associated with the operation of construction ancillary facilities would primarily result from the operation of fixed and mobile plant and truck movements. Consideration would be given to the layout of the site in order to maximise distance and shielding to nearby receivers. | Contractor | Pre-construction and construction |
| Noise | At ancillary facilities consider location of site sheds, earth bunds and hoarding to maximise shielding to residential receivers. | Contractor | Construction |
| Noise | In circumstances where the noise levels are predicted to exceed construction noise management levels after implementation of the general work practices, additional mitigation measures are required. For this project these measures would specifically include the following:<br>Monitoring<br>Notification (letterbox drop or equivalent). | Contractor | Construction |
| Vibration | Vibration intensive equipment size would be selected to avoid working within the structural damage minimum working distances. The use of less vibration intensive methods of construction or equipment would be considered where feasible and reasonable. | Contractor | Construction |

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| Vibration | Where the use of vibration intensive equipment within the relevant minimum working distances cannot be avoided, prior to the commencement of vibration intensive work, a detailed inspection would be carried out and a written and photographic report prepared to document the condition of buildings and structures within the minimum working distances. A copy of the report would be provided to the relevant landowner or land manager. | Contractor | Pre-Construction |

## 7.3 Additional mitigation measures

Details of the additional noise mitigation measures presented in Appendix C of the *Construction Noise and Vibration Guideline* are outlined below in Table 7-2.

**Table 7-2 Triggers for Additional Mitigation Measures – Airborne Noise**

| Perception | dB(A) above noise management levels | Additional mitigation measures type[1, 2] |
|---|---|---|
| **All hours** | | |
| > 75 dB(A) | - | N, V, PC, RO |
| **Standard hours[3]** | | |
| Noticeable | 0 | - |
| Clearly audible | 1 - 10 | - |
| Moderately intrusive | 11 – 20 | N,V |
| Highly intrusive | > 20 | N,V |
| **Out of hours work Period 1[4]** | | |
| Noticeable | 1 - 5 | - |
| Clearly audible | 6 - 15 | N, R1, DR |
| Moderately intrusive | 16 – 25 | V, N, R1, DR |
| Highly intrusive | > 25 | V, IB, N, R1, DR, PC, SN |
| **Out of hours work Period 2[5]** | | |
| Noticeable | 1 - 5 | N |
| Clearly audible | 6 - 15 | V, N, R2, DR |
| Moderately intrusive | 16 – 25 | V, IB, N, PC, SN, R2, DR |
| Highly intrusive | > 25 | AA, V, IB, N, PC, SN, R2, DR |

*Notes:*

1. *Refer to section below for detailed descriptions of the mitigation types.*
2. *These additional mitigation measures are applicable to the number of exceedances of the noise management levels presented in the construction noise prediction tables in section 5.0.*
3. *Standard Hours refers to Monday – Friday (7am – 6pm), Sat (8am – 1pm).*
4. ***Out of hours work** Period 1 refers to Monday – Friday (6pm – 10pm), Saturday (7am – 8am and 1pm – 10pm), Sunday /public holiday (8am – 6pm).*
5. ***Out of hours work** Period 2 refers to Monday – Friday (10pm – 7am), Saturday (10pm – 8am), Sunday /public holiday (6am – 7am).*

### 7.3.1 Overview of additional mitigation measures

#### *Notification (letterbox drop or equivalent) (N)*

Advanced warning of works and potential disruptions can assist in reducing the impact on the community. The notification may consist of a letterbox drop (or equivalent) detailing work activities, time periods over which these would occur, impacts and mitigation measures. Notification should be a minimum of five working days prior to the start of works. The approval conditions for projects may also specify requirements for notification to the community about works that may impact on them.

#### *Specific notifications (SN)*

Specific notifications are letterbox dropped (or equivalent) to identified stakeholders no later than seven calendar days ahead of construction activities that are likely to exceed the noise objectives. The specific notification provides additional information when relevant and informative to more highly affected receivers than covered in general letterbox drops. This form of communication is used to support periodic notifications, or to advertise unscheduled works.

### *Phone calls (PC)*

Phone calls detailing relevant information made to identified/affected stakeholders within seven calendar days of proposed work. Phone calls provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs. Where the resident cannot be telephoned then an alternative form of engagement should be used.

### *Individual briefings (IB)*

Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that would be implemented. Project representatives would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the project. Where the resident cannot be met with individually then an alternative form of engagement should be used.

### *Respite Offers (RO)*

Respite Offers should be considered where there are high noise and vibration generating activities near receivers. As a guide work should be carried out in continuous blocks that do not exceed three hours each, with a minimum respite period of one hour between each block. The actual duration of each block of work and respite should be flexible to accommodate the usage of and amenity at nearby receivers. The purpose of such an offer is to provide residents with respite from an ongoing impact. This measure is evaluated on a project-by-project basis and may not be applicable to all projects.

### *Respite Period 1 (R1)*

Out of hours construction noise in out of hours work period 1 shall be limited to no more than three consecutive evenings per week except where there is a Duration Respite. For night work these periods of work should be separated by not less than one week and no more than six evenings per month.

### *Respite Period 2 (R2)*

Night-time construction noise in out of hours work period 2 shall be limited to two consecutive nights except for where there is a Duration Respite. For night work these periods of work should be separated by not less than one week and six nights per month. Where possible, high noise generating works would be completed before 11pm.

### *Duration Respite (DR)*

Respite offers and respite periods 1 and 2 may be counterproductive in reducing the impact on the community for longer duration projects. In this instance and where it can be strongly justified it may be beneficial to increase the work duration, number of evenings or nights worked through Duration Respite so that the project can be completed more quickly. The project team should engage with the community where noise levels are expected to exceed the noise management level to demonstrate support for Duration Respite. Where there are few receivers above the noise management level each of these receivers should be visited to discuss the project to gain support for Duration Respite.

### *Alternative Accommodation (AA)*

Alternative accommodation options may be offered to residents living in close proximity to construction works that are likely to experience highly intrusive noise levels. The specifics of the offer would be identified on a project-by-project basis. Additional aspects for consideration shall include whether the highly intrusive activities occur throughout the night or before midnight.

### *Verification (V)*

Verification should include measurement of the background noise level and construction noise. A noise monitoring program would be implemented to assist in confirming and controlling the site specific potential for disturbance at particularly sensitive localities at the commencement of activities and periodically during the construction program as the works progress. The results would be reviewed to determine if additional mitigation measures are required. All measurements would be undertaken in accordance with Australian Standard 1055-2018 – Acoustics – Description and measurement of environmental noise.

A noise monitoring program would be presented in the CNVMP.

If ground-borne noise is reported to be a problem during vibration intensive works, attended and/or unattended noise measurements would be undertaken in the relevant building spaces to determine the level of ground-borne noise.

# 8.0 Conclusion

This assessment has been prepared to support the REF for the proposal. Specifically, this report has been prepared to assess the potential impacts of construction and operation of the proposal and to identify appropriate safeguards and management measures to address the impacts identified.

**Construction Impacts**

A construction noise assessment has been conducted in accordance with the *Interim Construction Noise Guideline* and *Construction Noise and Vibration Guideline*. Reasonable worst case construction scenarios have been assessed. Construction would largely be carried out during standard construction work hours in accordance with the *Interim Construction Noise Guideline*, with a small number of activities required to occur out of hours to minimise disruption to road traffic on the Pacific Highway.

The assessment of noise associated with the construction of the proposal indicates some exceedances of the *Interim Construction Noise Guideline* noise management levels at the most affected sensitive receivers. The magnitude and number of exceedances are detailed in Section 5.0. Some exceedances of the noise management levels occur during the day and night at the most affected sensitive receivers during certain activities.

Site establishment works are predicted to result in the greatest number of exceedances of the daytime construction noise management levels. Effective noise mitigation and management measures would need to be developed by the contractor to minimise the potential noise impacts from the works. The magnitude of these impacts is consistent with other similar works and highlights the need for effective noise mitigation and management planning.

Measures have been recommended to mitigate construction noise impacts upon nearby sensitive receivers. The final number, degree and nature of these measures would ultimately be selected by the contractor and be largely dependent on the construction strategy and work undertaken. Specific noise management and mitigation measures would be detailed in the contractor's Construction Noise and Vibration Management Plan. The recommended management and mitigation measures which would be considered in the plan include:

- Effective community consultation
- Training of construction site workers
- Use of noise barriers
- Noise monitoring
- Appropriate selection and maintenance of equipment
- Situating plant in less noise sensitive locations
- Construction traffic management.

Minimum working distances for vibration intensive construction works. Equipment size would be selected by the contractor taking into account the minimum working distances and the distance between the area of construction and the most affected sensitive receiver. If works need to be undertaken within minimum working distances, vibration monitoring would be undertaken.

Construction traffic is not likely to increase measurably compared with existing traffic flows along construction routes. Increases would be considerably less than 2 dB(A). An increase of 2 dB(A) or less is compliant with the traffic noise increase criterion in the *Road Noise Policy*.

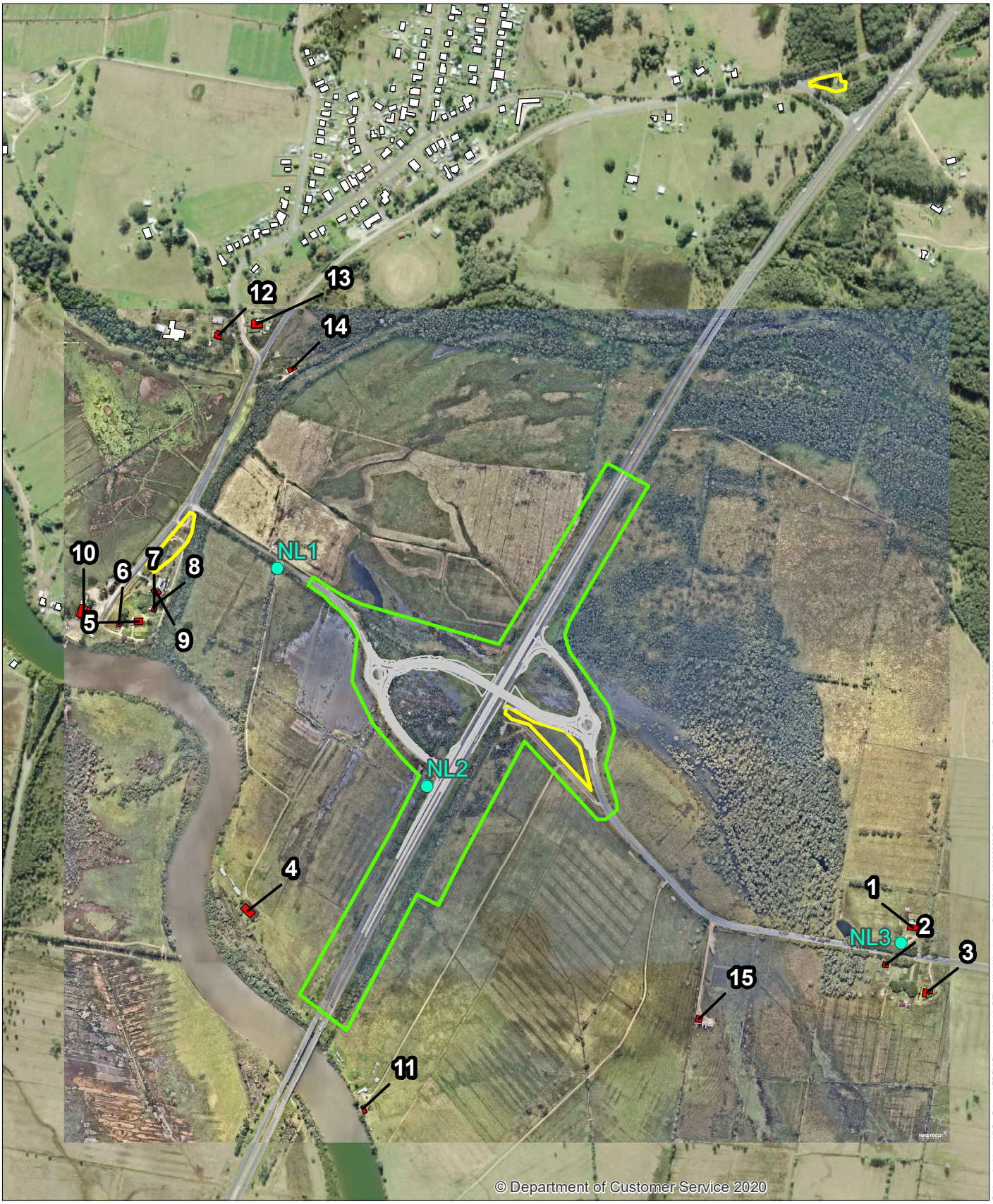
**Operational Impacts**

An operational road traffic noise assessment has been completed in accordance with *Road Noise Policy* and the *Road Noise Criteria Guideline* and *Road Noise Mitigation Guideline*.

Analysis of the road traffic noise modelling results has concluded that there are no predicted exceedances of the applicable minor works criteria outlined in the *Road Noise Criteria Guideline*. Therefore, no further consideration of road traffic noise mitigation is required.

# Appendix A

## Proposal overview and receivers




Receiver Locations

N

0 0.15 0.3 km

AECOM

- Proposal Area
- Construction Noise Receiver
- Operational Noise Receiver
- Construction Ancillary Facility
- Loggers
- Design

C:\Users\robinsonj6\OneDrive - AECOM\Desktop\Jack's Offline Work\Harrington Road\05_Maps\20230626_Receiver_Locations.mxd Date Saved: 26/06/2023

# Appendix B

## Noise logging results

# Noise Logger Report

**NL1 - 5 Coopernook Road, Coopernook**

| Item | Information |
|---|---|
| Logger Type | Cube |
| Serial number | 12226 |
| Address | 5 Coopernook Road, Coopernook |
| Location | Front Yard |
| Facade / Free Field | Free Field |
| Environment | Local road traffic noise on Coopernook Road 69-74 dBA. Background dominated by distant road traffic noise on Pacific Highway 50-53 dBA. Bird calls and insects audible. |

**Measured noise levels**

| Logging Date | $L_{Aeq,day}$ 7am-6pm | $L_{Aeq,evening}$ 6pm-10pm | $L_{Aeq,night}$ 10pm-7am | ABL Day 7am-6pm | ABL Eve 6pm-10pm | ABL Night 10pm-7am | $L_{Aeq,15hr}$ 7am-10pm | $L_{Aeq,9hr}$ 10pm-7am |
|---|---|---|---|---|---|---|---|---|
| Tue Aug 23 2022 | 58 | 55 | 54 | - | - | - | 58 | 54 |
| Wed Aug 24 2022 | 58 | 54 | 54 | - | 40 | - | 54 | 54 |
| Thu Aug 25 2022 | 59 | 55 | 52 | 40 | 39 | 36 | 58 | 52 |
| Fri Aug 26 2022 | 60 | 55 | 52 | - | 40 | 35 | 59 | 52 |
| Sat Aug 27 2022 | 58 | 54 | 51 | - | 38 | - | 57 | 51 |
| Sun Aug 28 2022 | 57 | 53 | 49 | - | 39 | 29 | 56 | 49 |
| Mon Aug 29 2022 | 60 | 59 | 53 | - | 47 | 28 | 60 | 53 |
| Tue Aug 30 2022 | 59 | 54 | 53 | 47 | 41 | 37 | 58 | 53 |
| Wed Aug 31 2022 | 60 | 55 | 53 | 42 | 38 | 36 | 59 | 53 |
| Thu Sep 1 2022 | 59 | 54 | 53 | - | 46 | 35 | 57 | 53 |
| Fri Sep 2 2022 | 58 | - | 54 | - | - | - | 58 | 54 |
| Sat Sep 3 2022 | - | - | - | - | - | - | - | - |
| Sun Sep 4 2022 | 60 | 55 | 48 | - | - | - | 56 | 48 |
| Mon Sep 5 2022 | 59 | 52 | 53 | - | 39 | - | 58 | 53 |
| **Summary** | **59** | **55** | **53** | **42** | **40** | **35** | **58** | **53** |

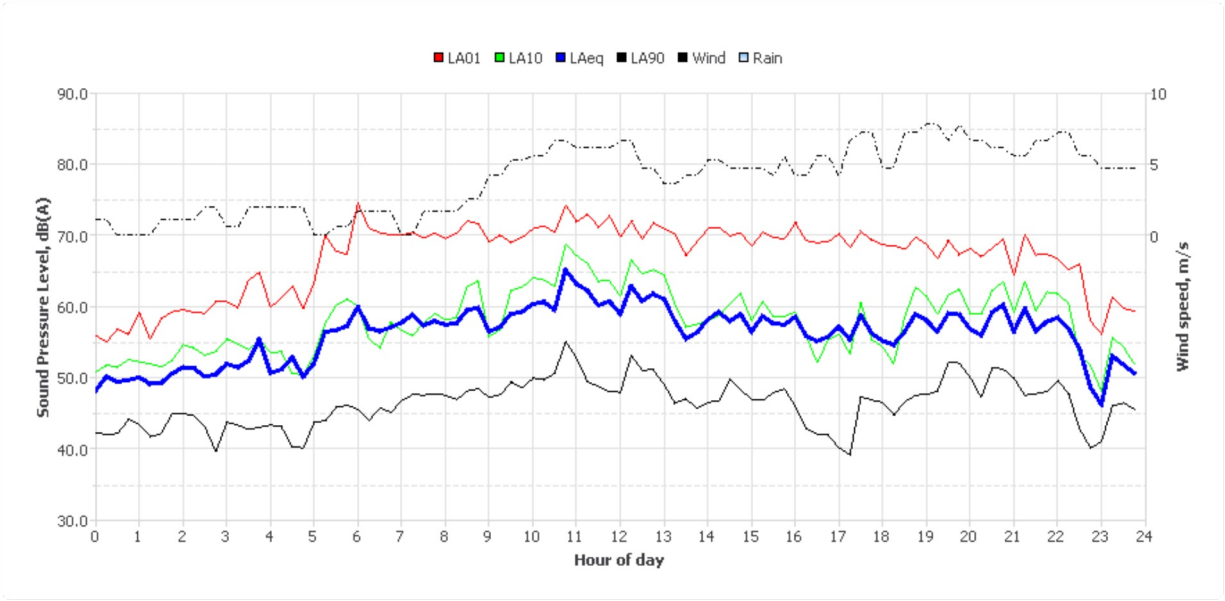
Note: Results denoted with '-' do not contain enough valid data for a value to be calculated. The data has been excluded either manually or automatically as a result of adverse weather conditions.

**Logger Location**


5 Coopernook Road, Coopernook

**Logger Deployment Photo**

## Tuesday, 23 Aug 2022

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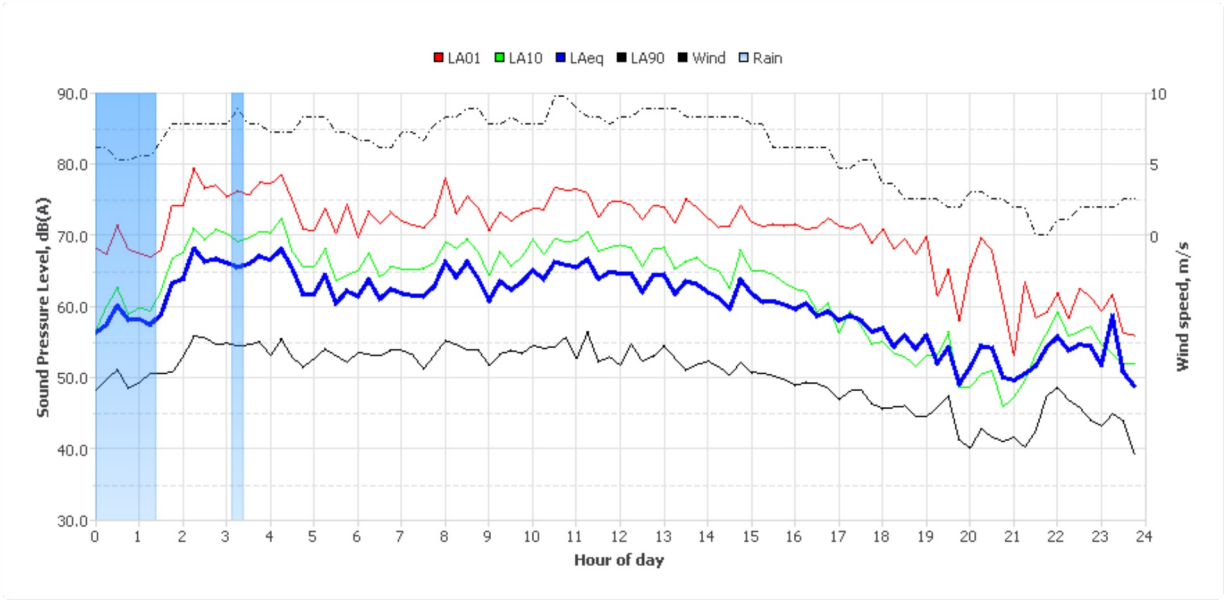


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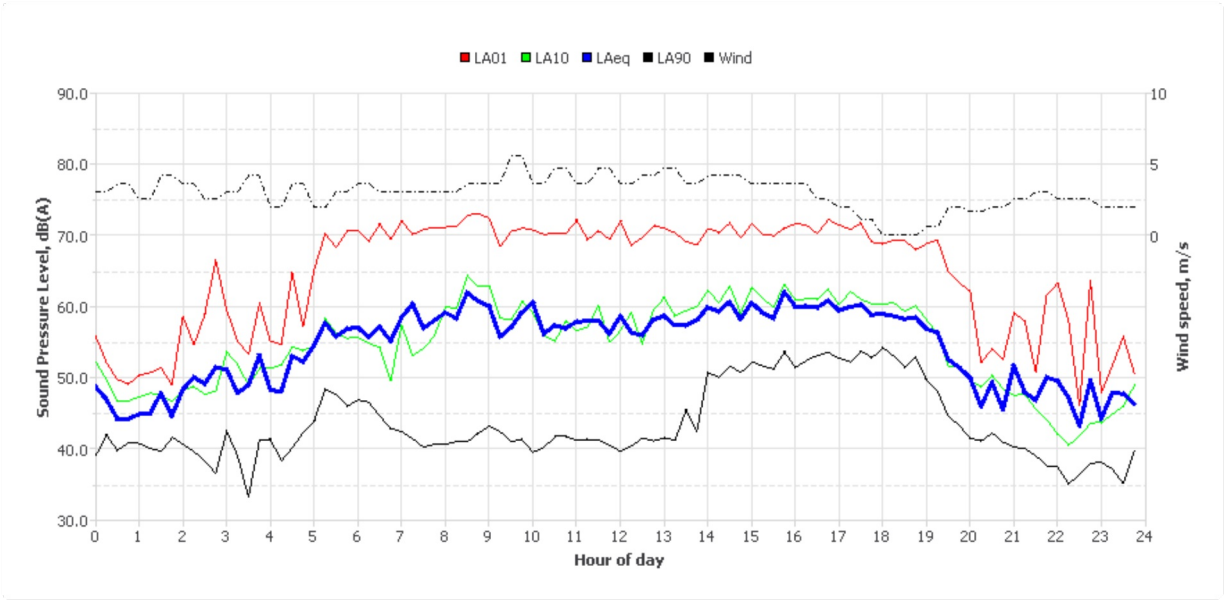

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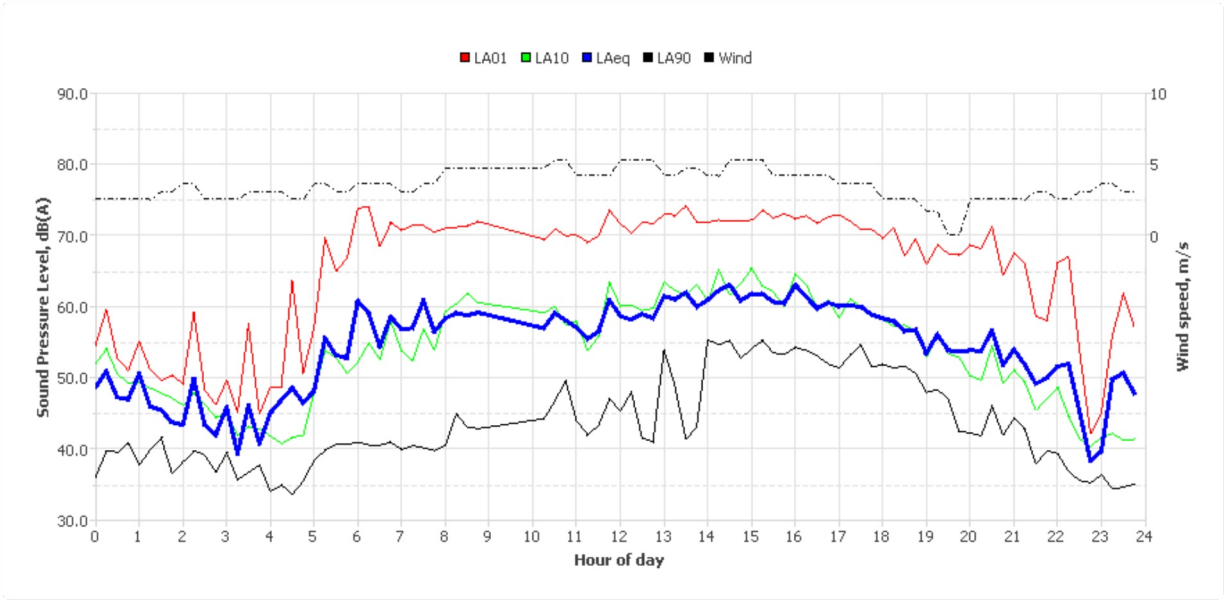


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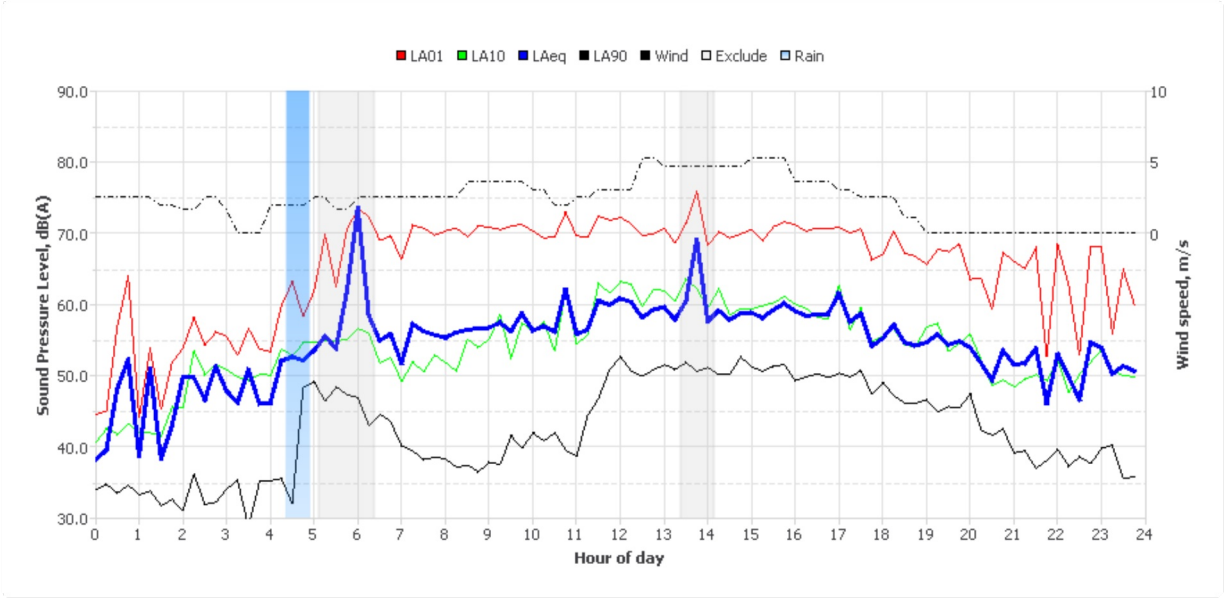


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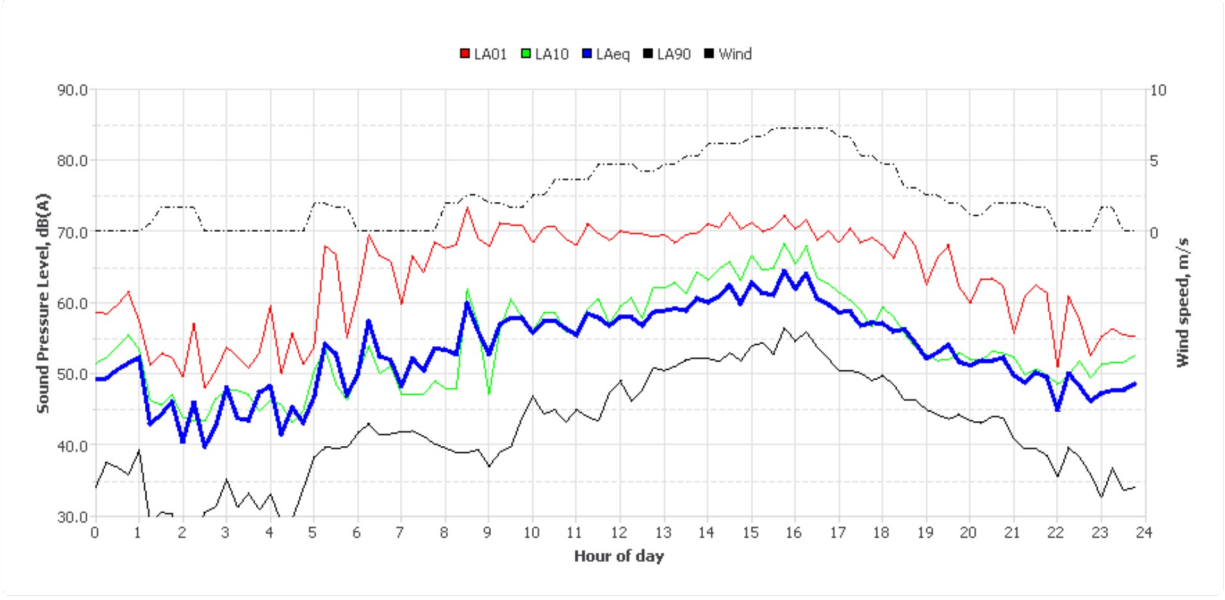

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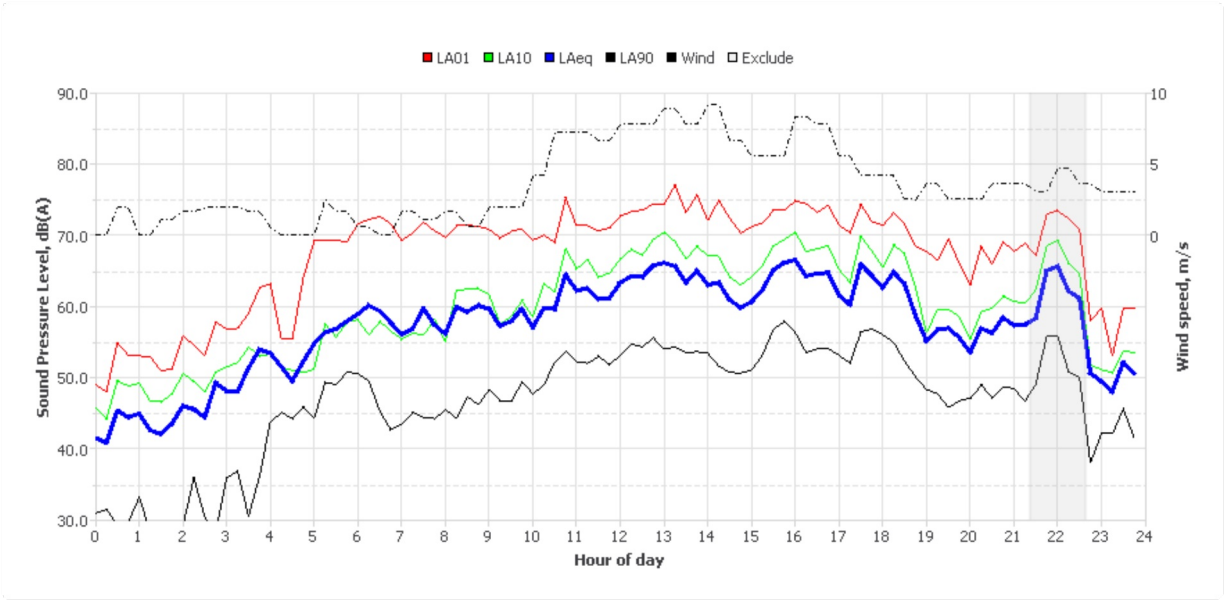


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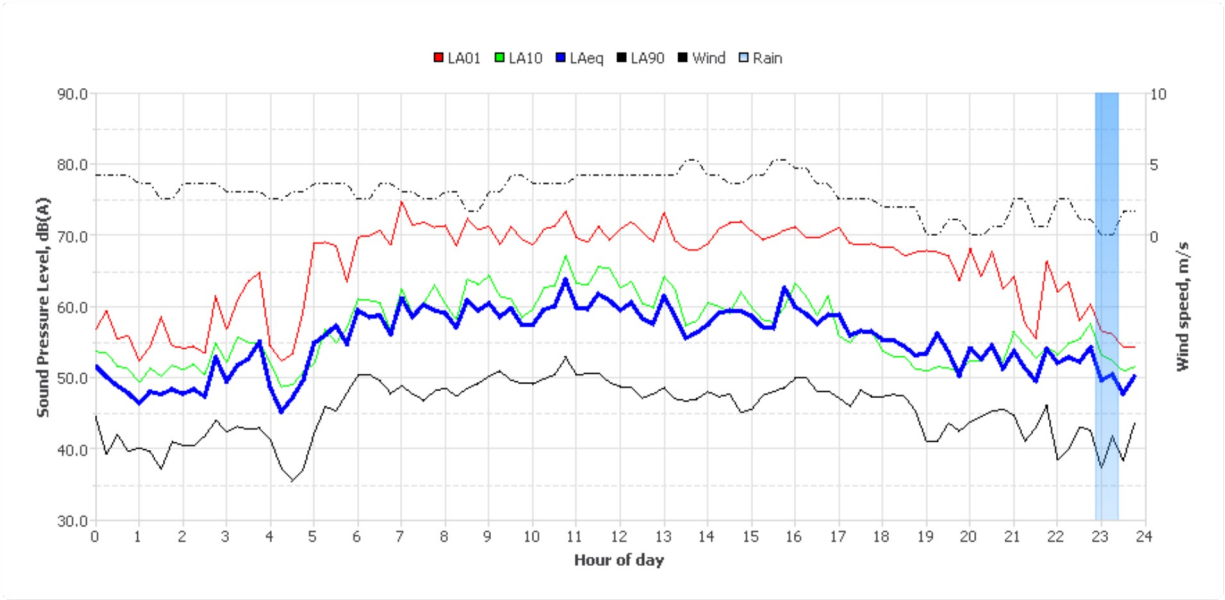


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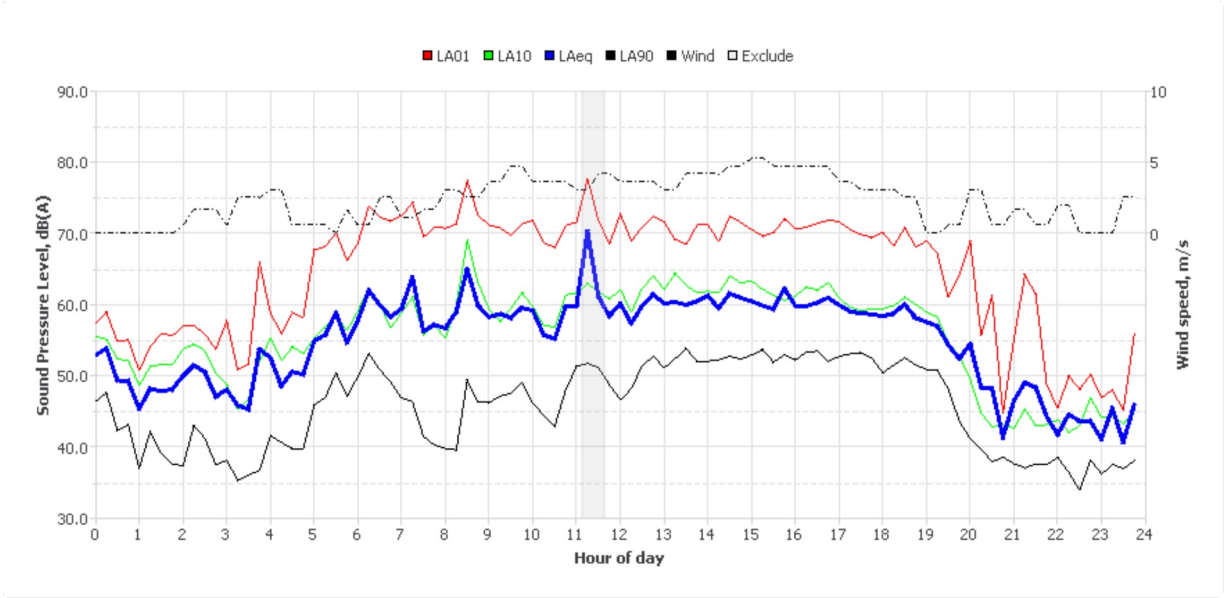
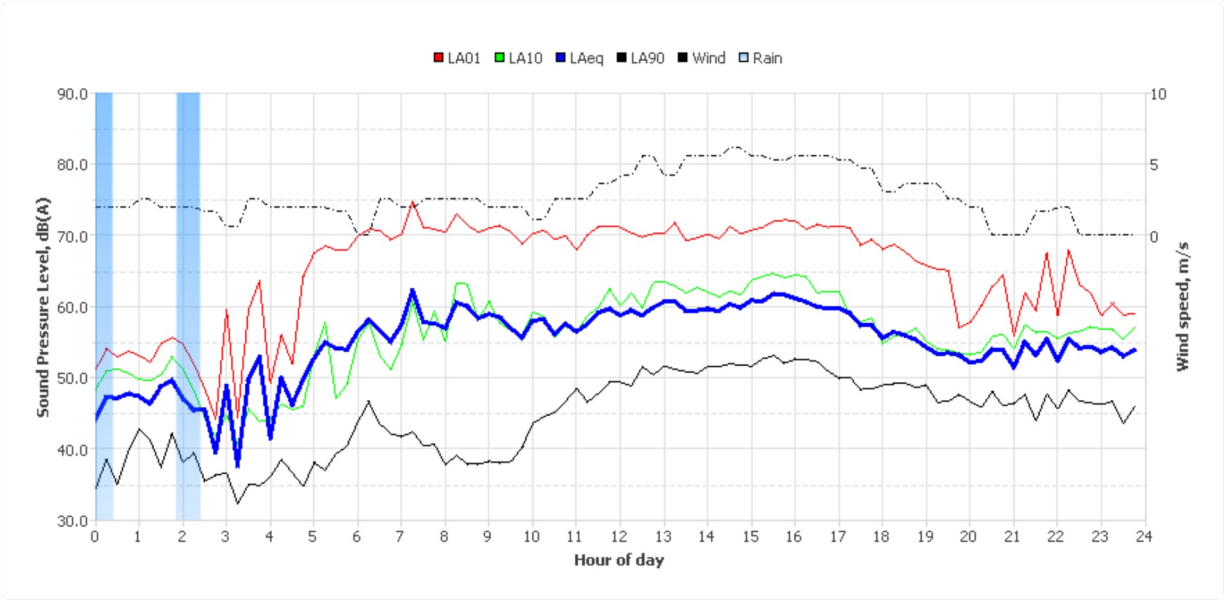


## Thursday, 01 Sep 2022

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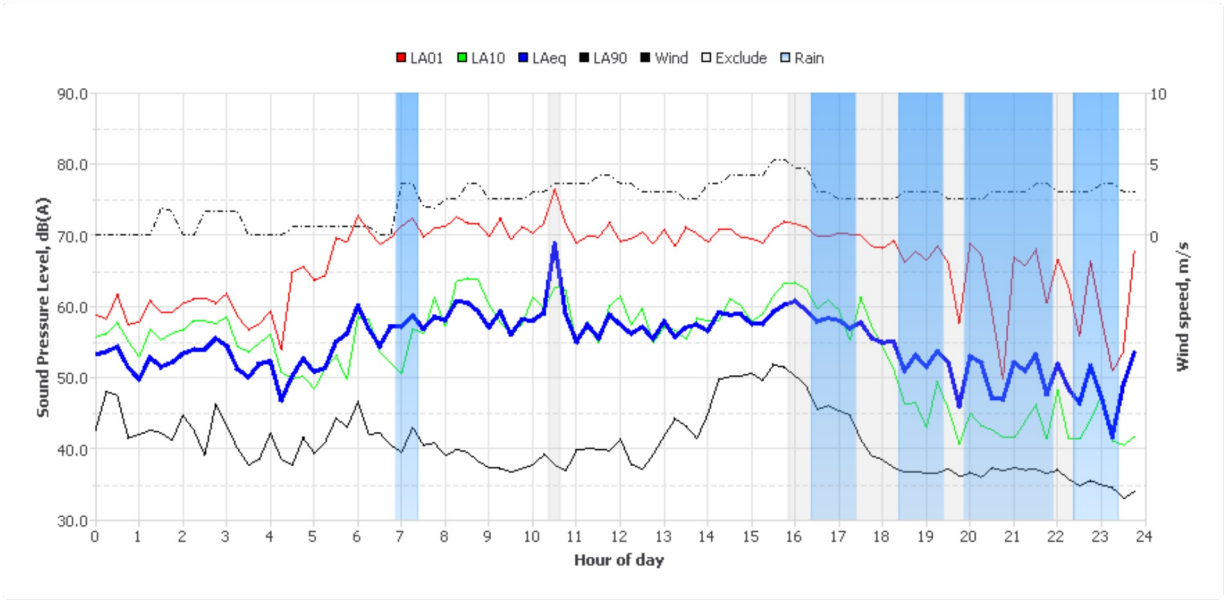


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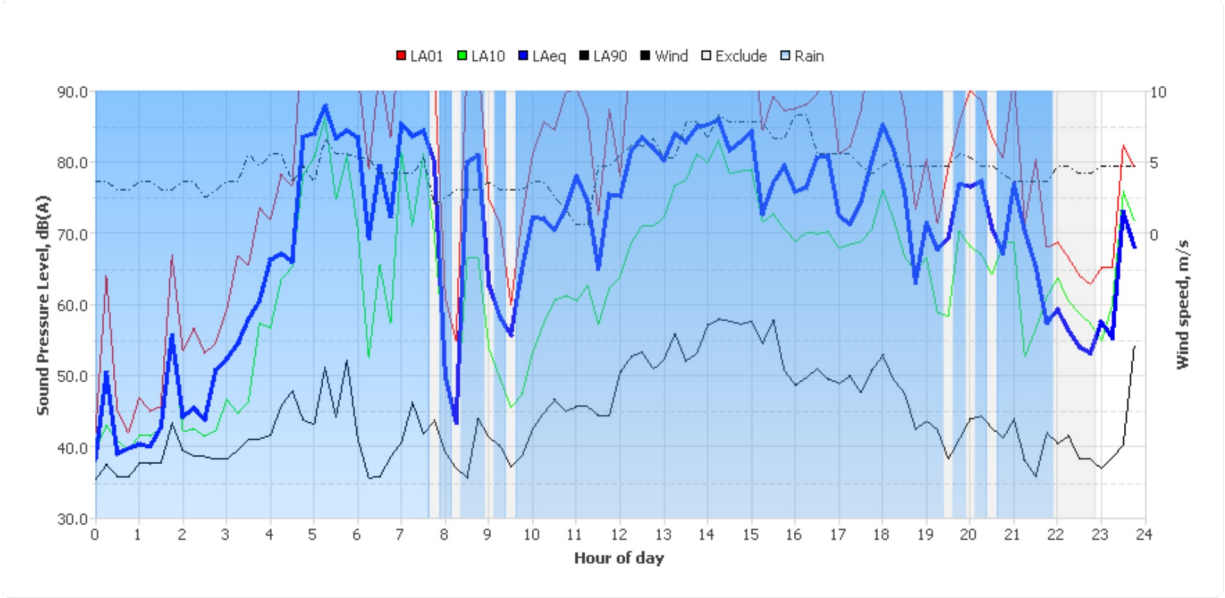

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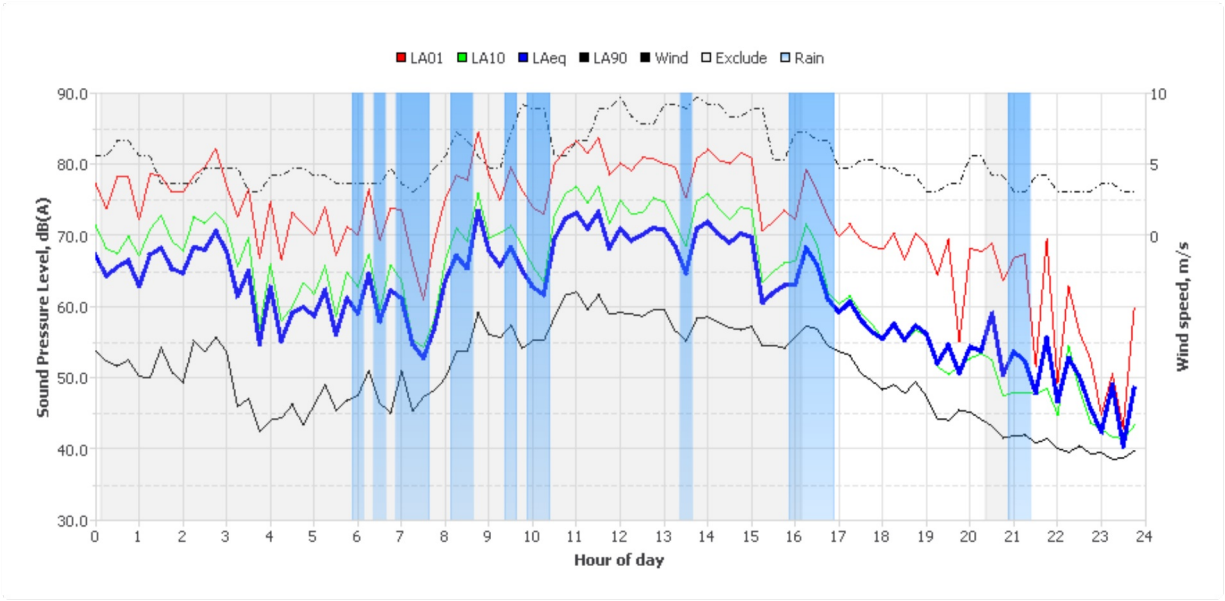


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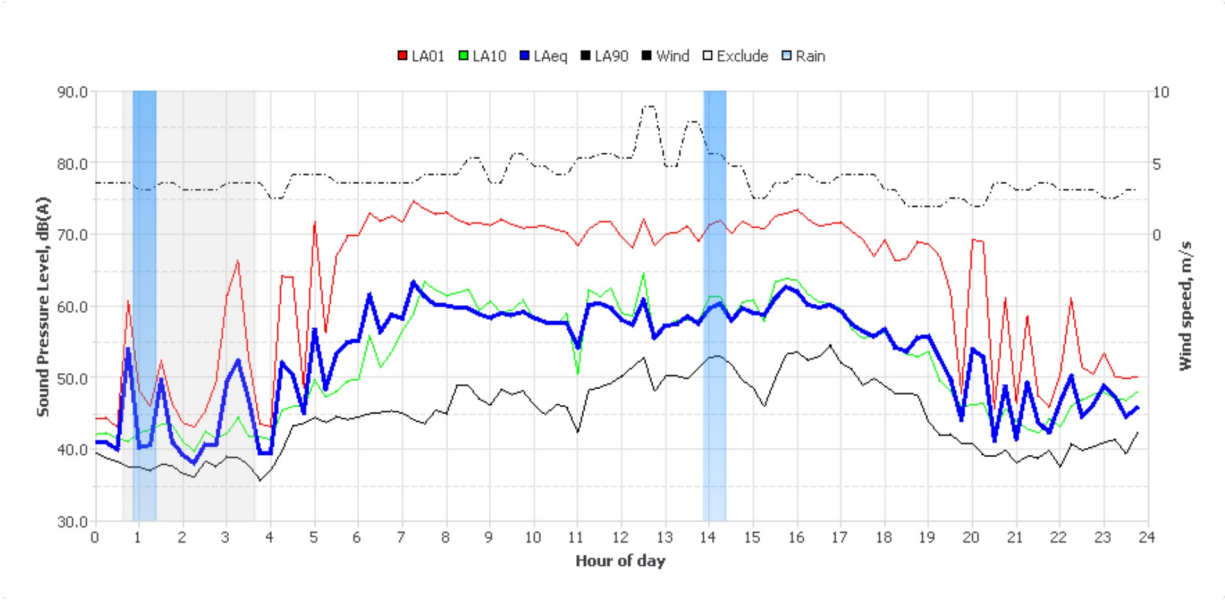


# Noise Logger Report

**NL2 - 5 Coopernook Road, Coopernook**

| Item | Information |
|---|---|
| Logger Type | Cube |
| Serial number | 12227 |
| Address | 5 Coopernook Road, Coopernook |
| Location | Field |
| Facade / Free Field | Free Field |
| Environment | Noise levels dominated by road traffic noise on Pacific Highway 62-78 dBA. Crickets audible. |

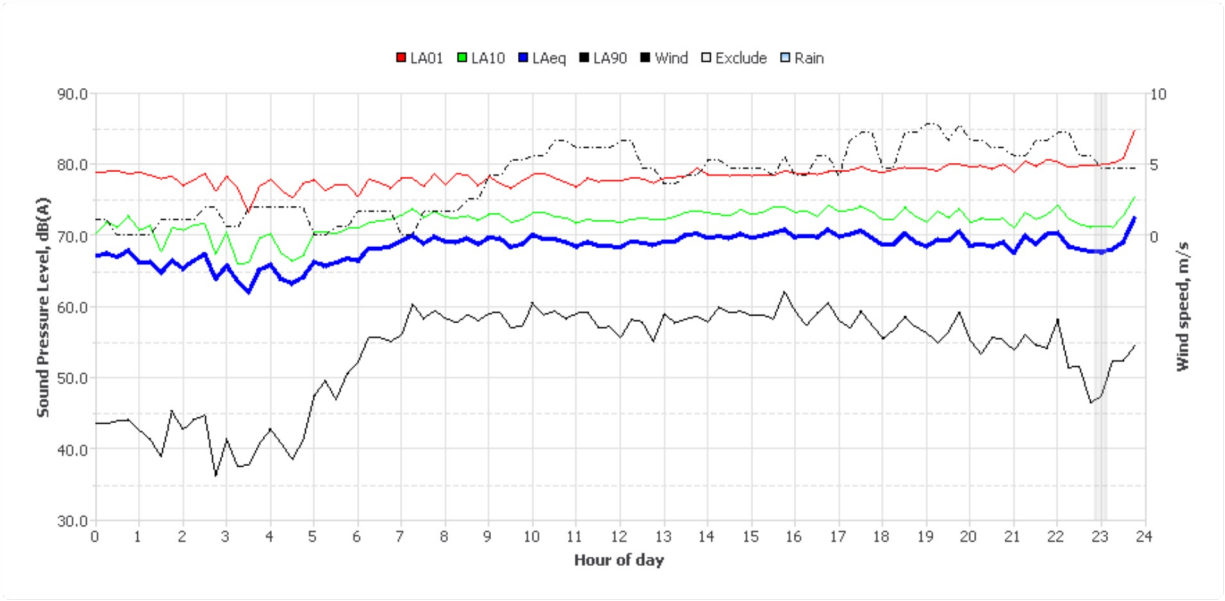
### Measured noise levels

| Logging Date | $L_{Aeq,day}$ 7am-6pm | $L_{Aeq,evening}$ 6pm-10pm | $L_{Aeq,night}$ 10pm-7am | ABL Day 7am-6pm | ABL Eve 6pm-10pm | ABL Night 10pm-7am | $L_{Aeq,15hr}$ 7am-10pm | $L_{Aeq,9hr}$ 10pm-7am |
|---|---|---|---|---|---|---|---|---|
| Tue Aug 23 2022 | 70 | 69 | 66 | - | - | - | 69 | 66 |
| Wed Aug 24 2022 | 71 | 69 | 68 | - | 48 | - | 69 | 68 |
| Thu Aug 25 2022 | 69 | 68 | 67 | 55 | 47 | 43 | 69 | 67 |
| Fri Aug 26 2022 | 70 | 69 | 67 | - | 48 | 41 | 70 | 67 |
| Sat Aug 27 2022 | 69 | 65 | 65 | 53 | 42 | 38 | 68 | 65 |
| Sun Aug 28 2022 | 68 | 67 | 62 | - | 41 | 30 | 68 | 62 |
| Mon Aug 29 2022 | 69 | 68 | 65 | - | 47 | 29 | 69 | 65 |
| Tue Aug 30 2022 | 70 | 68 | 67 | 57 | 47 | 38 | 69 | 67 |
| Wed Aug 31 2022 | 69 | 68 | 67 | 55 | 45 | 40 | 69 | 67 |
| Thu Sep 1 2022 | 69 | 68 | 67 | - | 48 | 40 | 69 | 67 |
| Fri Sep 2 2022 | 69 | - | 67 | - | - | - | 69 | 67 |
| Sat Sep 3 2022 | - | - | - | - | - | - | - | - |
| Sun Sep 4 2022 | 71 | 69 | 66 | - | - | - | 69 | 66 |
| Mon Sep 5 2022 | 71 | 69 | 66 | - | 46 | 40 | 70 | 66 |
| **Summary** | **70** | **68** | **66** | **55** | **47** | **40** | **69** | **66** |

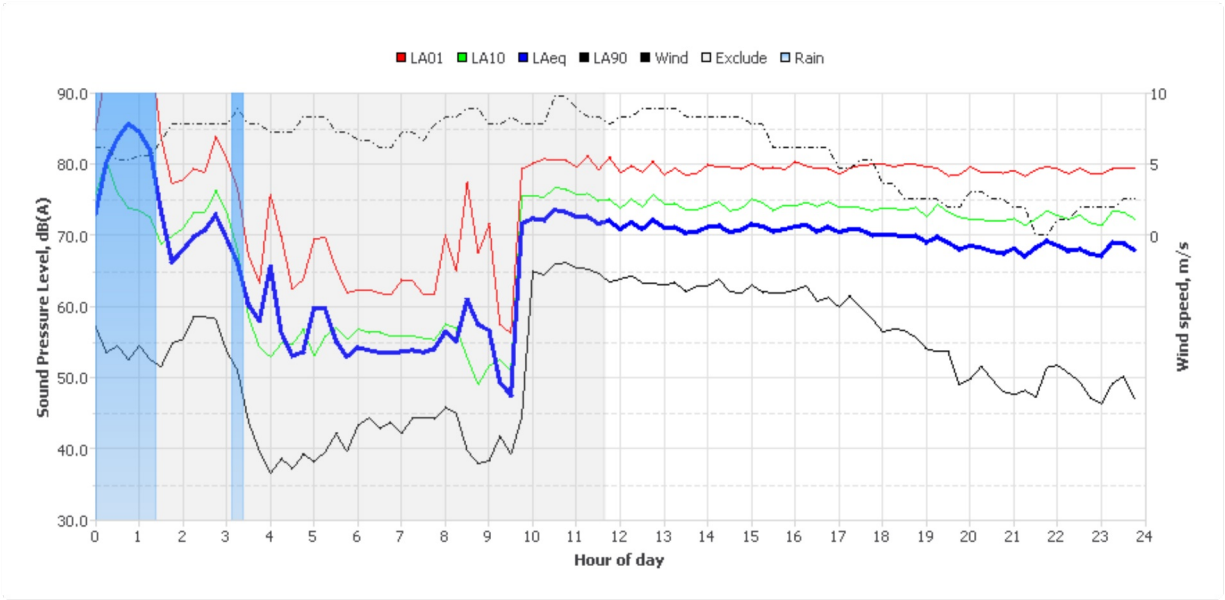
Note: Results denoted with '-' do not contain enough valid data for a value to be calculated. The data has been excluded either manually or automatically as a result of adverse weather conditions.

| Logger Location | Logger Deployment Photo |
|---|---|
|  |  |

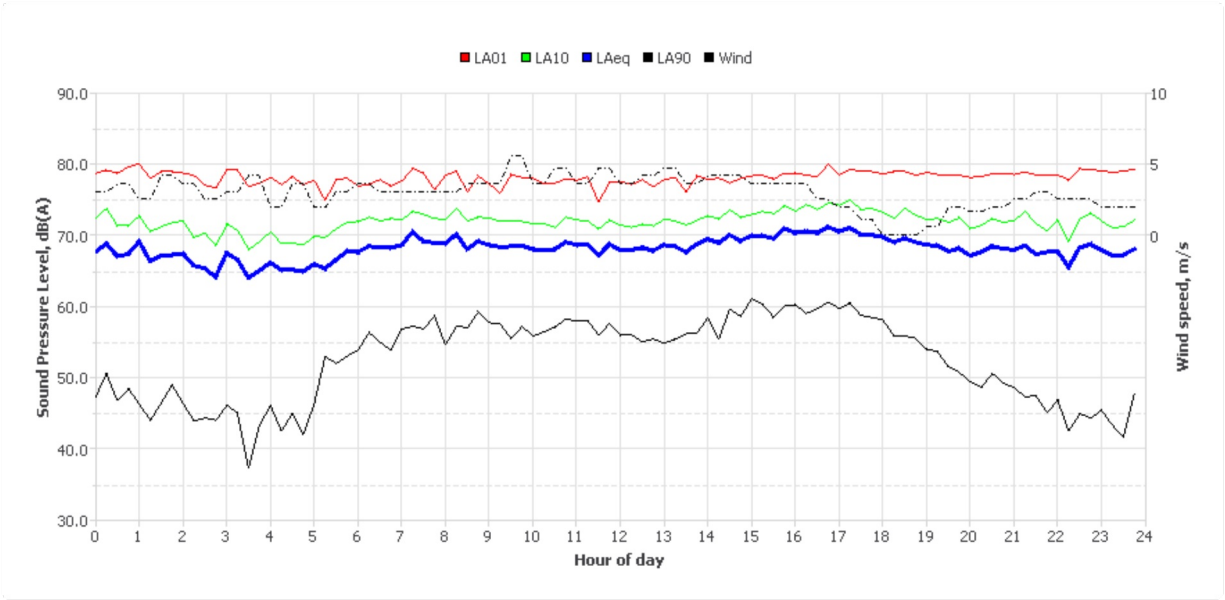
## Tuesday, 23 Aug 2022



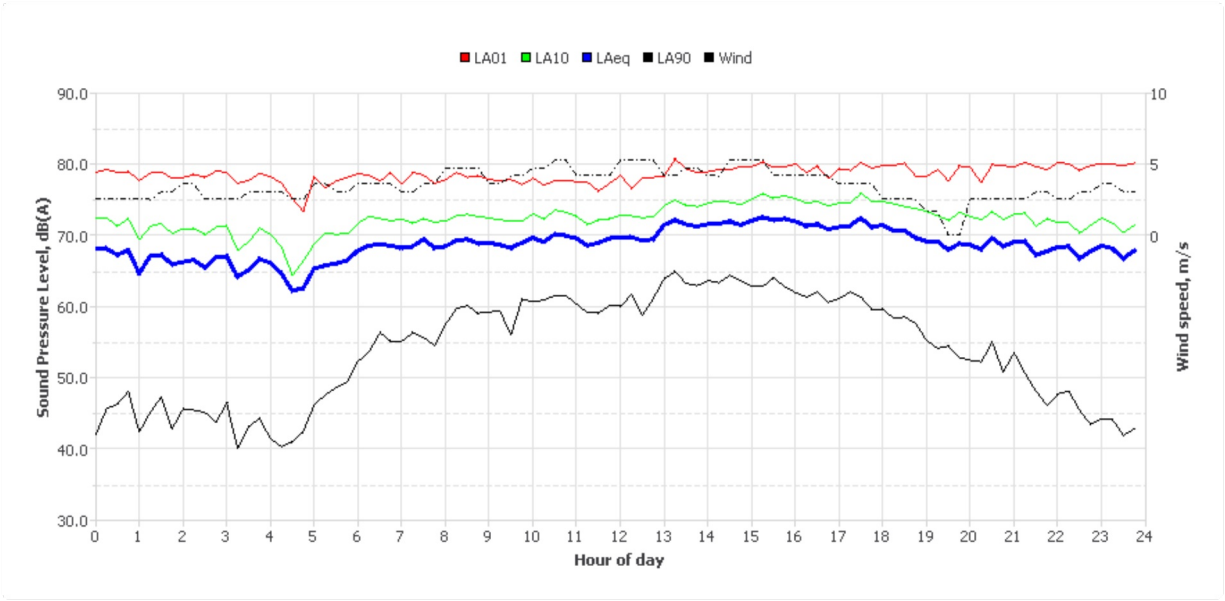

## Wednesday, 24 Aug 2022



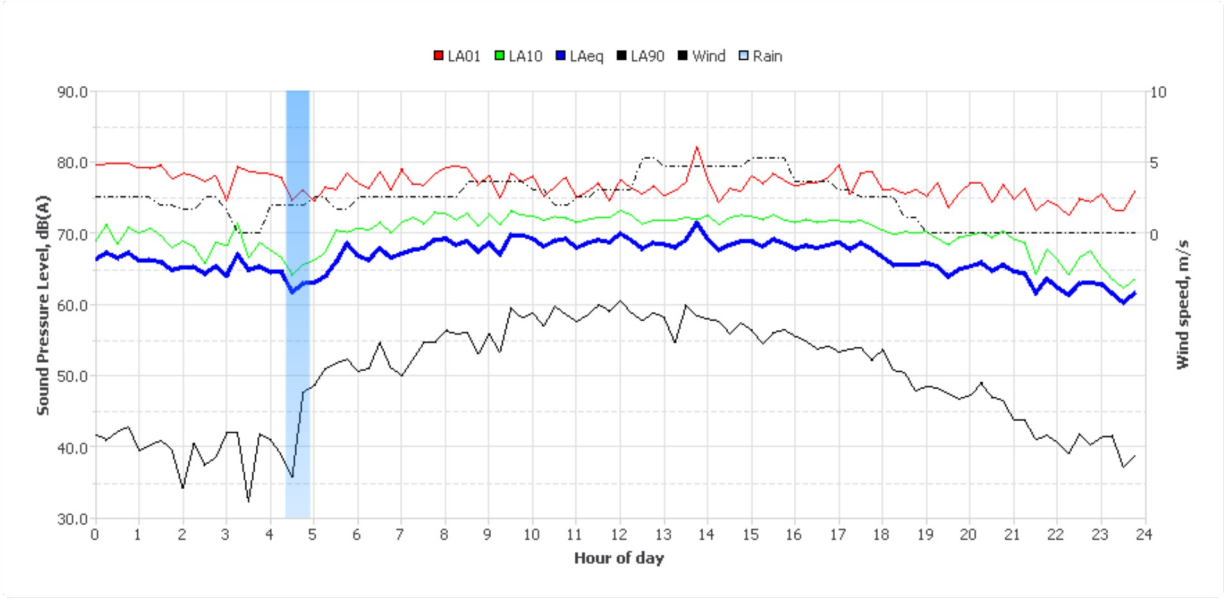

## Thursday, 25 Aug 2022



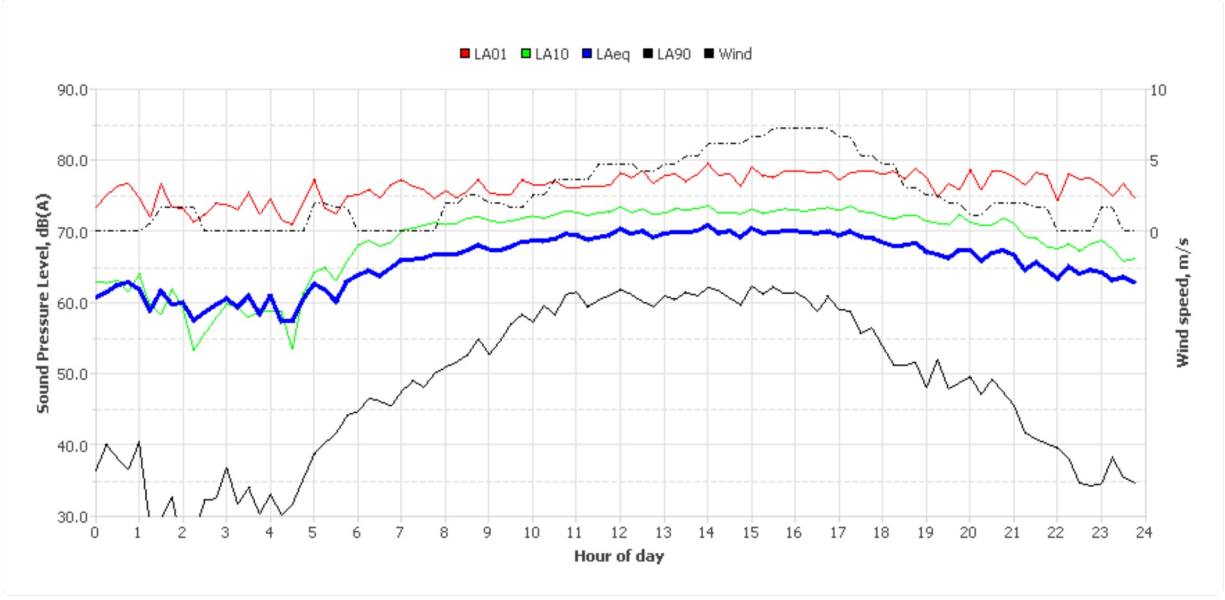
## Friday, 26 Aug 2022



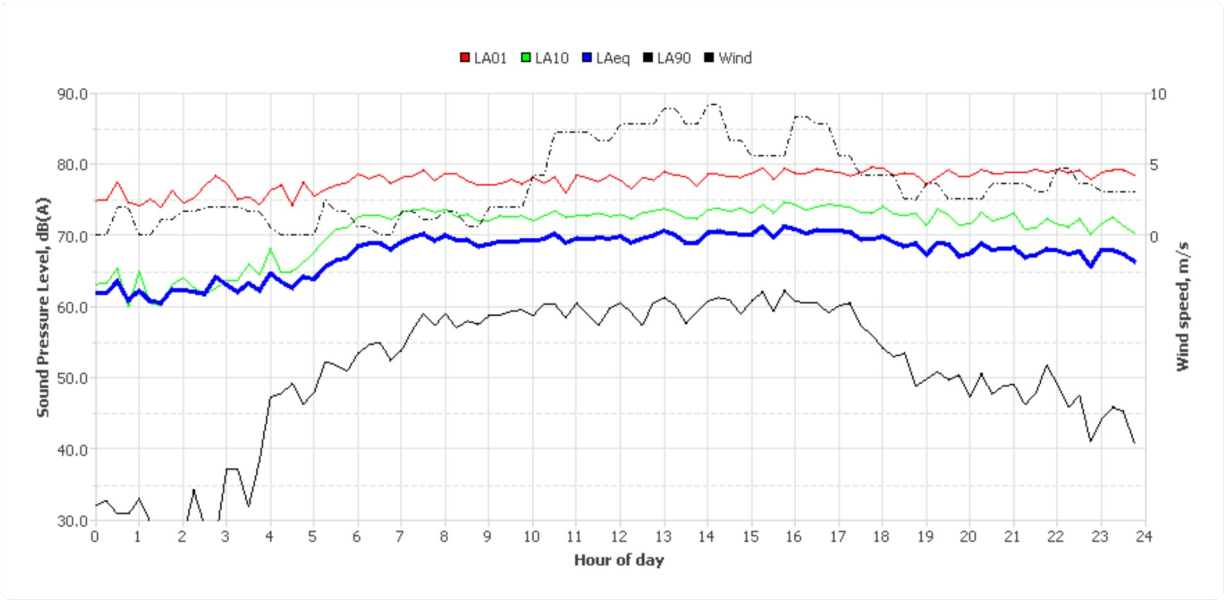

## Saturday, 27 Aug 2022



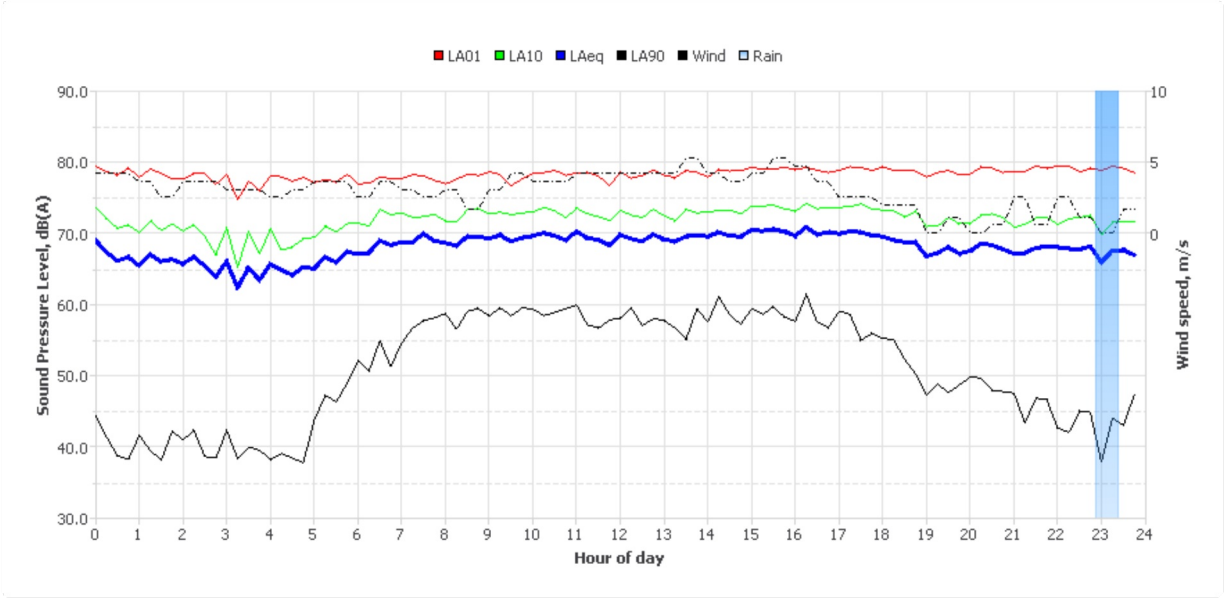

## Sunday, 28 Aug 2022



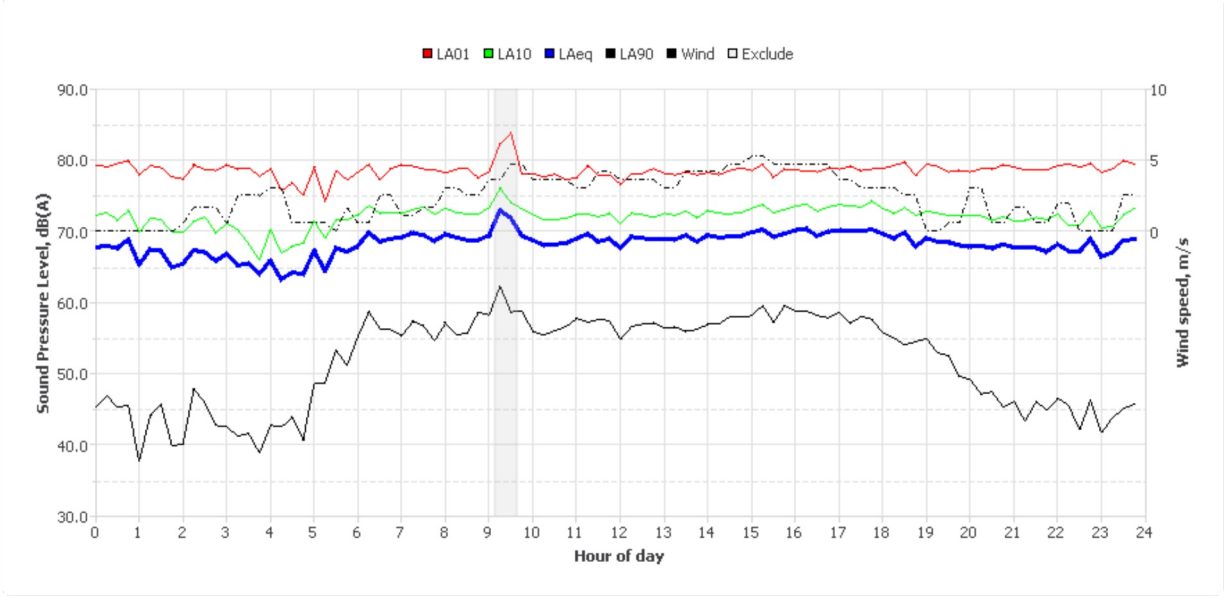
## Monday, 29 Aug 2022



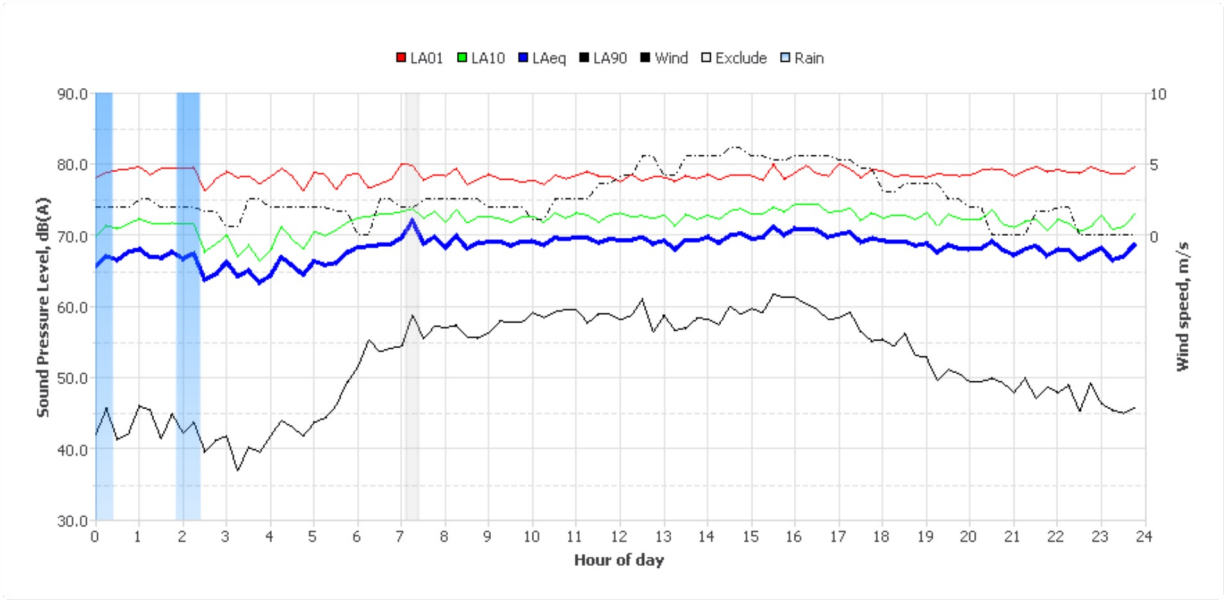

## Tuesday, 30 Aug 2022



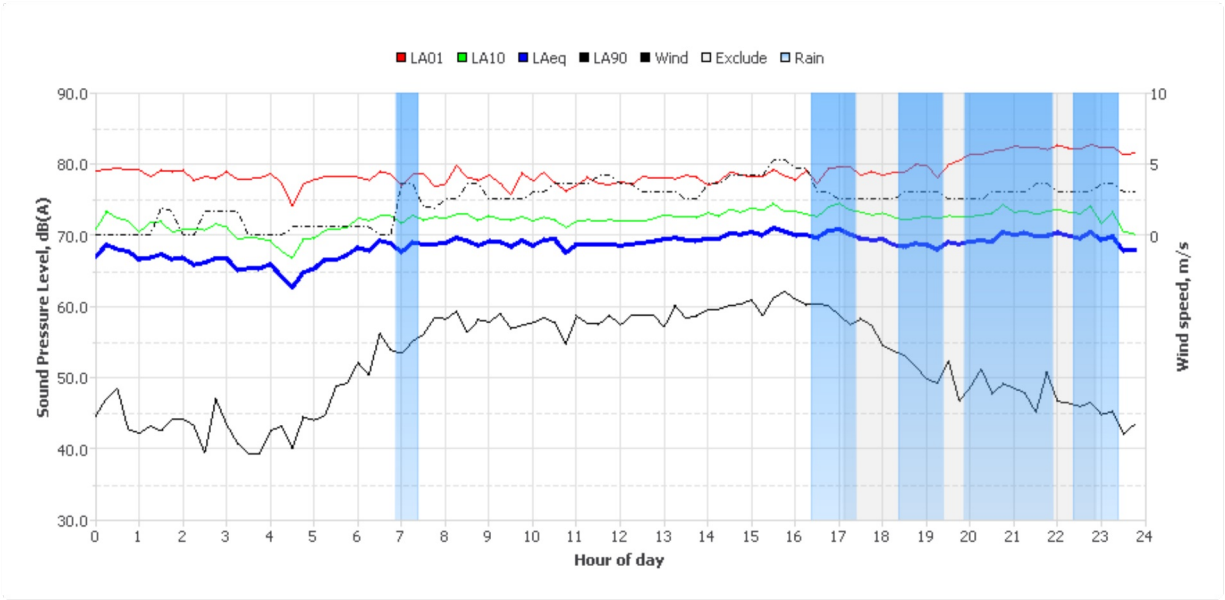

## Wednesday, 31 Aug 2022



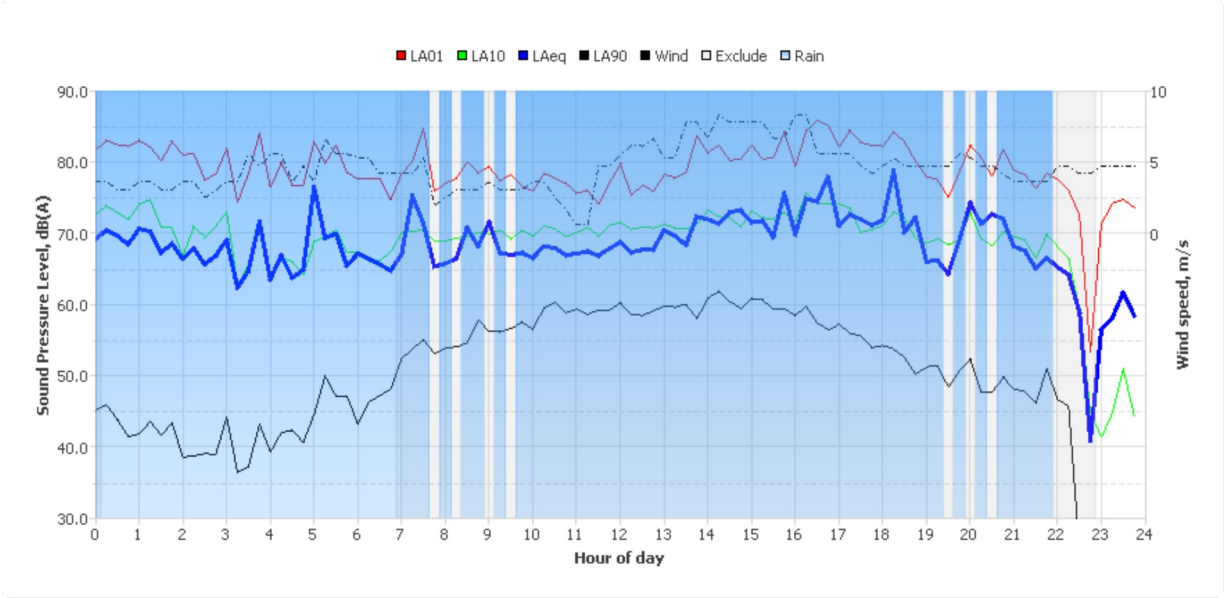
## Thursday, 01 Sep 2022



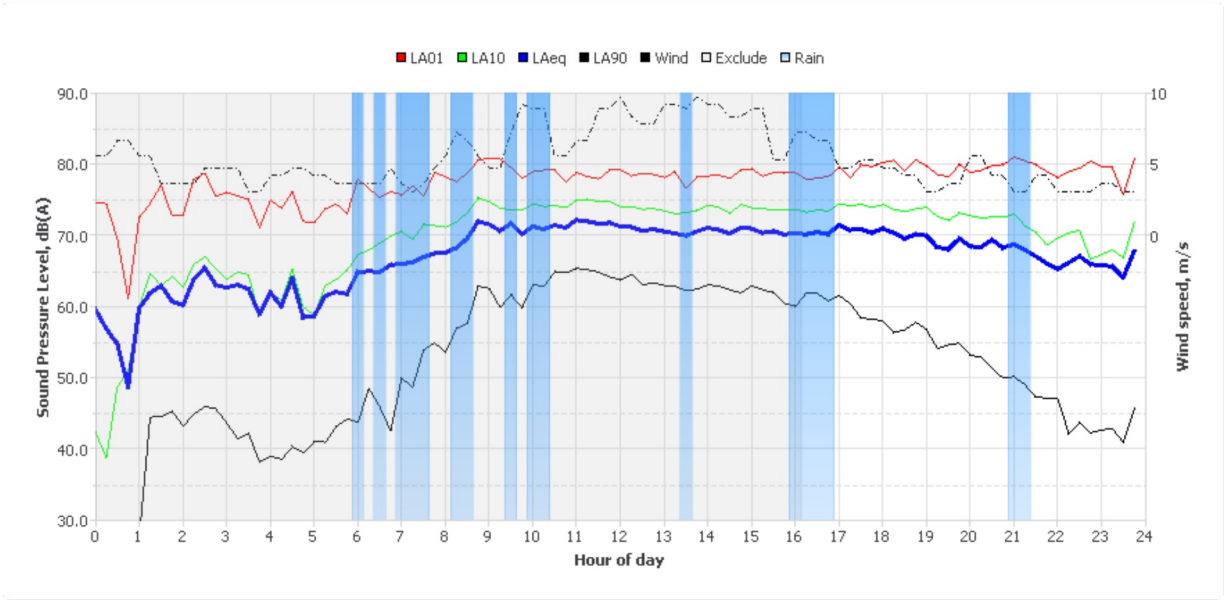

## Friday, 02 Sep 2022



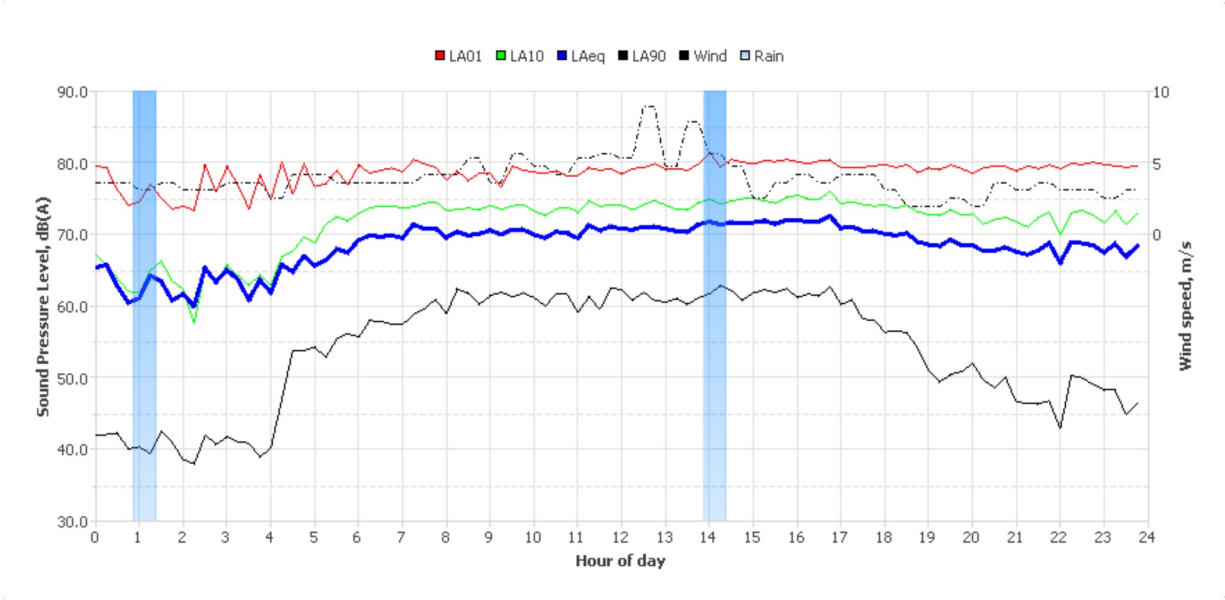

## Saturday, 03 Sep 2022



**Sunday, 04 Sep 2022**




**Monday, 05 Sep 2022**



# Noise Logger Report

**NL3 - 173 Harrington Road, Coopernook**

| Item | Information |
|---|---|
| Logger Type | Cube |
| Serial number | 12029 |
| Address | 173 Harrington Road, Coopernook |
| Location | Front Yard |
| Facade / Free Field | Free Field |
| Environment | Background dominated by road traffic noise on Pacific Highway 44-54 dBA. Local road traffic noise on Harrington Road 69-75 dBA. Bird calls and insects audible occasionally 51 dBA. |

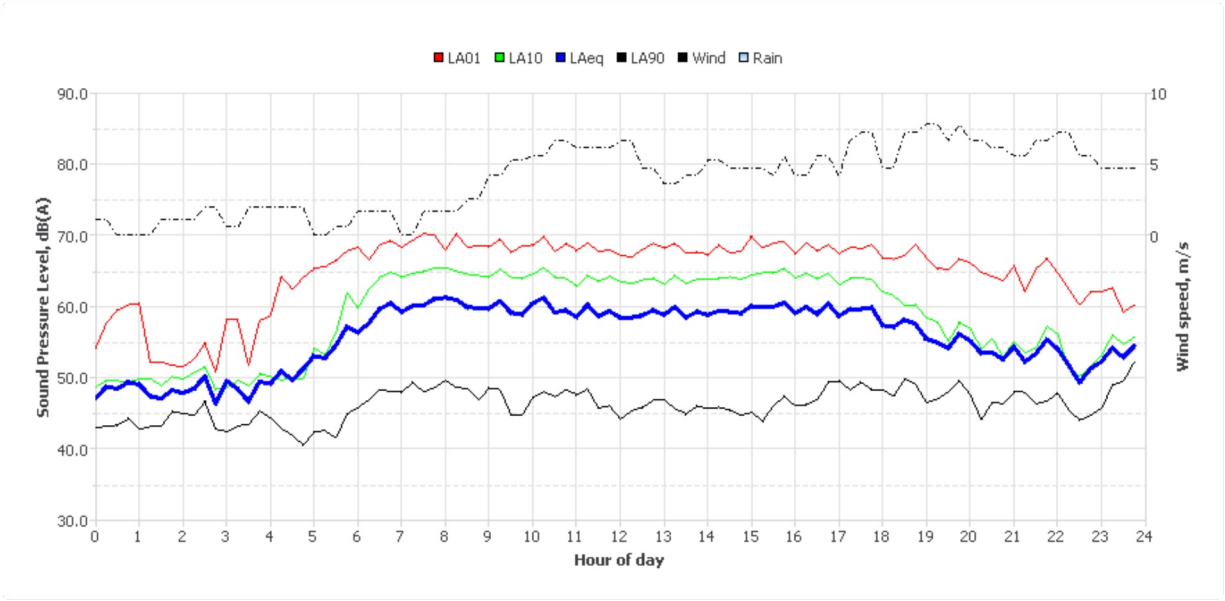
### Measured noise levels

| Logging Date | $L_{Aeq,day}$ 7am-6pm | $L_{Aeq,evening}$ 6pm-10pm | $L_{Aeq,night}$ 10pm-7am | ABL Day 7am-6pm | ABL Eve 6pm-10pm | ABL Night 10pm-7am | $L_{Aeq,15hr}$ 7am-10pm | $L_{Aeq,9hr}$ 10pm-7am |
|---|---|---|---|---|---|---|---|---|
| Tue Aug 23 2022 | 60 | 57 | 53 | - | - | - | 60 | 53 |
| Wed Aug 24 2022 | 61 | 56 | 52 | - | 43 | - | 57 | 52 |
| Thu Aug 25 2022 | 60 | 56 | 55 | 40 | 44 | 41 | 59 | 55 |
| Fri Aug 26 2022 | 60 | 56 | 54 | - | 43 | 41 | 59 | 54 |
| Sat Aug 27 2022 | 59 | 55 | 52 | 40 | 38 | 37 | 58 | 52 |
| Sun Aug 28 2022 | 59 | 53 | 51 | - | 36 | 30 | 57 | 51 |
| Mon Aug 29 2022 | 60 | 55 | 53 | - | 43 | 28 | 59 | 53 |
| Tue Aug 30 2022 | 60 | 54 | 53 | 44 | 38 | 37 | 59 | 53 |
| Wed Aug 31 2022 | 60 | 56 | 54 | 41 | 41 | 36 | 59 | 54 |
| Thu Sep 1 2022 | 60 | 55 | 54 | - | 40 | 39 | 59 | 54 |
| Fri Sep 2 2022 | 60 | - | 54 | - | - | - | 60 | 54 |
| Sat Sep 3 2022 | - | - | 54 | - | - | - | - | 54 |
| Sun Sep 4 2022 | 60 | 55 | 50 | - | - | - | 56 | 50 |
| Mon Sep 5 2022 | 61 | 56 | 55 | - | 45 | 40 | 60 | 55 |
| **Summary** | **60** | **56** | **53** | **41** | **42** | **37** | **59** | **53** |

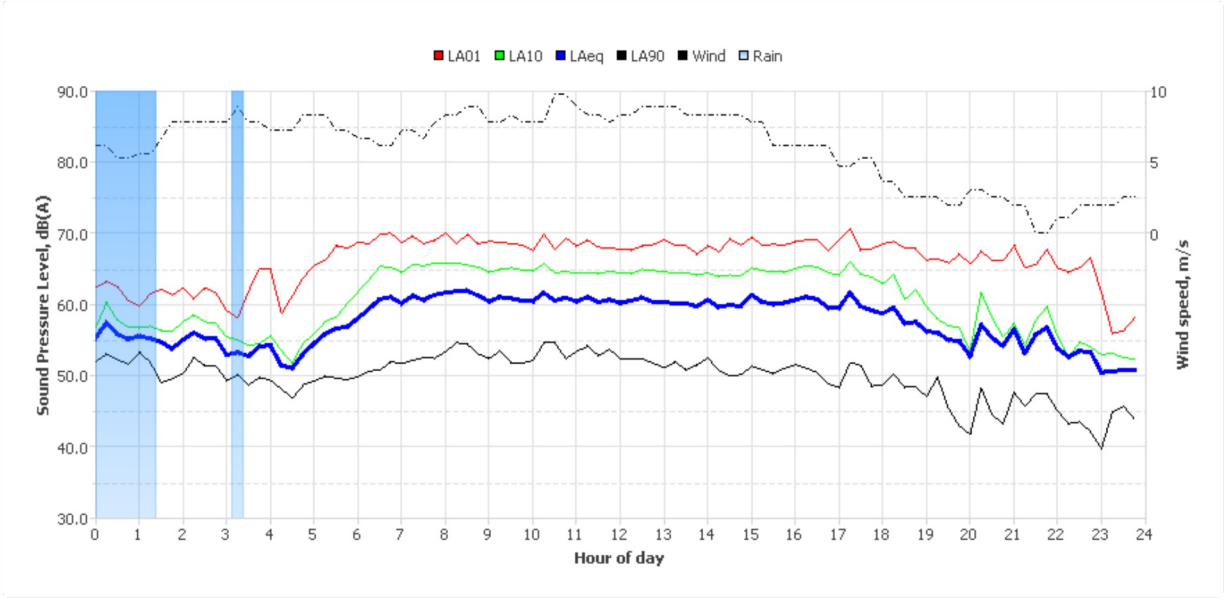
Note: Results denoted with '-' do not contain enough valid data for a value to be calculated. The data has been excluded either manually or automatically as a result of adverse weather conditions.

| Logger Location | Logger Deployment Photo |
|---|---|
|  |  |

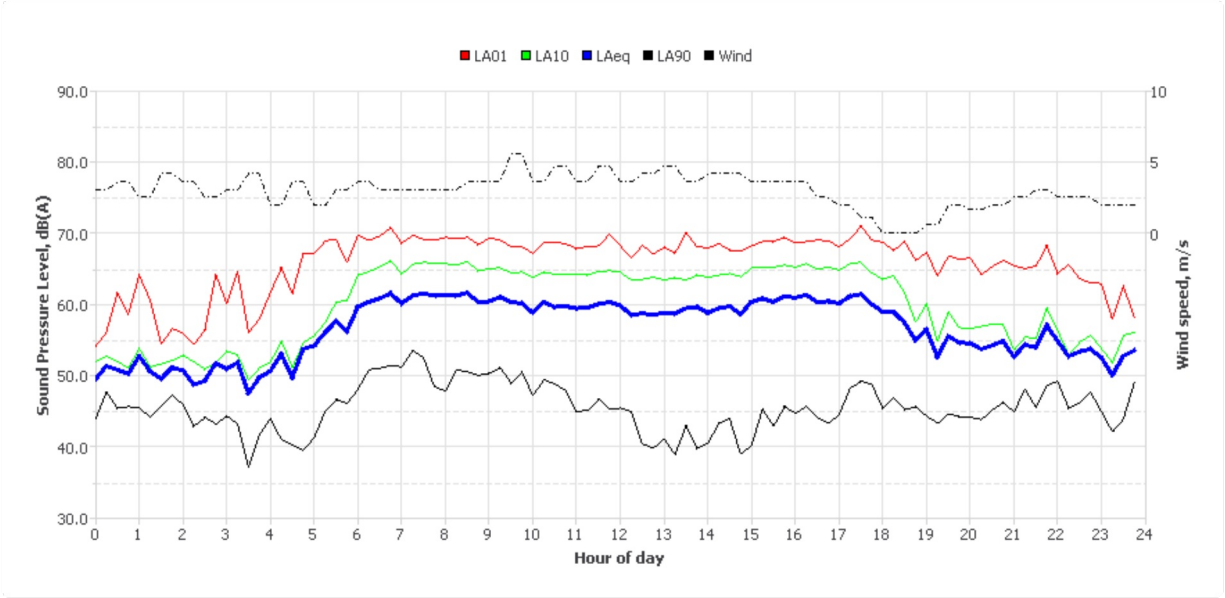
## Tuesday, 23 Aug 2022



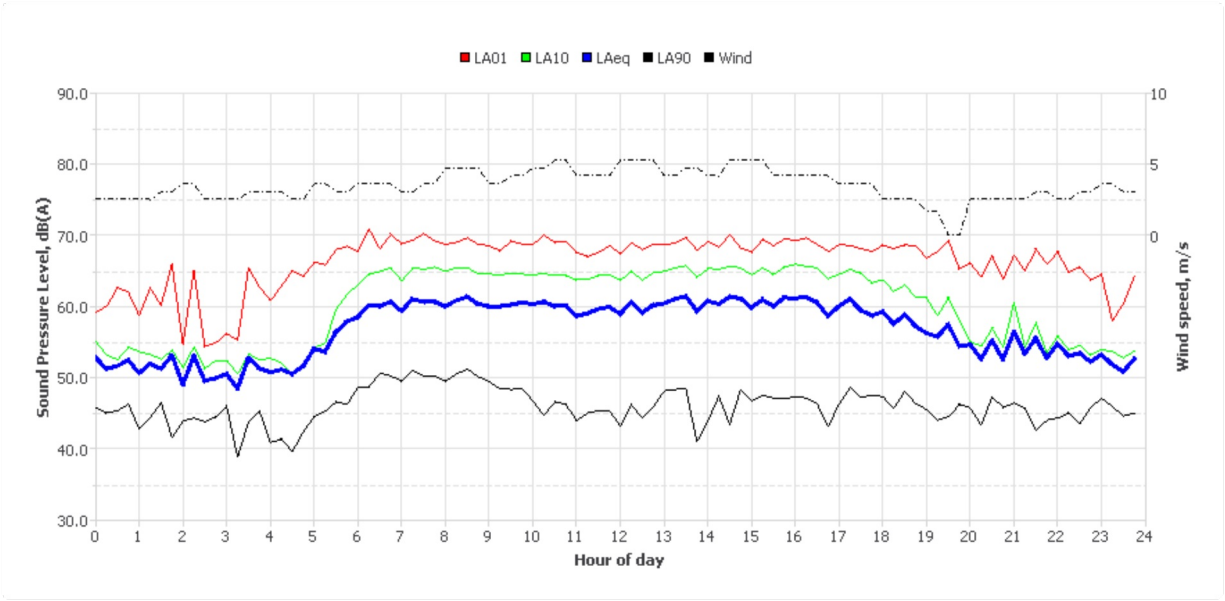

## Wednesday, 24 Aug 2022



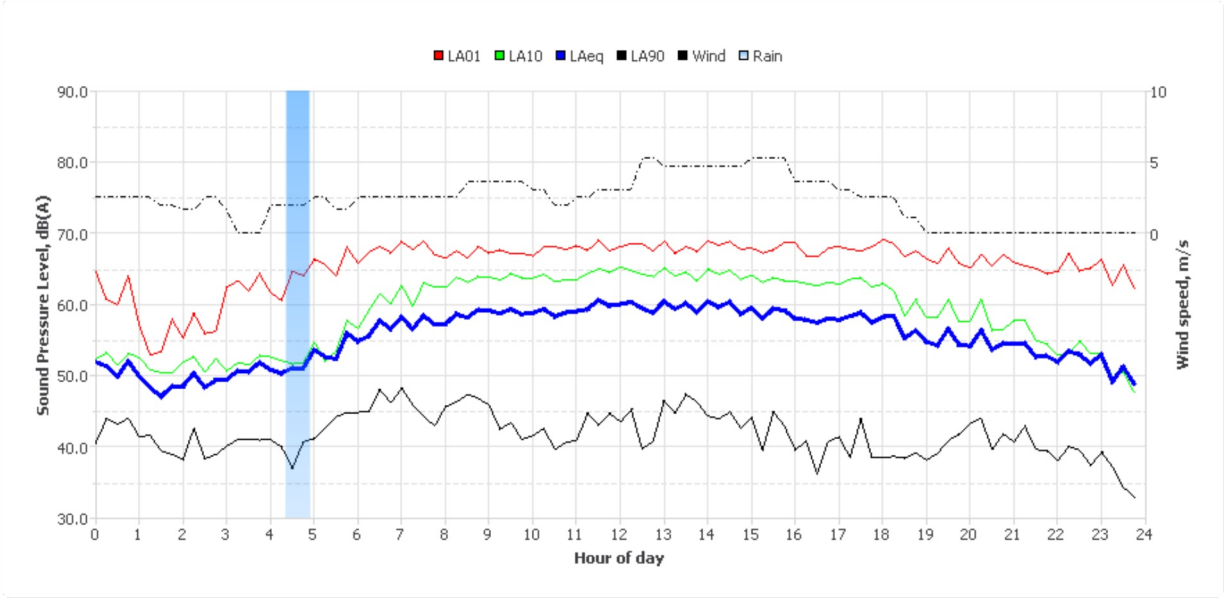

## Thursday, 25 Aug 2022



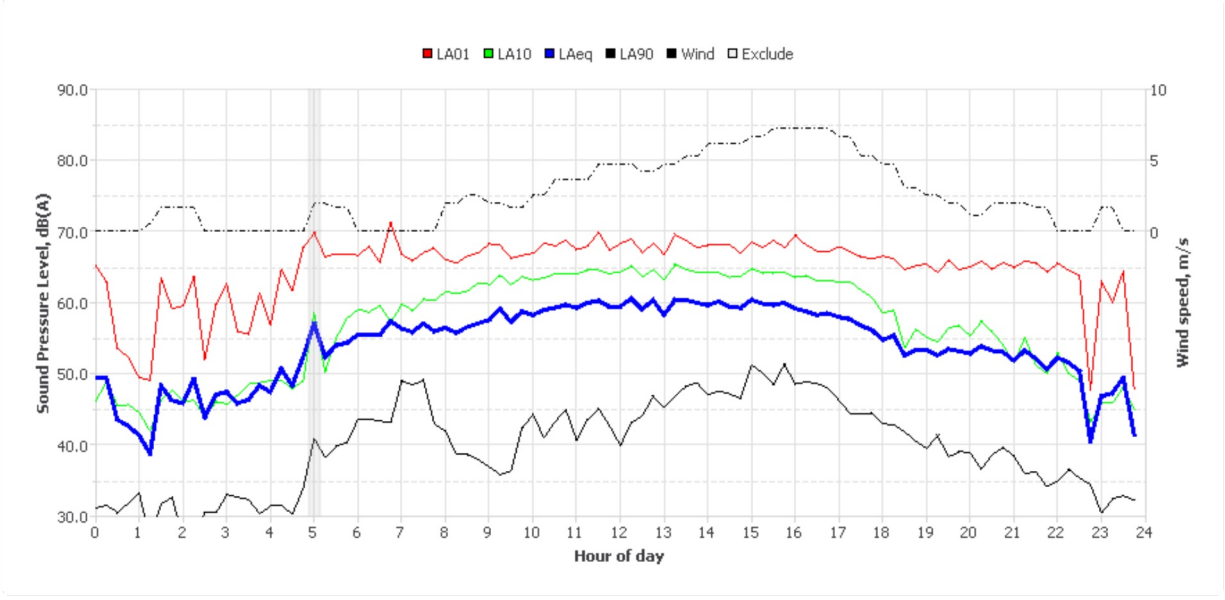
## Friday, 26 Aug 2022



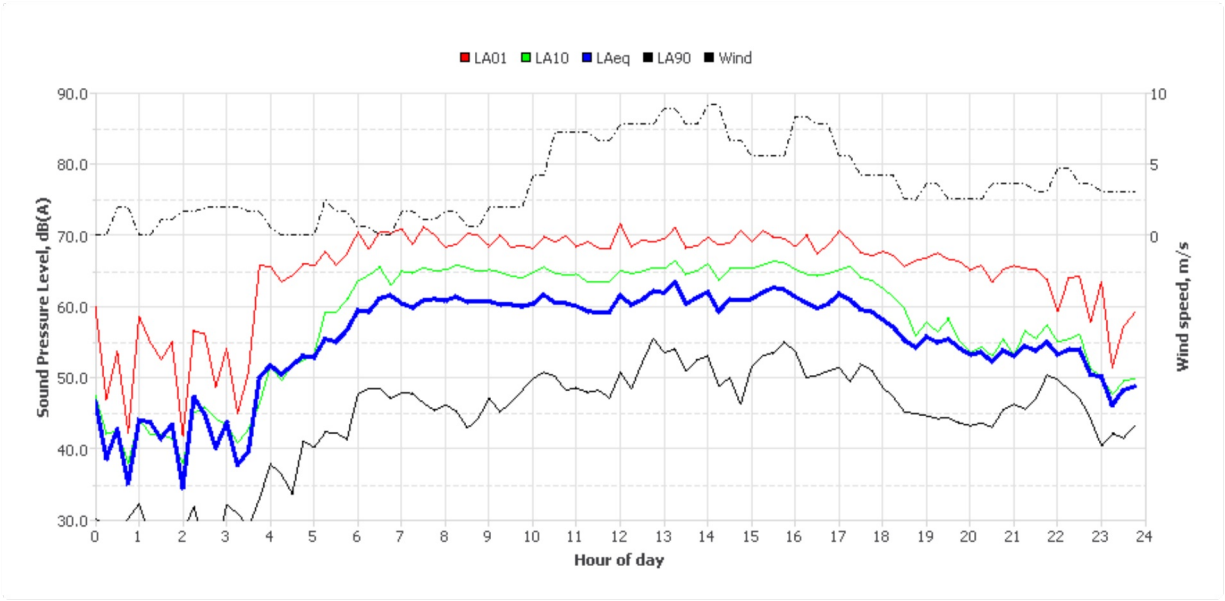

## Saturday, 27 Aug 2022



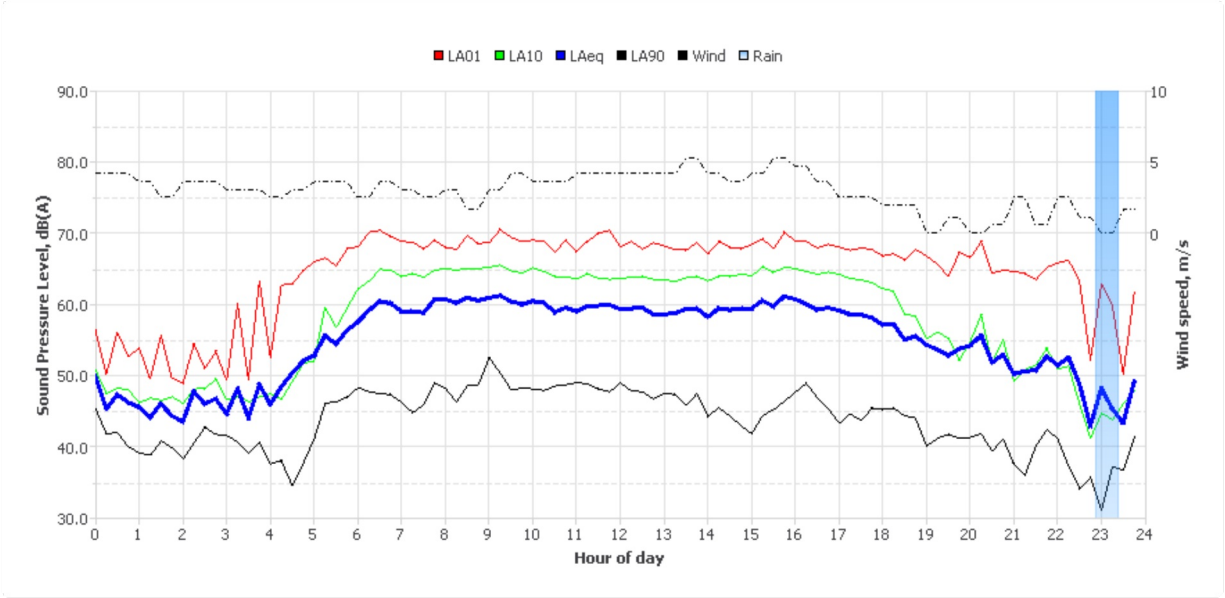

## Sunday, 28 Aug 2022



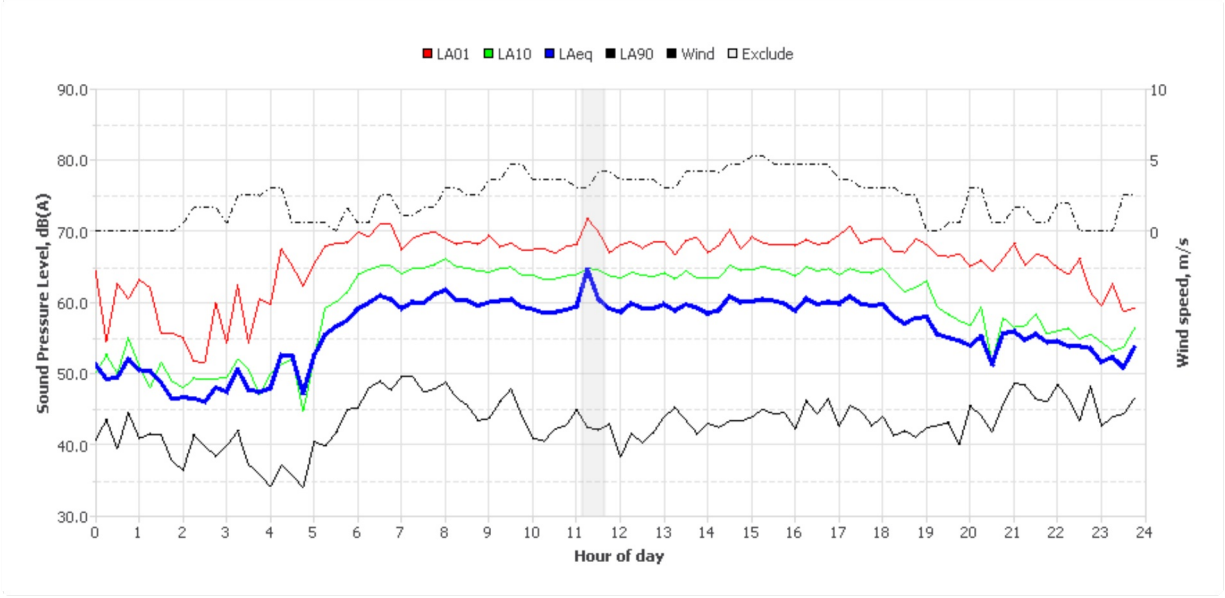
## Monday, 29 Aug 2022



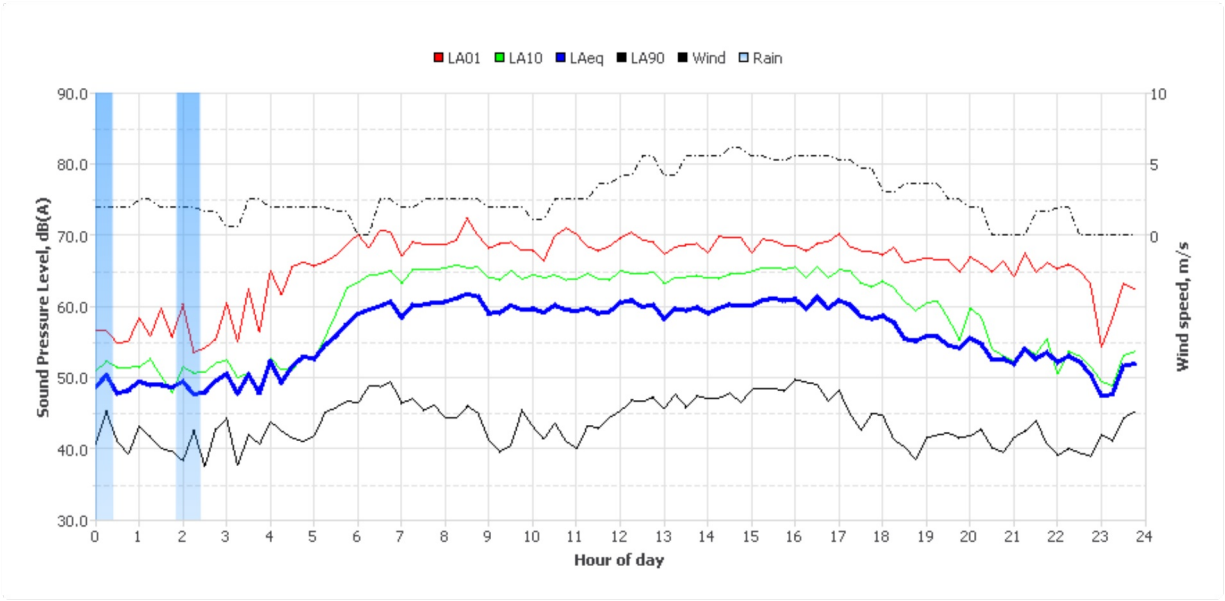

## Tuesday, 30 Aug 2022



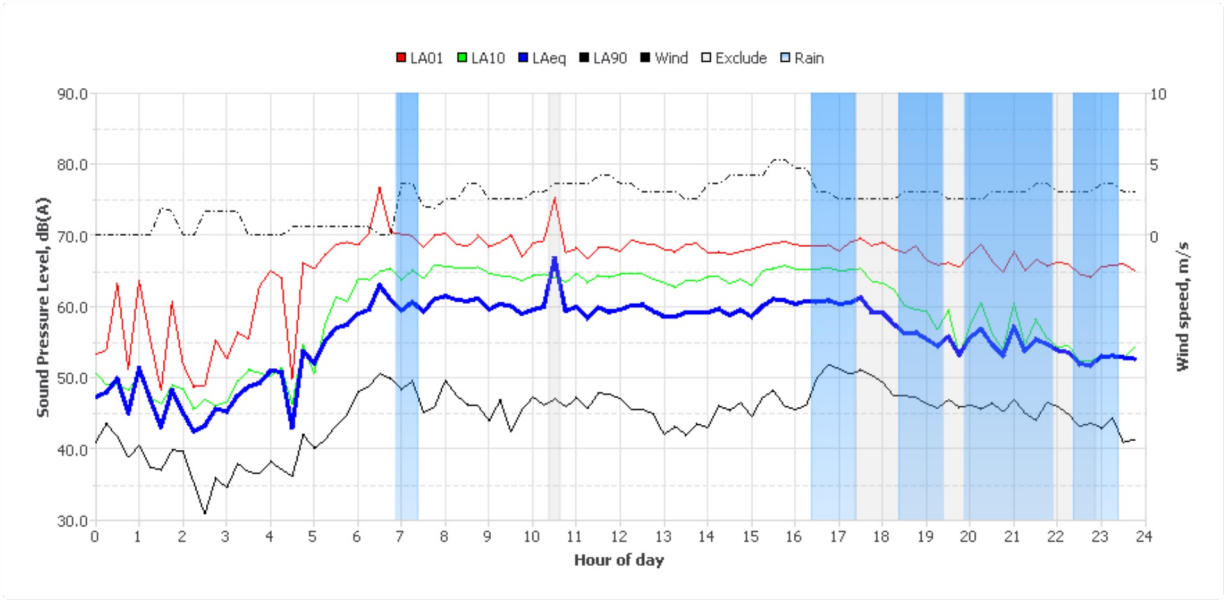

## Wednesday, 31 Aug 2022



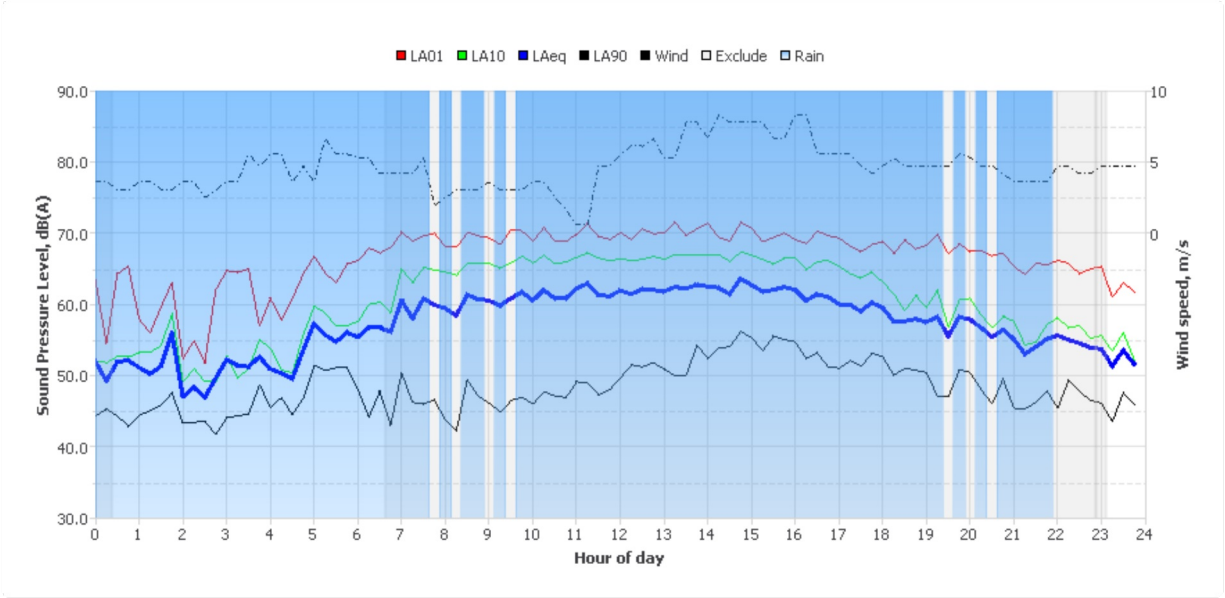
## Thursday, 01 Sep 2022



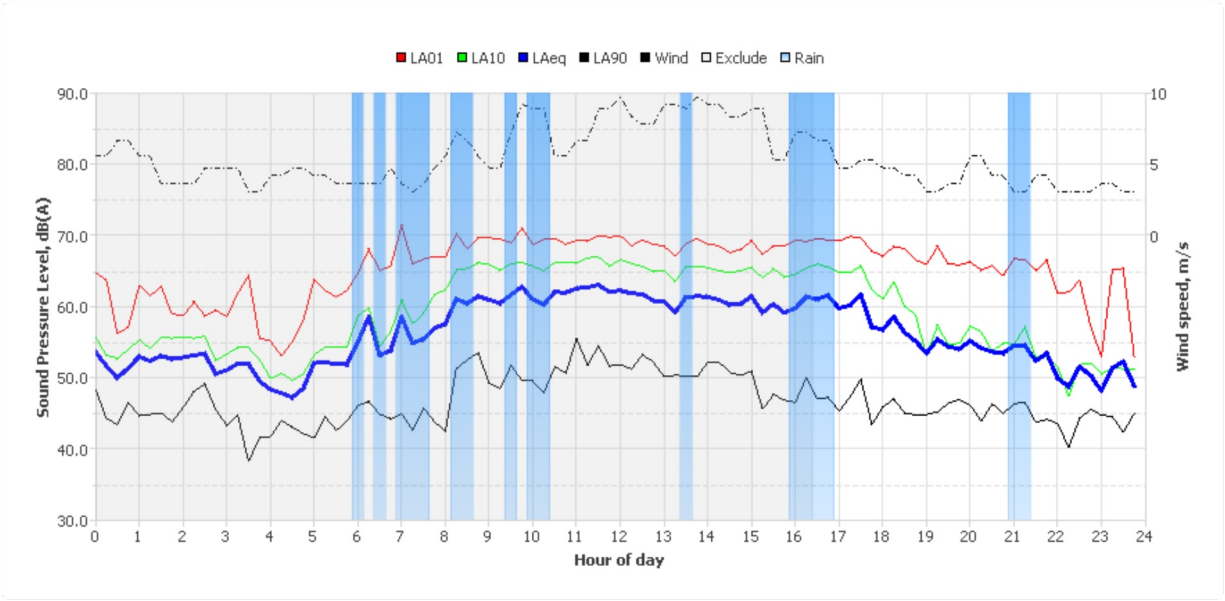

## Friday, 02 Sep 2022



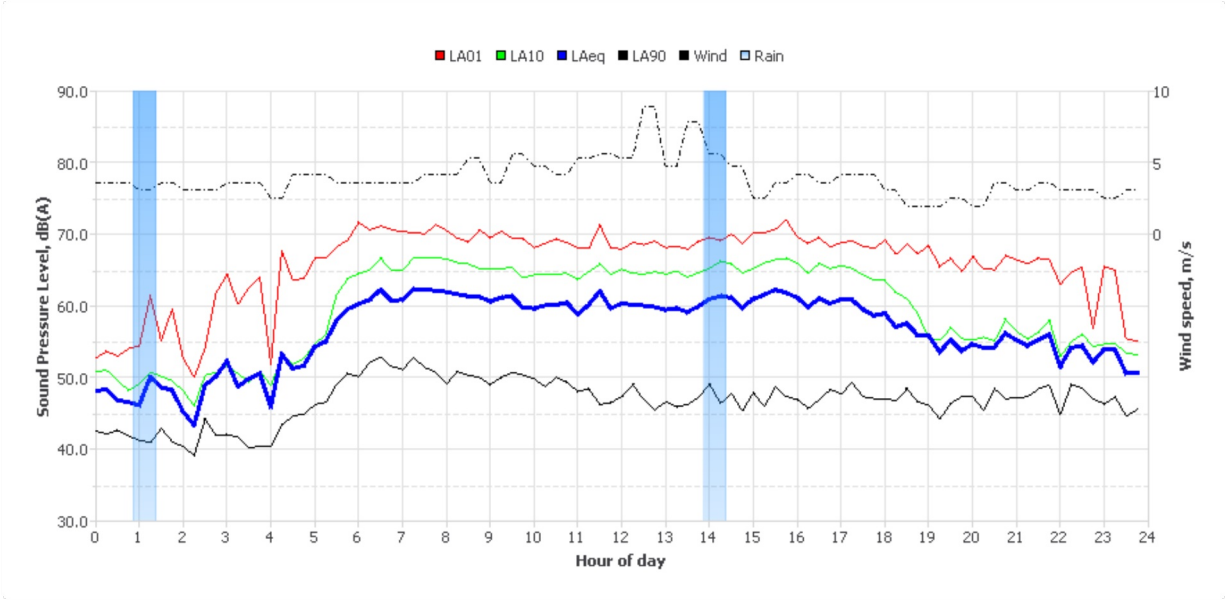

## Saturday, 03 Sep 2022



## Sunday, 04 Sep 2022

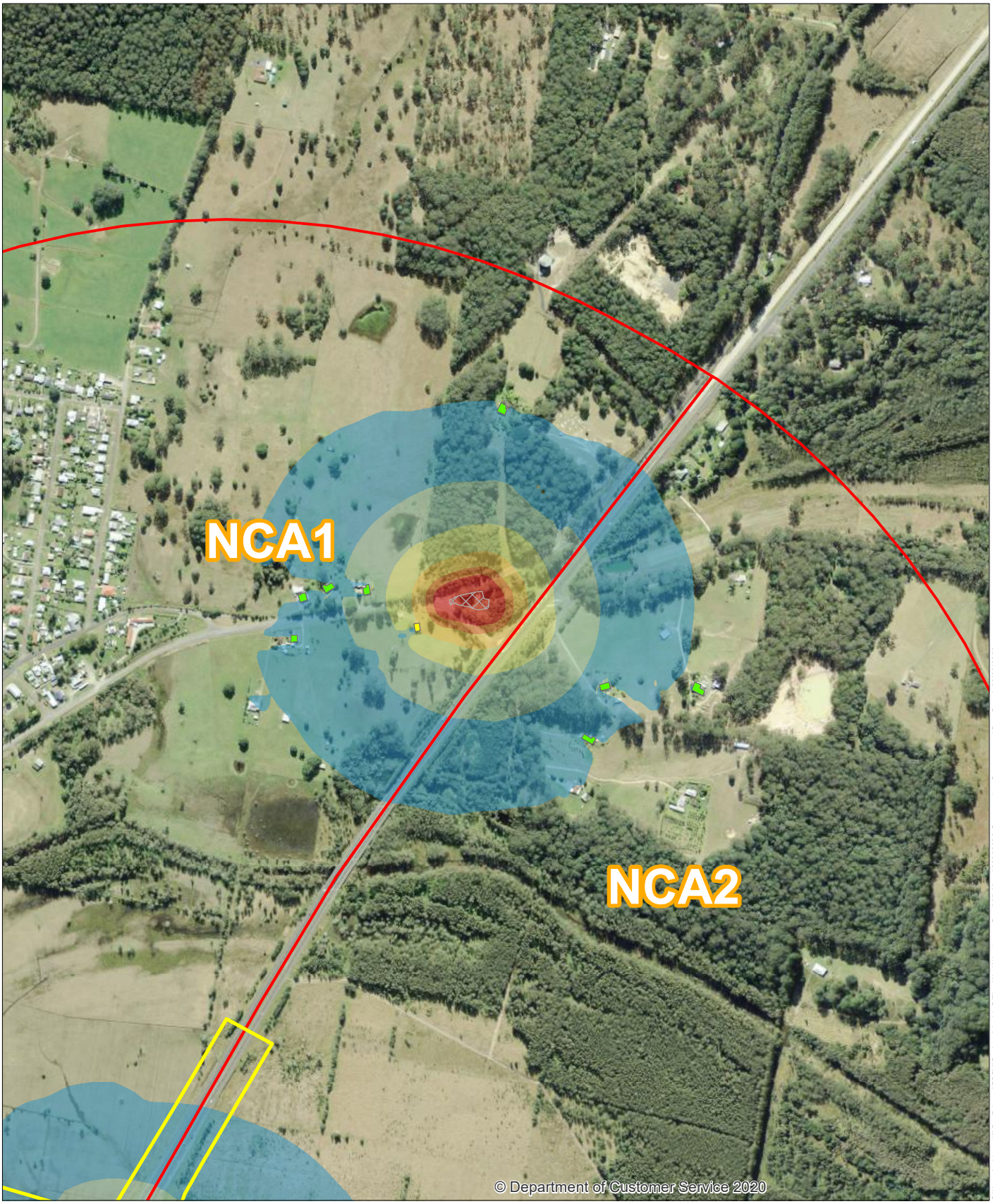



## Monday, 05 Sep 2022



# Appendix C

## Construction $L_{Aeq}$ contour maps




Construction Noise Contours

C01 - Site Establishment - Daytime

N

0 0.15 0.3 km

AECOM

**Sound Pressure Level, $L_{Aeq,15min}$, dB(A)**

50 - 55 | 55 - 60 | 60 - 65 | 65 - 70 | 70 - 75 | > 75

**Exceedance of NML, dB(A)**

1 - 10

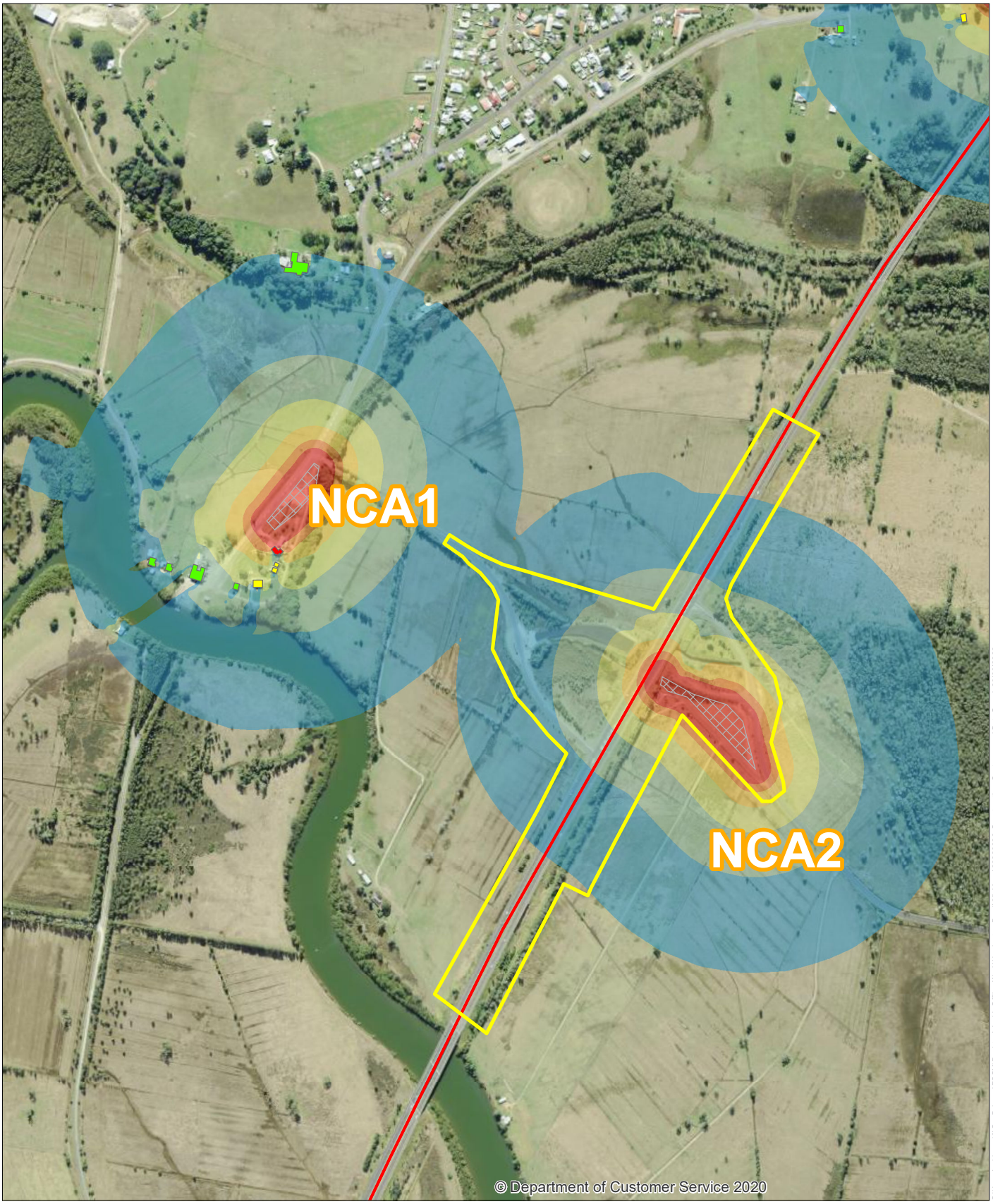
11 - 20

Proposal Area

Construction Compound

Noise Catchment Area

C:\Users\robinsonj6\OneDrive - AECOM\Desktop\Jack's Offline Work\Harrington Road\05_Maps\20230626_Construction_Contours.mxd Date Saved: 26/06/2023




Construction Noise Contours

C01 - Site Establishment - Daytime

N

0 0.15 0.3 km

AECOM

**Sound Pressure Level, $L_{Aeq,15min}$, dB(A)**

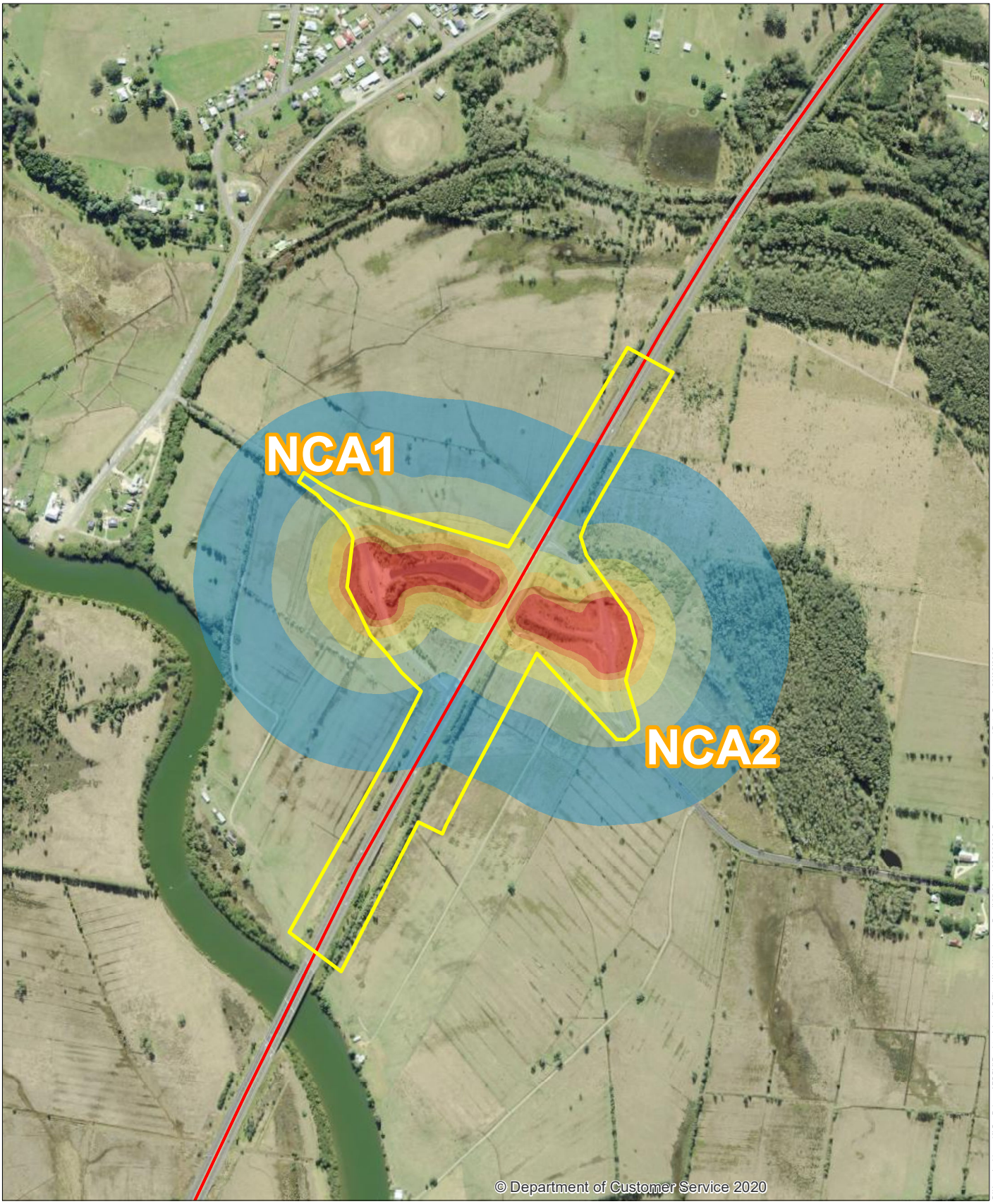
50 - 55
55 - 60
60 - 65
65 - 70
70 - 75
> 75

**Exceedance of NML, dB(A)**

1 - 10
11 - 20
> 20

Proposal Area
Construction Compound
Noise Catchment Area

C:\Users\robinsonj6\OneDrive - AECOM\Desktop\Jack's Offline Work\Harrington Road\05_Map\20230626_Construction_Contours.mxd Date Saved: 26/06/2023




Construction Noise Contours

C02 - Utility Relocations - Daytime

N

0 0.15 0.3 km

AECOM

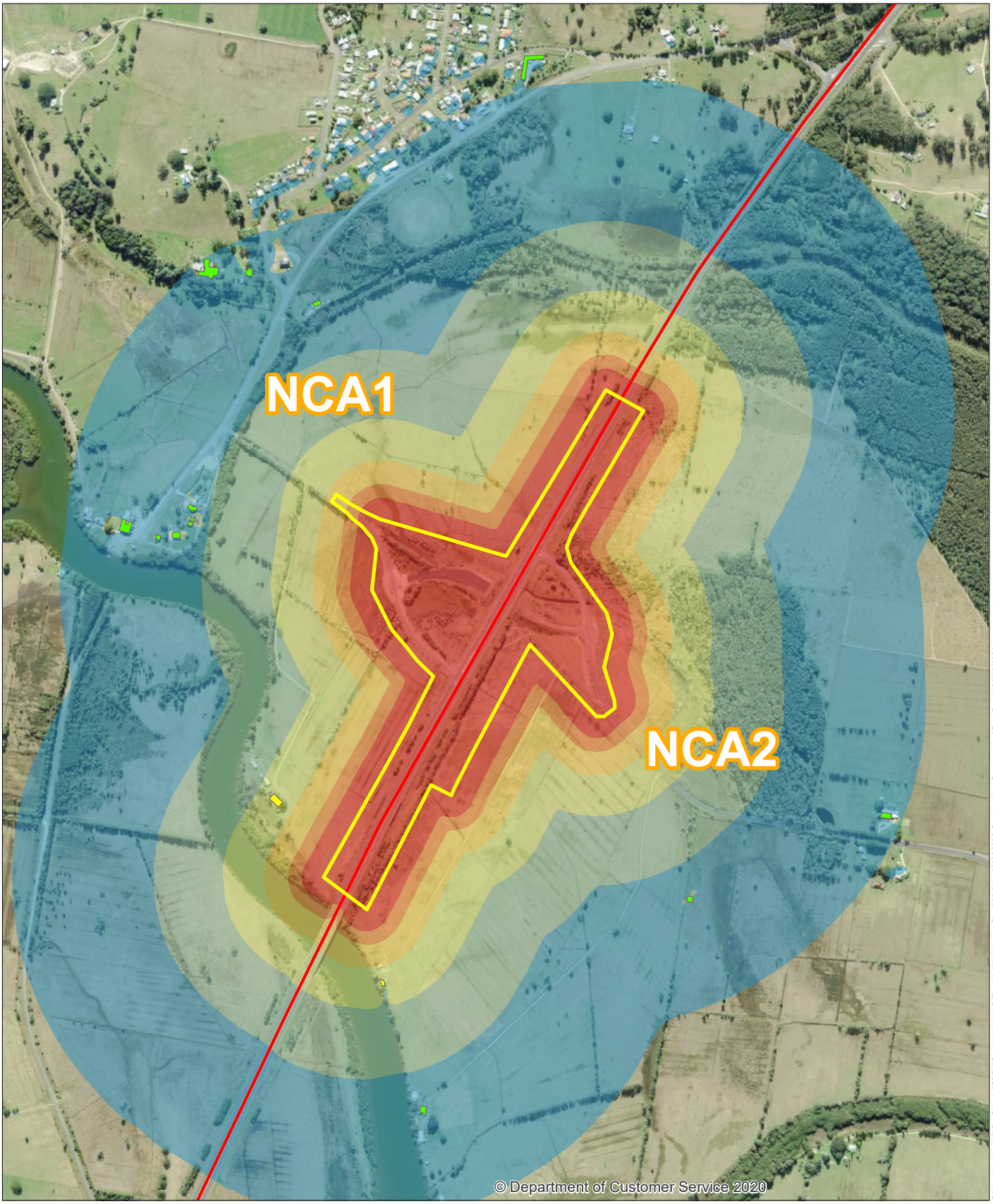
**Sound Pressure Level, $L_{Aeq,15min}$, dB(A)**

50 - 55 | 55 - 60 | 60 - 65 | 65 - 70 | 70 - 75 | > 75

Proposal Area

Noise Catchment Area

C:\Users\robinsonj6\OneDrive - AECOM\Desktop\Jack's Offline Work\Harrington Road\05_Maps\20230626_Construction_Contours.mxd Date Saved: 26/06/2023




Construction Noise Contours

C03 - Vegetation Clearing- Daytime

N

0 0.15 0.3 km

AECOM

**Sound Pressure Level, $L_{Aeq,15min}$, dB(A)**

50 - 55 | 55 - 60 | 60 - 65 | 65 - 70 | 70 - 75 | > 75

**Exceedance of NML, dB(A)**

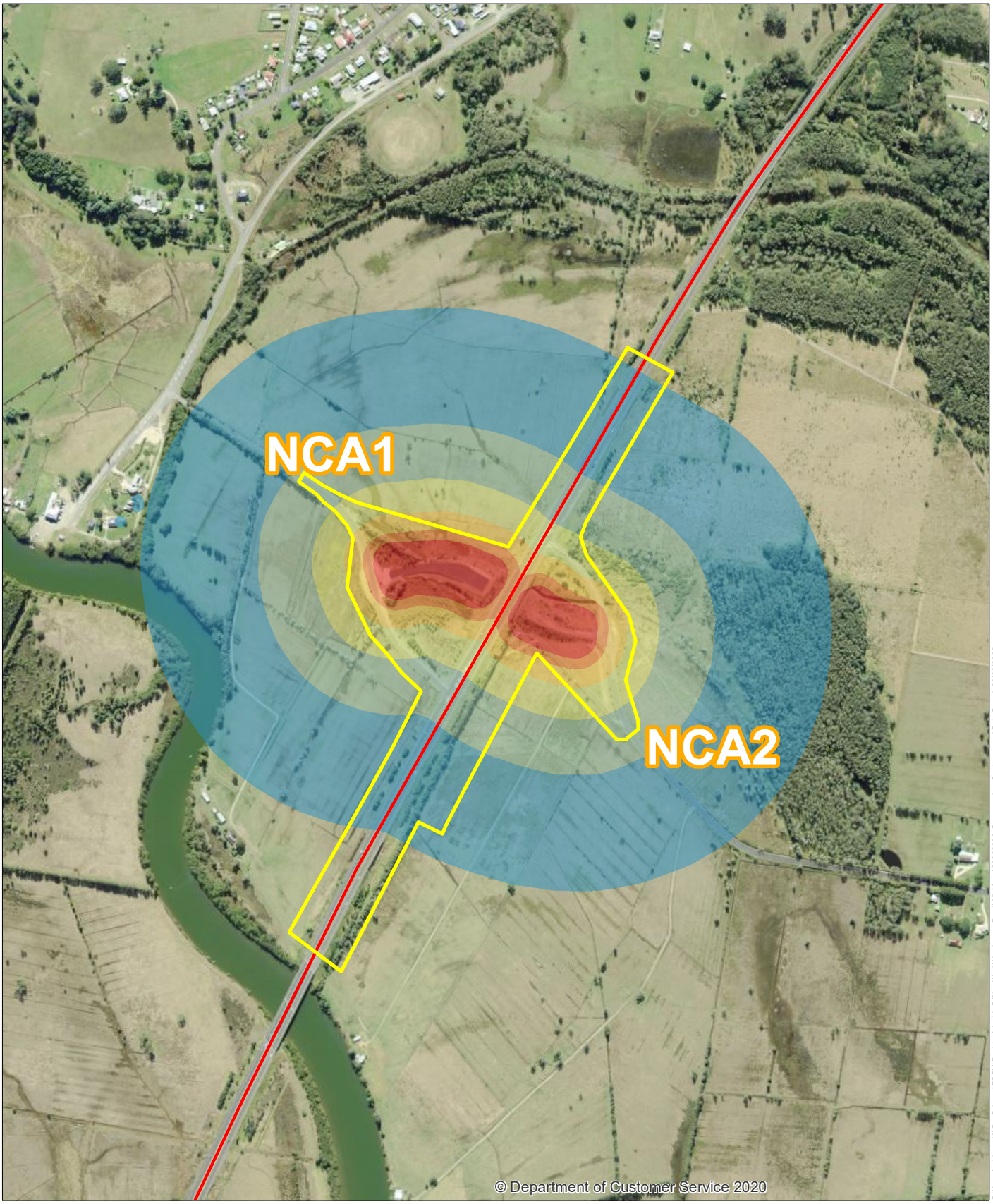
1 - 10

11 - 20

Proposal Area

Noise Catchment Area

C:\Users\robinsonj6\OneDrive - AECOM\Desktop\Jack's Offline Work\Harrington Road\05_Maps\20230626_Construction_Contours.mxd Date Saved: 26/06/2023




Construction Noise Contours

C04 - Earthworks and Drainage - Daytime

N

0 0.15 0.3 km

AECOM

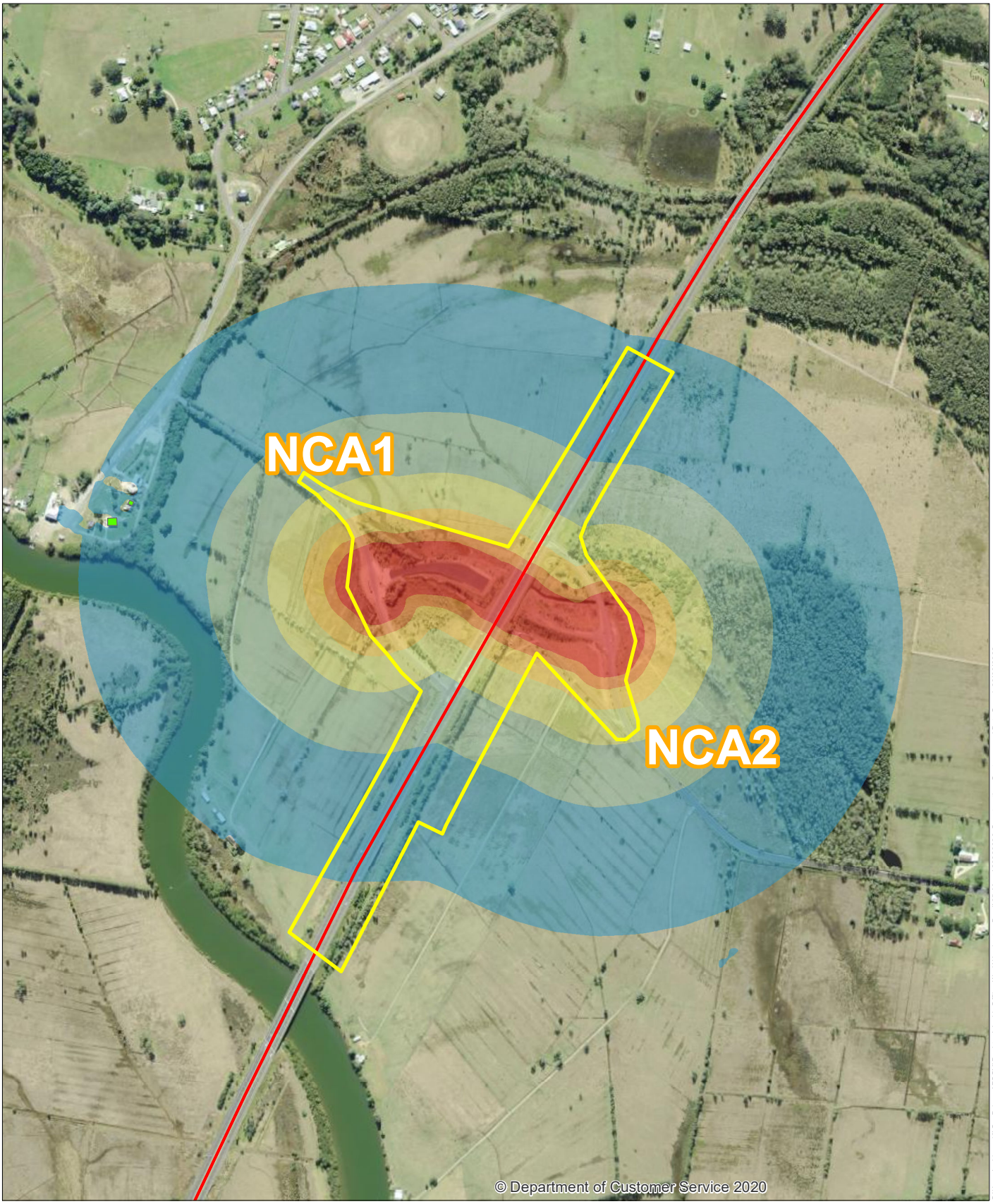
**Sound Pressure Level, $L_{Aeq,15min}$, dB(A)**

50 - 55 | 55 - 60 | 60 - 65 | 65 - 70 | 70 - 75 | > 75

Proposal Area

Noise Catchment Area

C:\Users\robinsonj6\OneDrive - AECOM\Desktop\Jack's Offline Work\Harrington Road\05_Maps\20230626_Construction_Contours.mxd Date Saved: 26/06/2023




Construction Noise Contours

C05 - Bridge Construction - Daytime

N

0 0.15 0.3 km

AECOM

**Sound Pressure Level, $L_{Aeq,15min}$, dB(A)**

50 - 55 | 55 - 60 | 60 - 65 | 65 - 70 | 70 - 75 | > 75

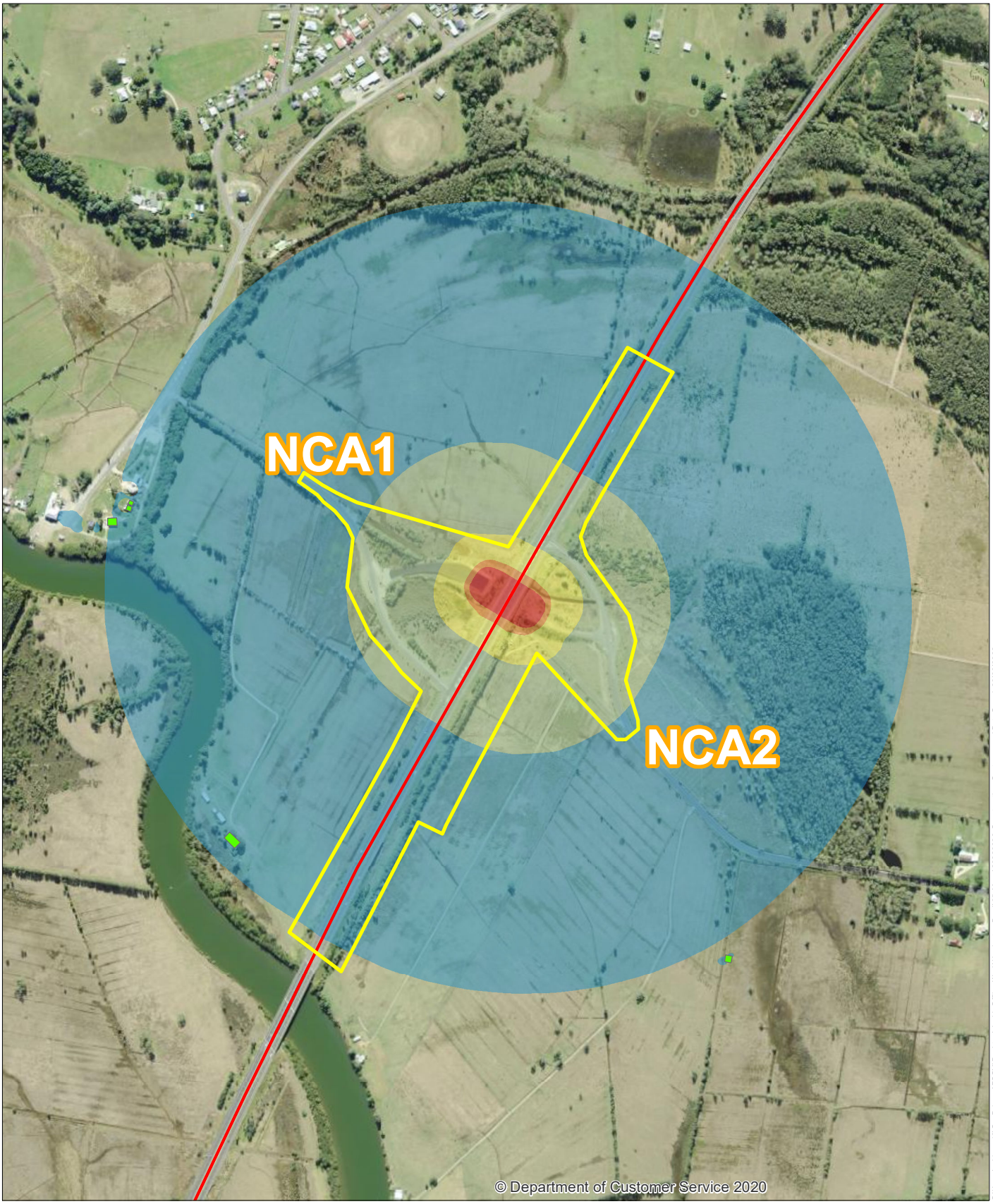
**Exceedance of NML, dB(A)**

1 - 10

Proposal Area

Noise Catchment Area

C:\Users\robinsonj6\OneDrive - AECOM\Desktop\Jack's Offline Work\Harrington Road\05_Maps\20230626_Construction_Contours.mxd Date Saved: 26/06/2023




Construction Noise Contours

C05 Night - Bridge Construction - Night-time

N

0 0.15 0.3 km

AECOM

**Sound Pressure Level, $L_{Aeq,15min}$, dB(A)**

40 - 50 | 50 - 60 | 60 - 70 | 70 - 75 | > 75

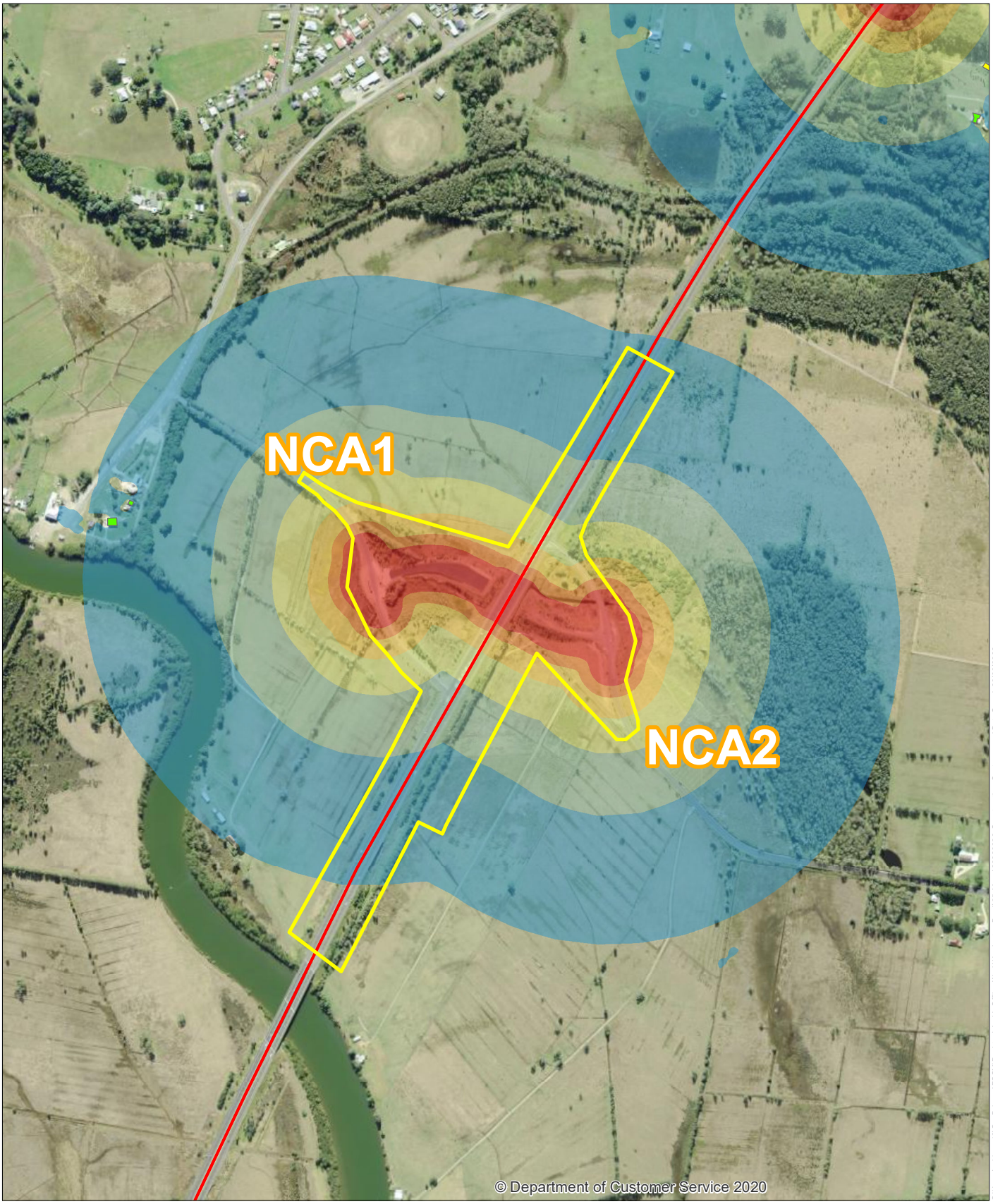
**Exceedance of NML, dB(A)**

1 - 5

Proposal Area

Noise Catchment Area

C:\Users\robinsonj6\OneDrive - AECOM\Desktop\Jack's Offline Work\Harrington Road\05_Maps\20230626_Construction_Contours.mxd Date Saved: 26/06/2023




Construction Noise Contours

C06 - Pavement Construction - Daytime

N

0 0.15 0.3 km

AECOM

**Sound Pressure Level, $L_{Aeq,15min}$, dB(A)**

50 - 55 | 55 - 60 | 60 - 65 | 65 - 70 | 70 - 75 | > 75

**Exceedance of NML, dB(A)**

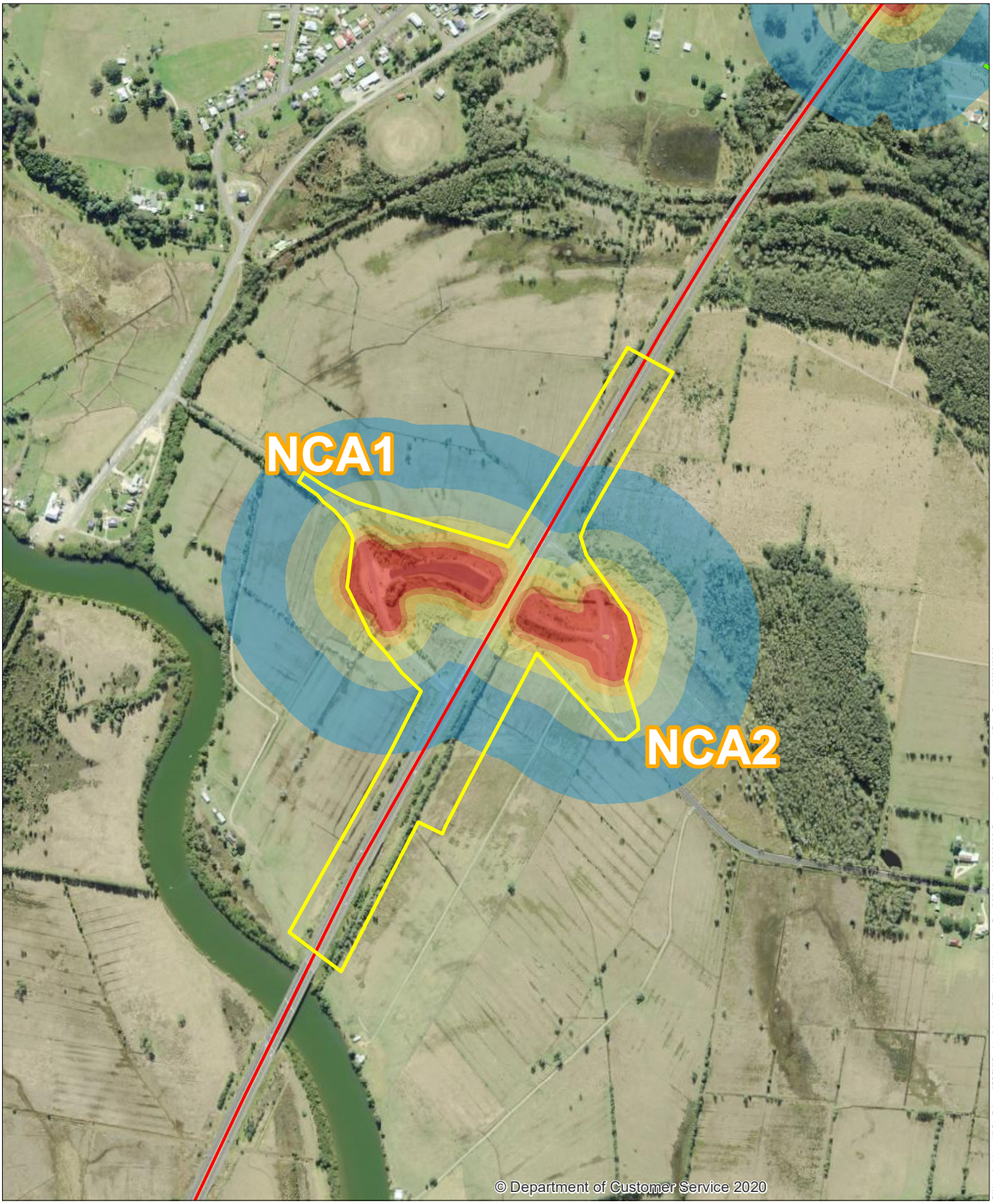
1 - 10

11 - 20

Proposal Area

Noise Catchment Area

C:\Users\robinsonj6\OneDrive - AECOM\Desktop\Jack's Offline Work\Harrington Road\05_Maps\20230626_Construction_Contours.mxd Date Saved: 26/06/2023




Construction Noise Contours

C07 - Landscaping and Finishing Work - Daytime

N

0 0.15 0.3 km

AECOM

**Sound Pressure Level, $L_{Aeq,15min}$, dB(A)**

50 - 55 | 55 - 60 | 60 - 65 | 65 - 70 | 70 - 75 | > 75

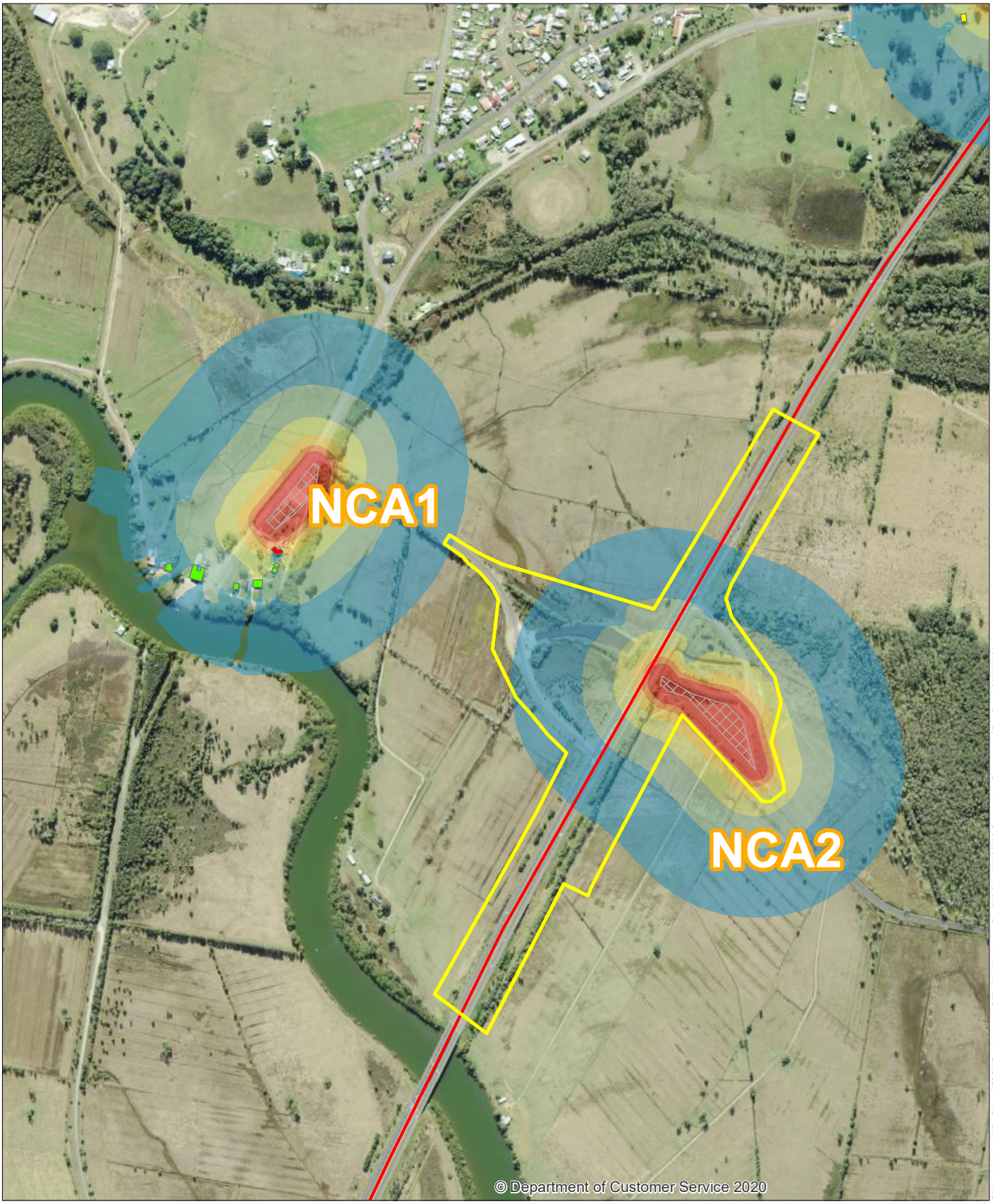
**Exceedance of NML, dB(A)**

1 - 10

Proposal Area

Noise Catchment Area

C:\Users\robinsonj6\OneDrive - AECOM\Desktop\Jack's Offline Work\Harrington Road\05_Maps\20230626_Construction_Contours.mxd Date Saved: 26/06/2023




Construction Noise Contours

C08 - Demobilisation - Daytime

N

0 0.15 0.3 km

AECOM

**Sound Pressure Level, $L_{Aeq,15min}$, dB(A)**

50 - 55 | 55 - 60 | 60 - 65 | 65 - 70 | 70 - 75 | > 75

**Exceedance of NML, dB(A)**

1 - 10

11 - 20

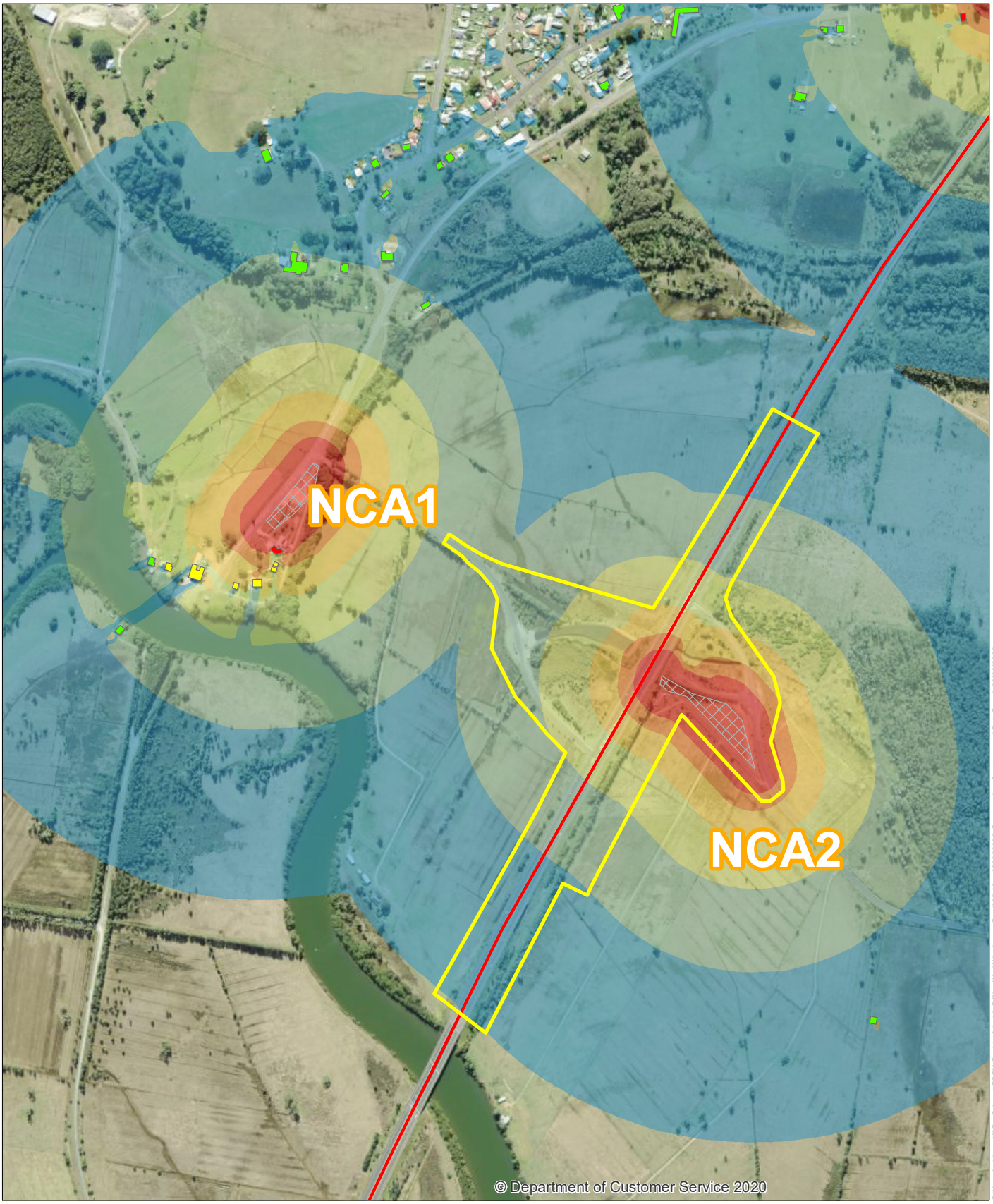
> 20

Proposal Area

Construction Compound

Noise Catchment Area

C:\Users\robinsonj6\OneDrive - AECOM\Desktop\Jack's Offline Work\Harrington Road\05_Maps\20230626_Construction_Contours.mxd Date Saved: 26/06/2023




Construction Noise Contours

A01 - Vegetation Clearing - Daytime

N

0 0.15 0.3 km

AECOM

**Sound Pressure Level, $L_{Aeq,15min}$, dB(A)**

50 - 55 | 55 - 60 | 60 - 65 | 65 - 70 | 70 - 75 | > 75

**Exceedance of NML, dB(A)**

1 - 10

11 - 20

> 20

Proposal Area

Construction Compound

Noise Catchment Area

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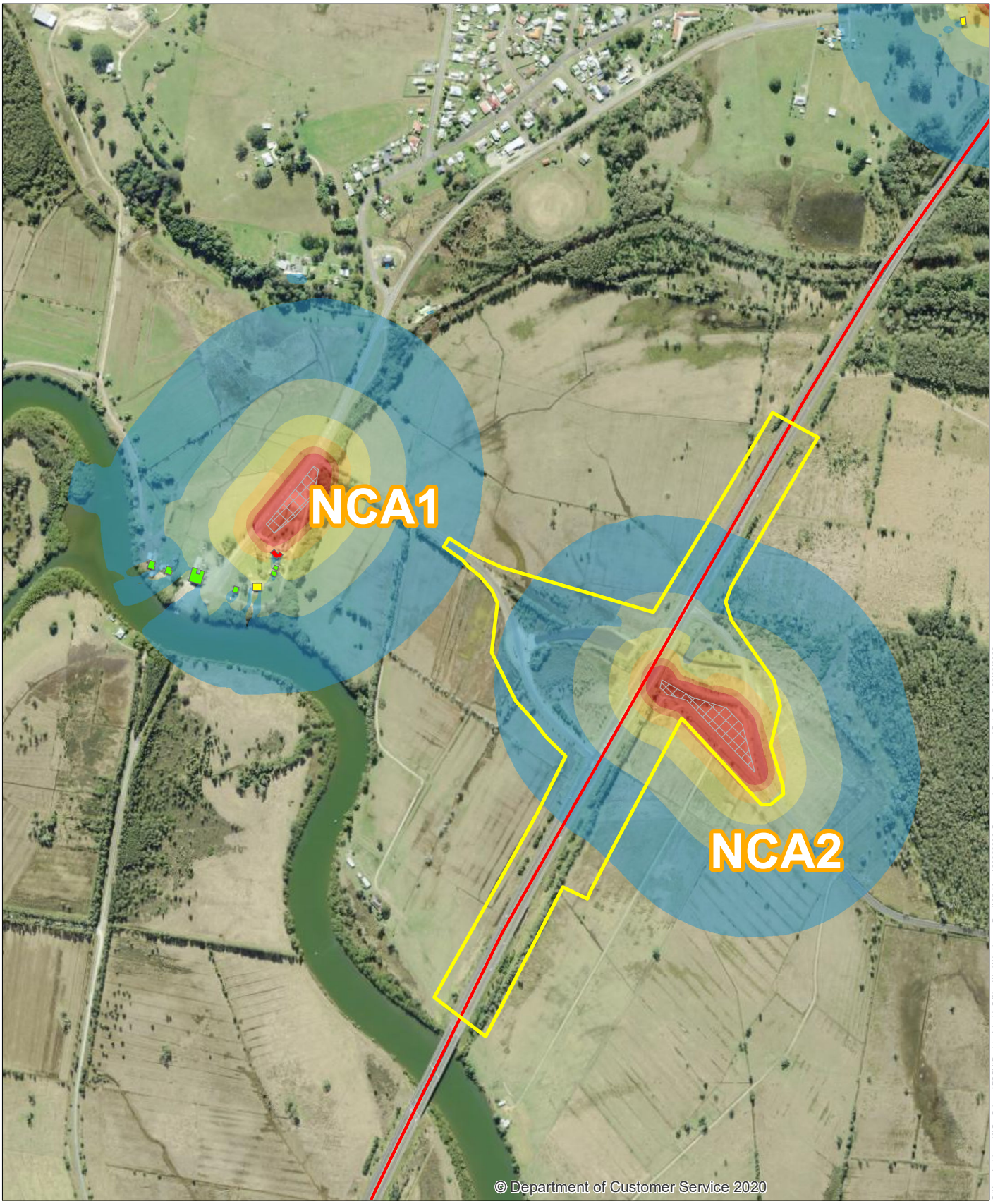


Construction Noise Contours

A02 - Utility Works - Daytime

N

0 0.15 0.3 km

AECOM

**Sound Pressure Level, $L_{Aeq,15min}$, dB(A)**

50 - 55
55 - 60
60 - 65
65 - 70
70 - 75
> 75

**Exceedance of NML, dB(A)**

1 - 10
11 - 20
> 20

Proposal Area
Construction Compound
Noise Catchment Area

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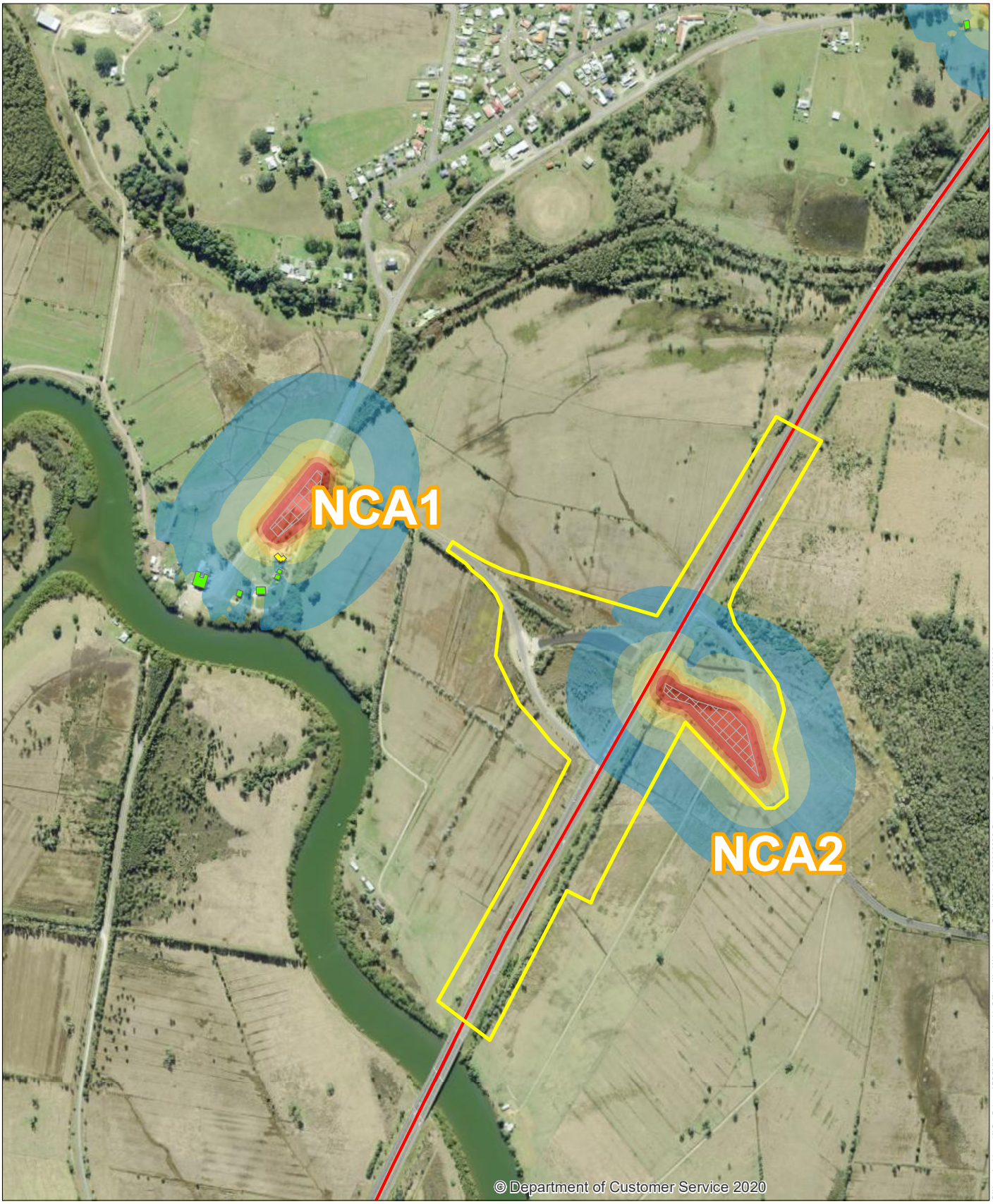


Construction Noise Contours

A03 - Laydown, Storage, and Delivery - Daytime

N

0 0.15 0.3 km

AECOM

**Sound Pressure Level, $L_{Aeq,15min}$, dB(A)**

50 - 55 | 55 - 60 | 60 - 65 | 65 - 70 | 70 - 75 | > 75

**Exceedance of NML, dB(A)**

1 - 10

11 - 20

Proposal Area

Construction Compound

Noise Catchment Area

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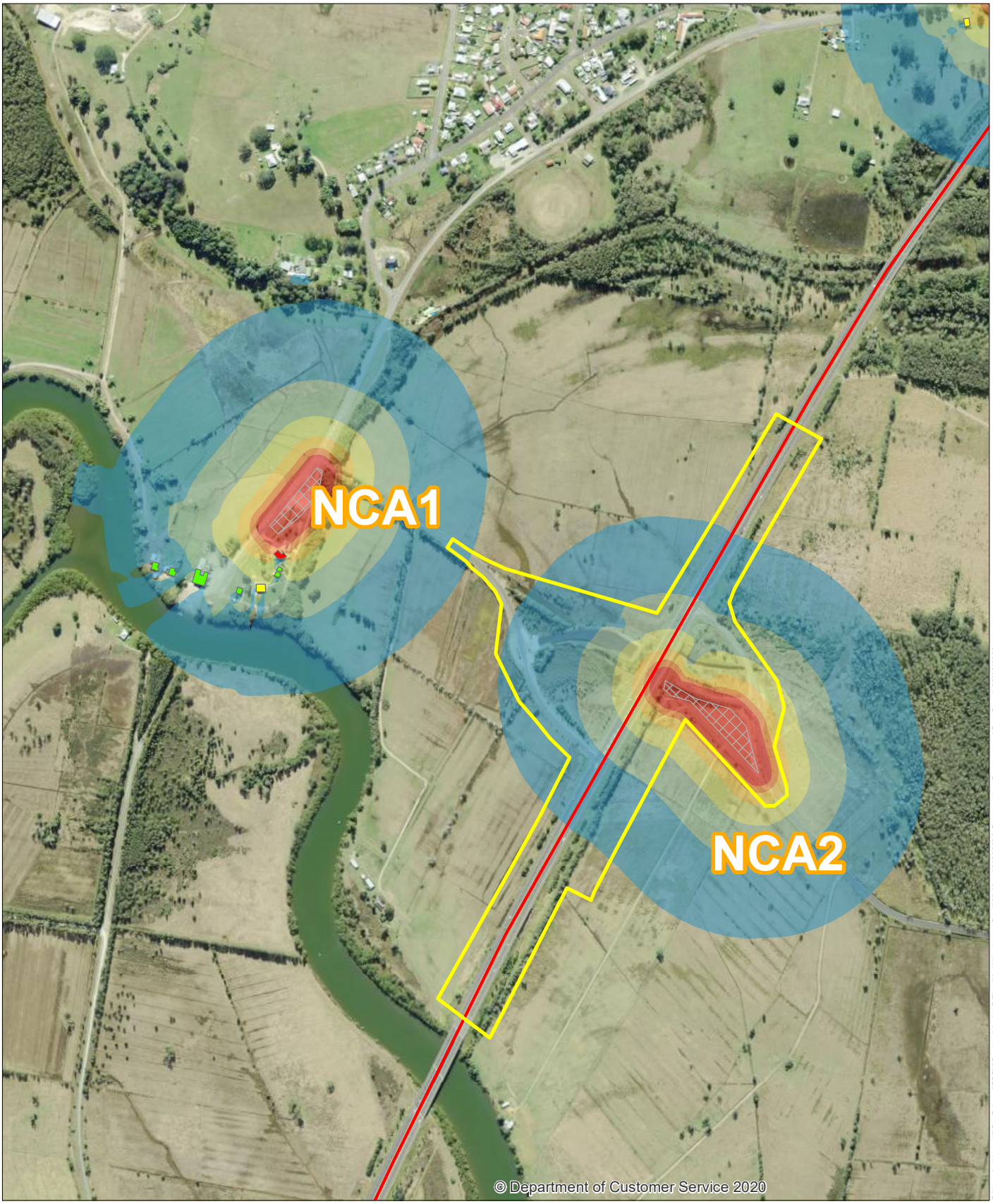


Construction Noise Contours

A04 - Crushing - Daytime

N

0 0.15 0.3 km

AECOM

**Sound Pressure Level, $L_{Aeq,15min}$, dB(A)**

50 - 55 | 55 - 60 | 60 - 65 | 65 - 70 | 70 - 75 | > 75

**Exceedance of NML, dB(A)**

1 - 10

11 - 20

> 20

Proposal Area

Construction Compound

Noise Catchment Area

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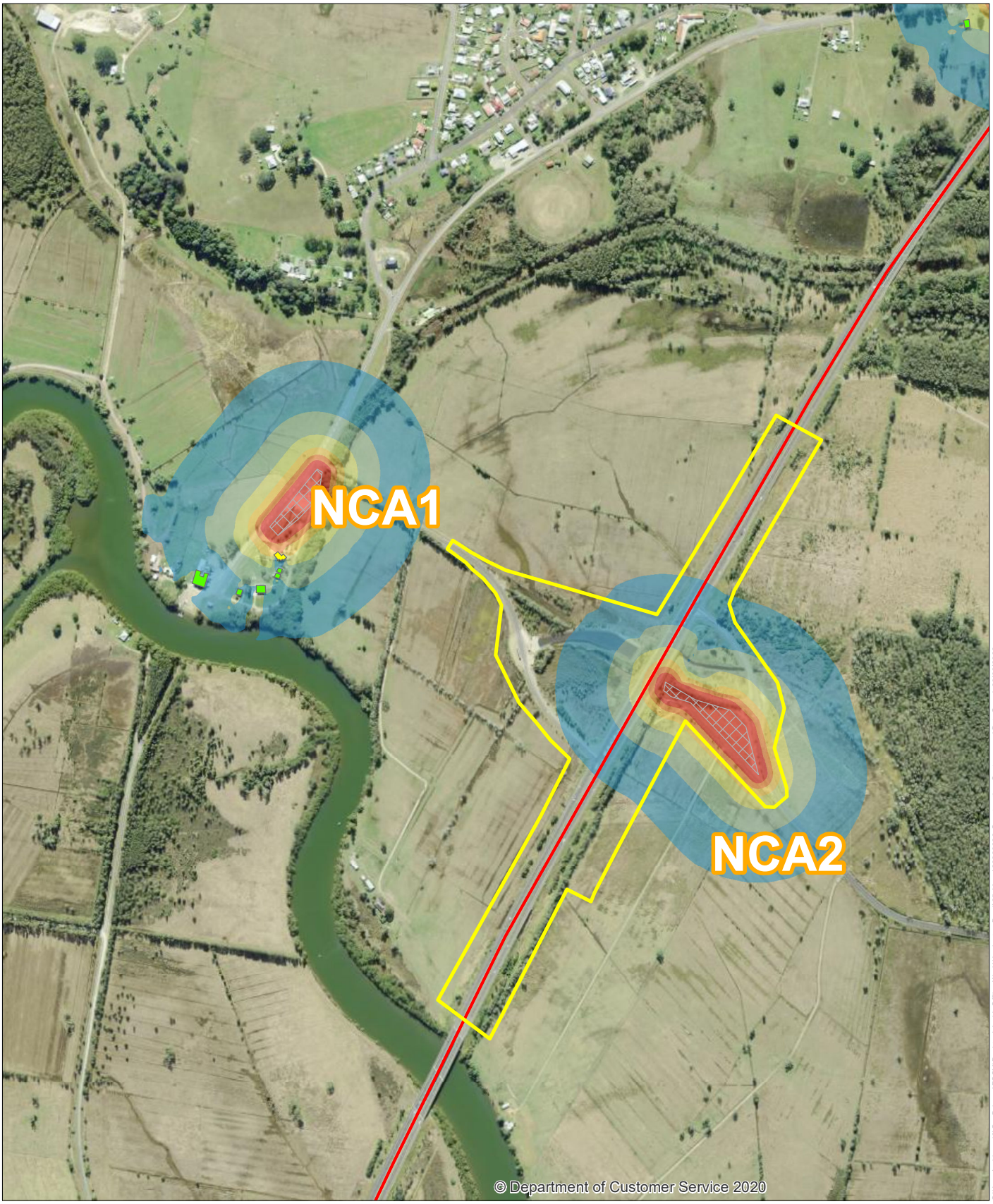



Construction Noise Contours

A05 - Stockpiling - Daytime

N

0 0.15 0.3 km

AECOM

**Sound Pressure Level, $L_{Aeq,15min}$, dB(A)**

50 - 55 | 55 - 60 | 60 - 65 | 65 - 70 | 70 - 75 | > 75

**Exceedance of NML, dB(A)**

1 - 10

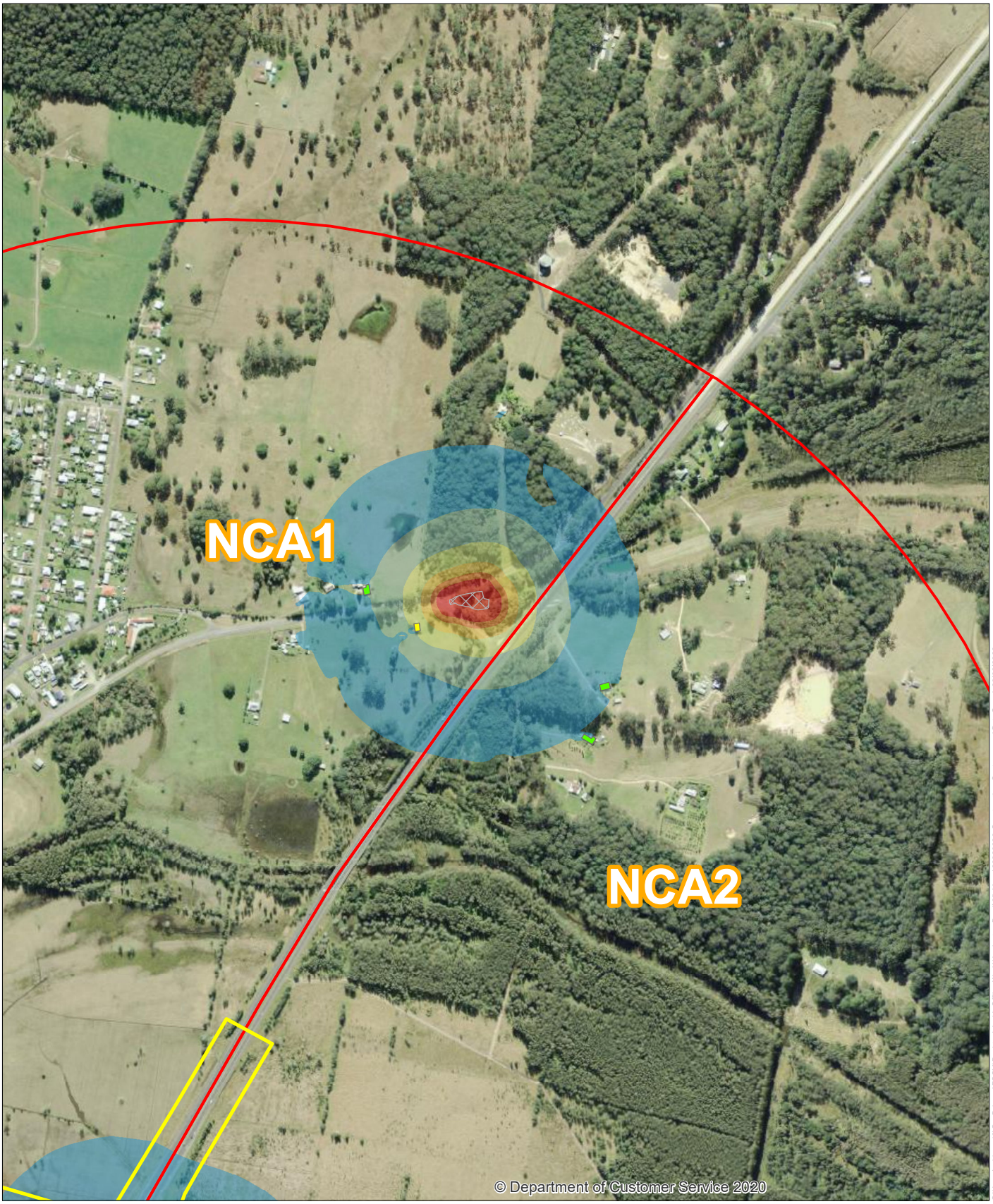
11 - 20

Proposal Area

Construction Compound

Noise Catchment Area

C:\Users\robinsonj6\OneDrive - AECOM\Desktop\Jack's Offline Work\Harrington Road\05_Map\20230626_Construction_Contours.mxd Date Saved: 26/06/2023




Construction Noise Contours

C08 - Demobilisation - Daytime

N

0 0.15 0.3 km

AECOM

**Sound Pressure Level, $L_{Aeq,15min}$, dB(A)**

50 - 55 | 55 - 60 | 60 - 65 | 65 - 70 | 70 - 75 | > 75

**Exceedance of NML, dB(A)**

1 - 10

11 - 20

Proposal Area

Construction Compound

Noise Catchment Area

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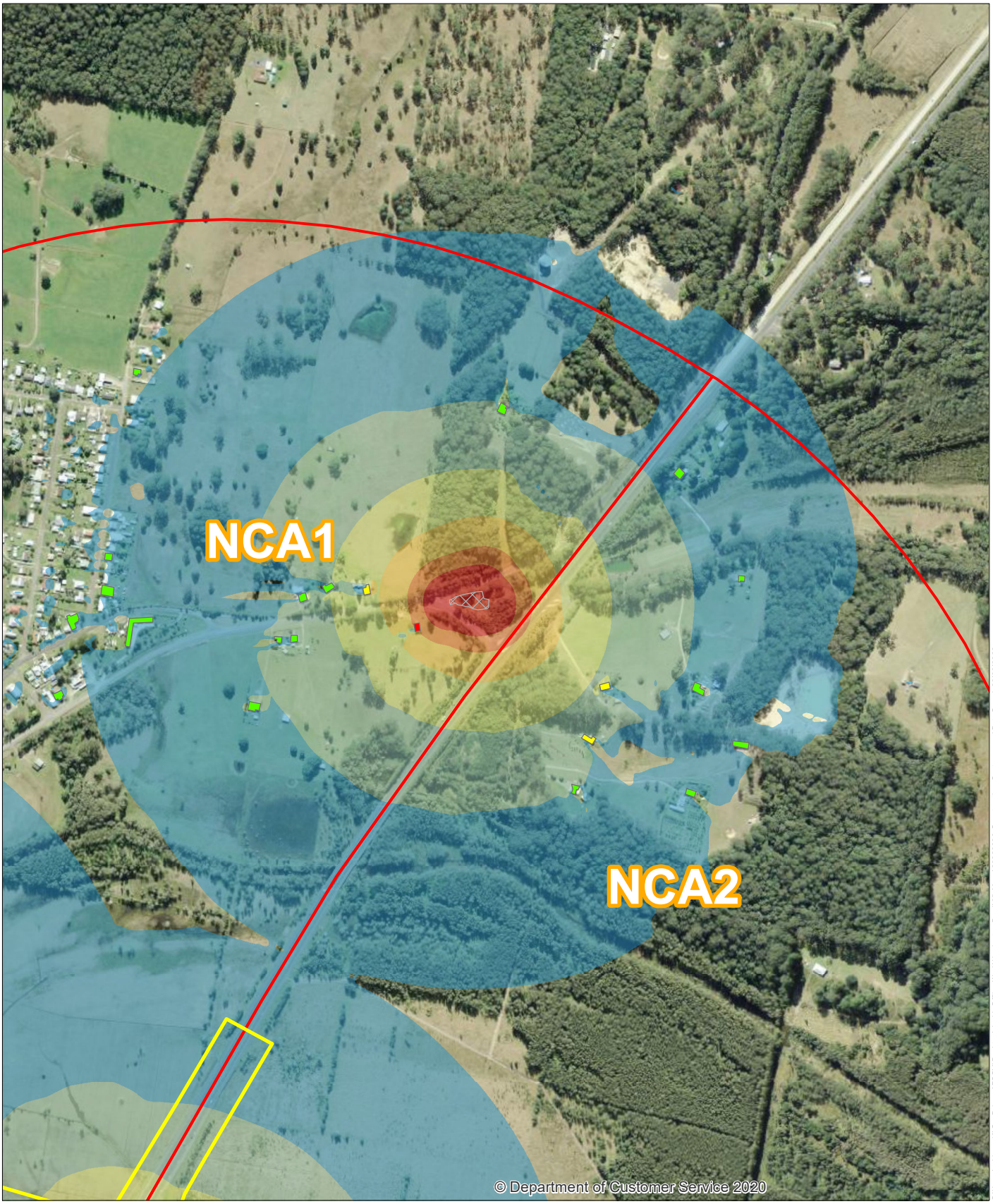


Construction Noise Contours

A01 - Vegetation Clearing - Daytime

N

0 0.15 0.3 km

AECOM

**Sound Pressure Level, $L_{Aeq,15min}$, dB(A)**

50 - 55 | 55 - 60 | 60 - 65 | 65 - 70 | 70 - 75 | > 75

**Exceedance of NML, dB(A)**

1 - 10

11 - 20

> 20

Proposal Area

Construction Compound

Noise Catchment Area

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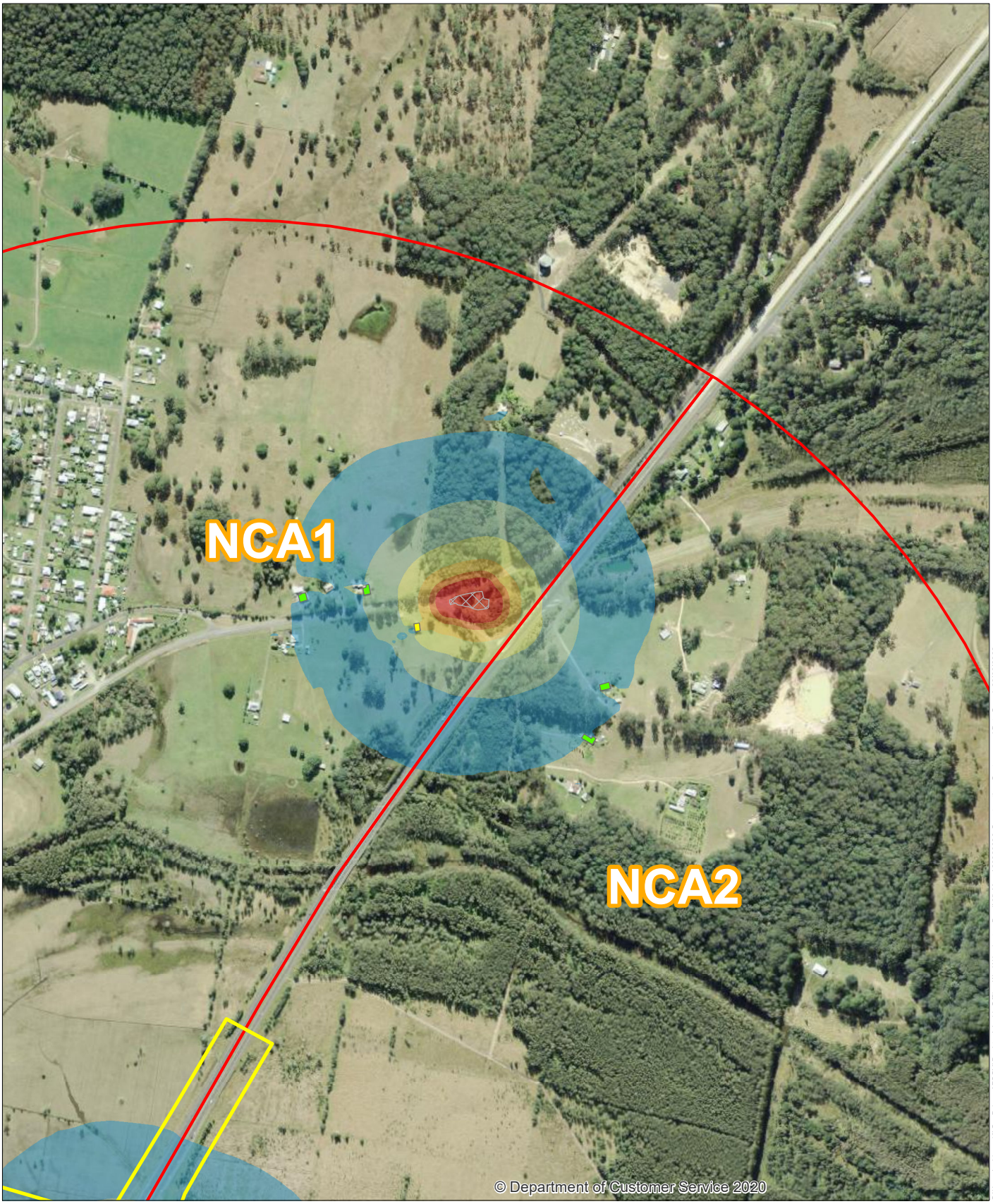


Construction Noise Contours

A02 - Utility Works - Daytime

N

0 0.15 0.3 km

AECOM

**Sound Pressure Level, $L_{Aeq,15min}$, dB(A)**

50 - 55 | 55 - 60 | 60 - 65 | 65 - 70 | 70 - 75 | > 75

**Exceedance of NML, dB(A)**

1 - 10

11 - 20

Proposal Area

Construction Compound

Noise Catchment Area

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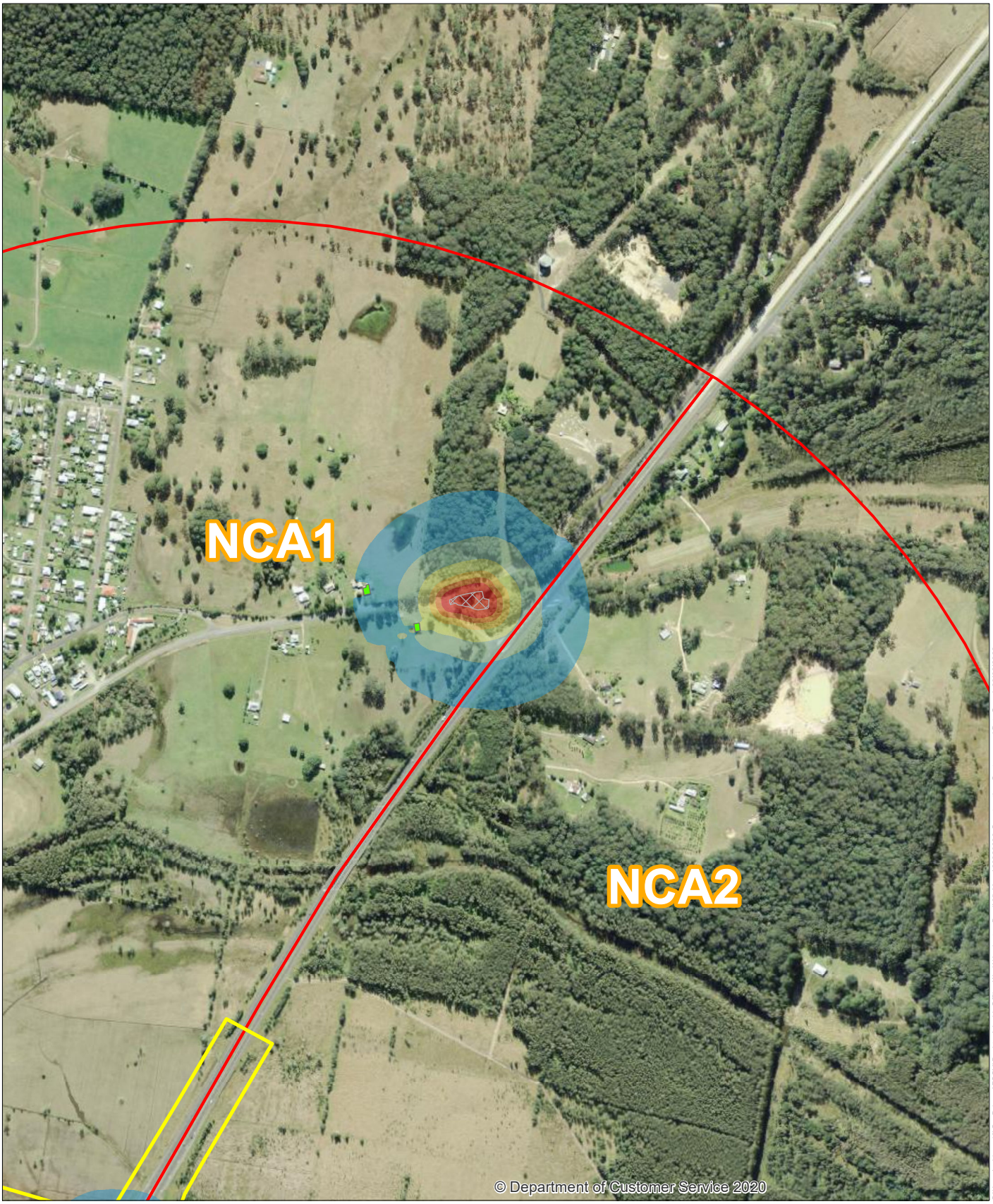


Construction Noise Contours

A03 - Laydown, Storage, and Delivery - Daytime

N

0 0.15 0.3 km

AECOM

**Sound Pressure Level, $L_{Aeq,15min}$, dB(A)**

50 - 55 | 55 - 60 | 60 - 65 | 65 - 70 | 70 - 75 | > 75

**Exceedance of NML, dB(A)**

1 - 10

Proposal Area

Construction Compound

Noise Catchment Area

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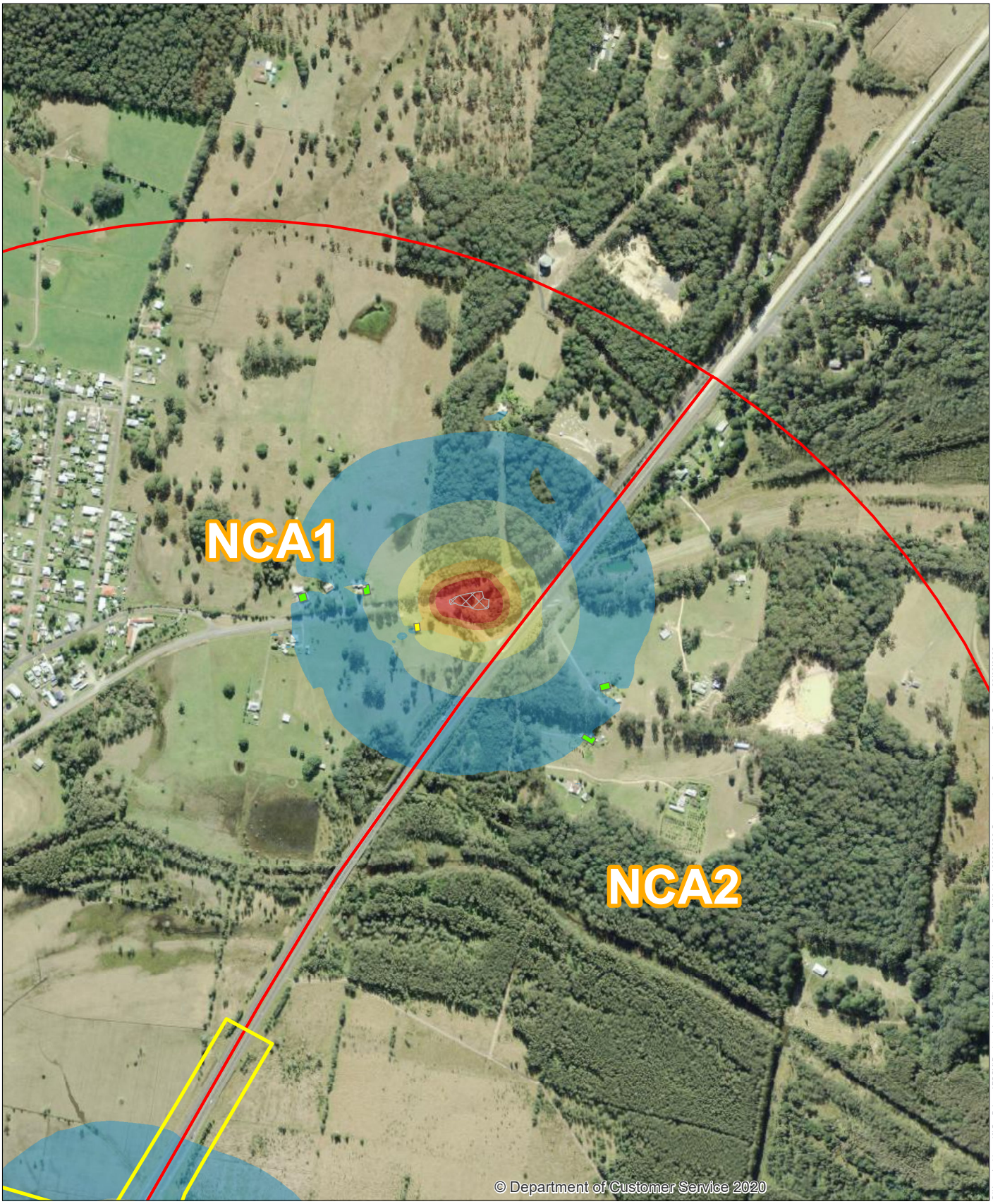



Construction Noise Contours

A04 - Crushing - Daytime

N

0 0.15 0.3 km

AECOM

**Sound Pressure Level, $L_{Aeq,15min}$, dB(A)**

50 - 55 | 55 - 60 | 60 - 65 | 65 - 70 | 70 - 75 | > 75

**Exceedance of NML, dB(A)**

1 - 10

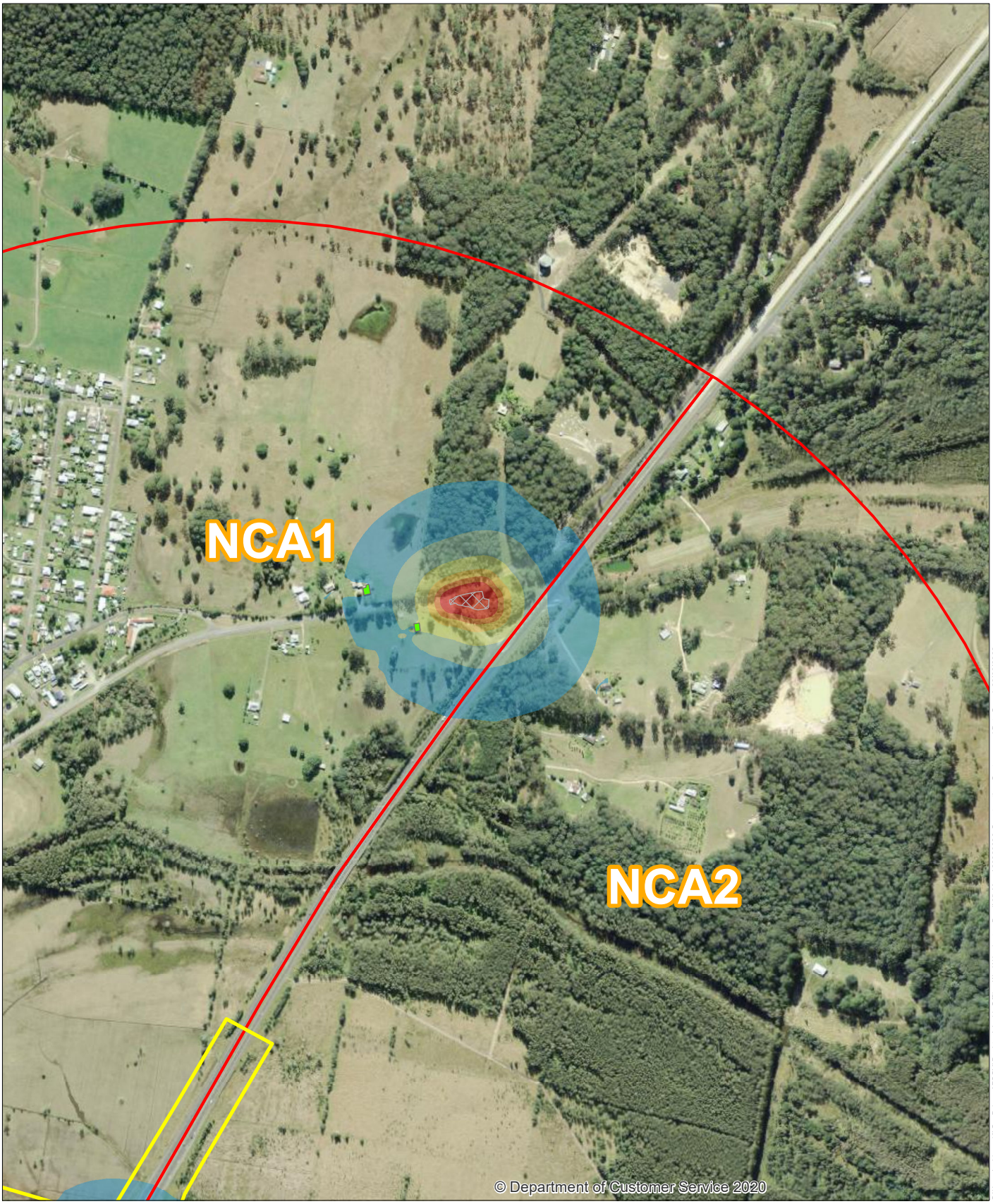
11 - 20

Proposal Area

Construction Compound

Noise Catchment Area

C:\Users\robinsonj6\OneDrive - AECOM\Desktop\Jack's Offline Work\Harrington Road\05_Maps\20230626_Construction_Contours.mxd Date Saved: 26/06/2023




Construction Noise Contours

A05 - Stockpiling - Daytime

N

0 0.15 0.3 km

AECOM

**Sound Pressure Level, $L_{Aeq,15min}$, dB(A)**

50 - 55 | 55 - 60 | 60 - 65 | 65 - 70 | 70 - 75 | > 75

**Exceedance of NML, dB(A)**

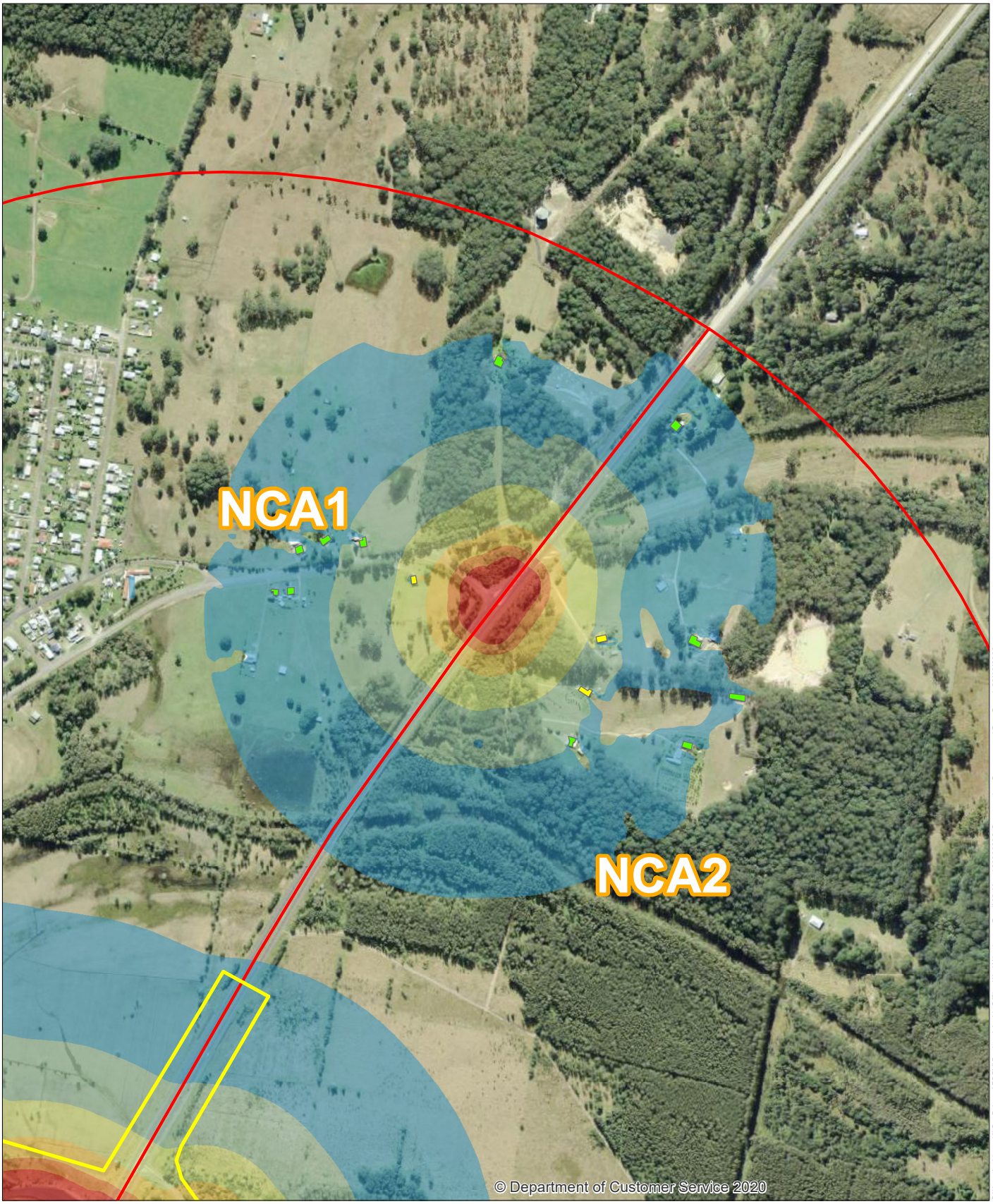
1 - 10

Proposal Area

Construction Compound

Noise Catchment Area

C:\Users\robinsonj6\OneDrive - AECOM\Desktop\Jack's Offline Work\Harrington Road\05_Maps\20230626_Construction_Contours.mxd Date Saved: 26/06/2023




Construction Noise Contours

C06 - Pavement Construction - Daytime

N

0 0.15 0.3 km

AECOM

**Sound Pressure Level, $L_{Aeq,15min}$, dB(A)**

50 - 55 | 55 - 60 | 60 - 65 | 65 - 70 | 70 - 75 | > 75

**Exceedance of NML, dB(A)**

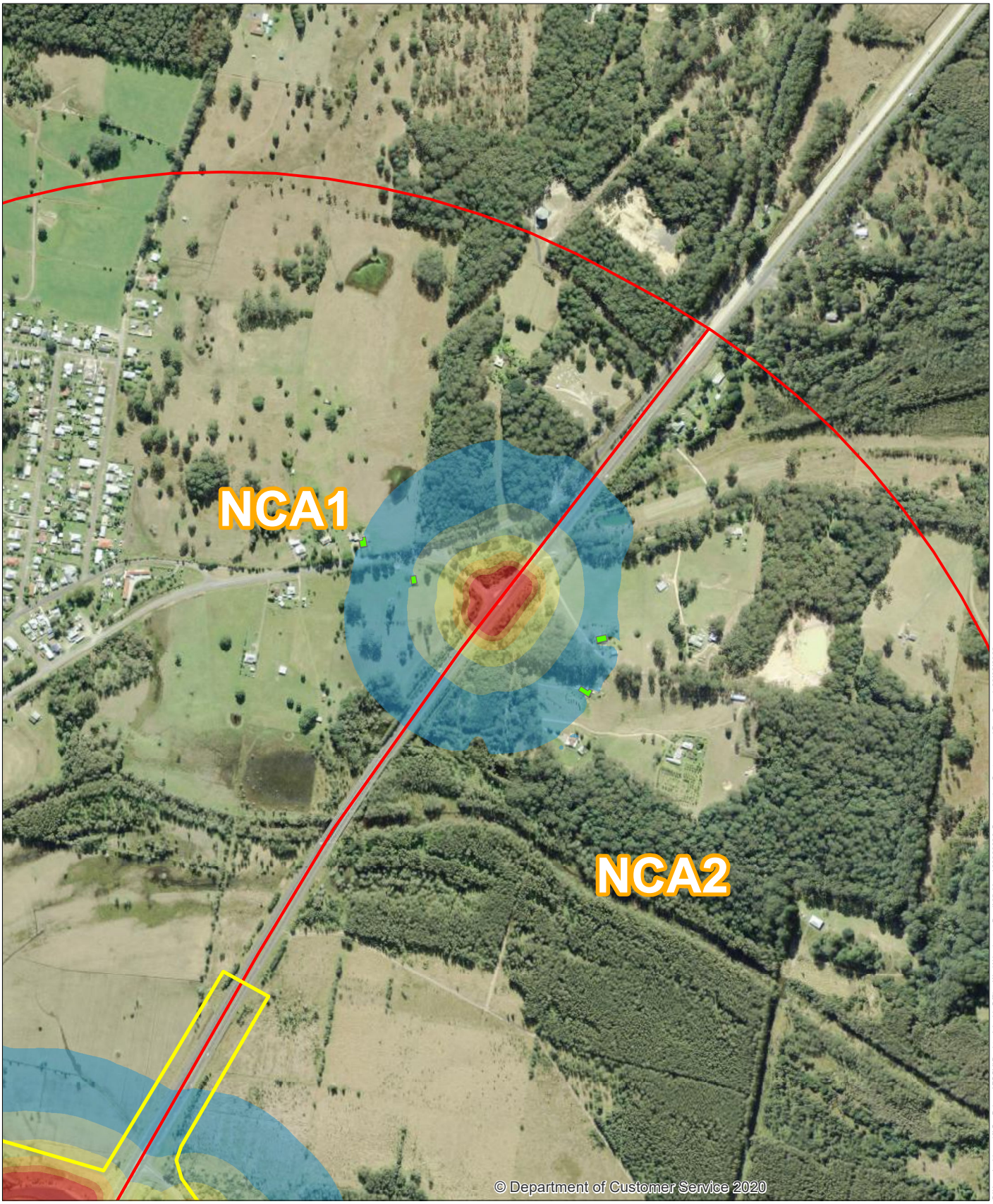
1 - 10

11 - 20

Proposal Area

Noise Catchment Area

C:\Users\robinsonj6\OneDrive - AECOM\Desktop\Jack's Offline Work\Harrington Road\05_Maps\20230626_Construction_Contours.mxd Date Saved: 26/06/2023




Construction Noise Contours

C07 - Landscaping and Finishing Work - Daytime

N

0 0.15 0.3 km

AECOM

**Sound Pressure Level, $L_{Aeq,15min}$, dB(A)**

50 - 55 | 55 - 60 | 60 - 65 | 65 - 70 | 70 - 75 | > 75

**Exceedance of NML, dB(A)**

1 - 10

Proposal Area

Noise Catchment Area

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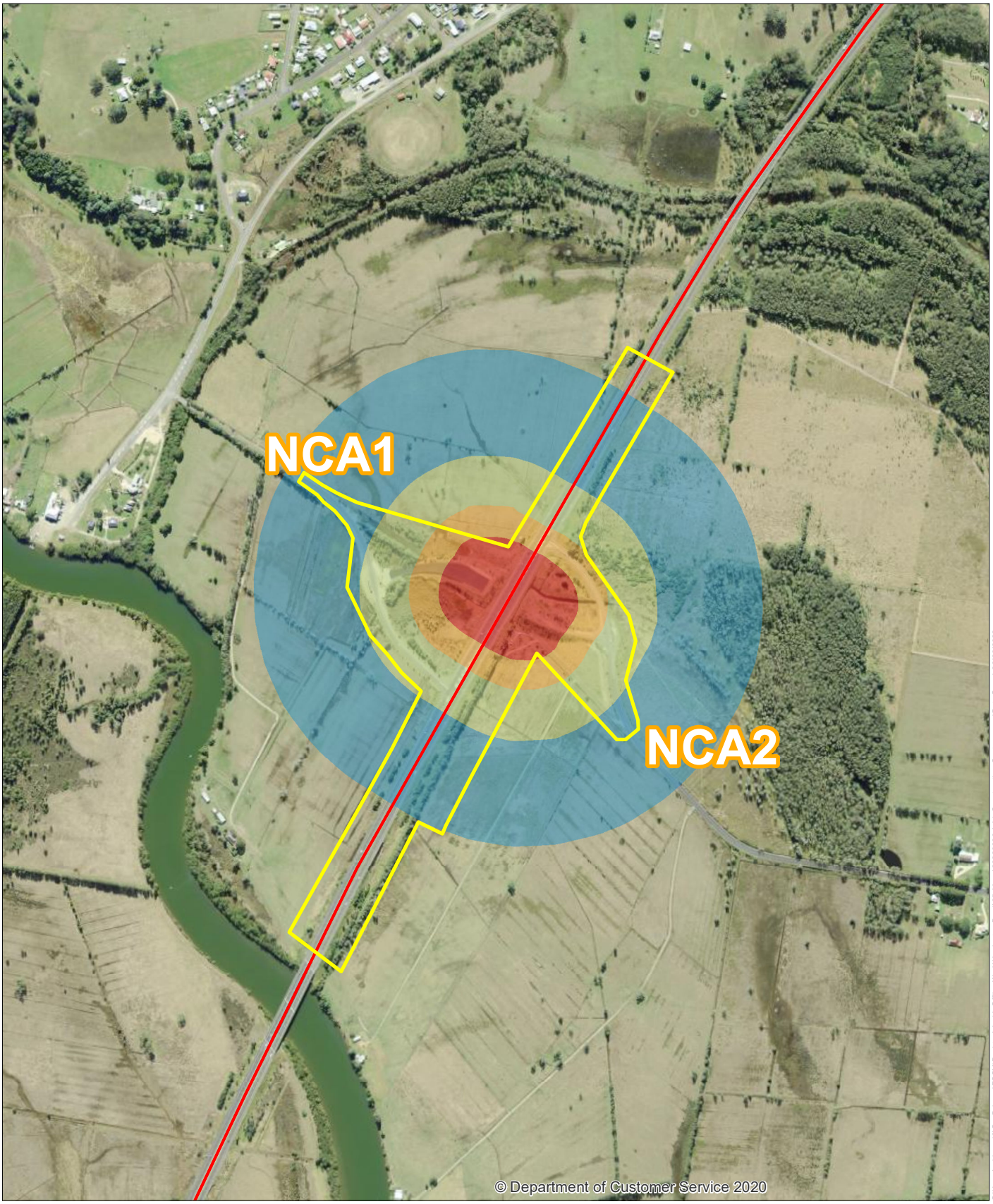
# Appendix D

## Construction $L_{A1,1min}$ contour maps




Construction Noise Sleep Disturbance Contours

N

0 0.15 0.3 km

AECOM

$L_{A1,1min}$ **Noise Level, dB(A)**

50 - 55 | 55 - 60 | 60 - 65 | > 65

Proposal Area

Noise Catchment Area

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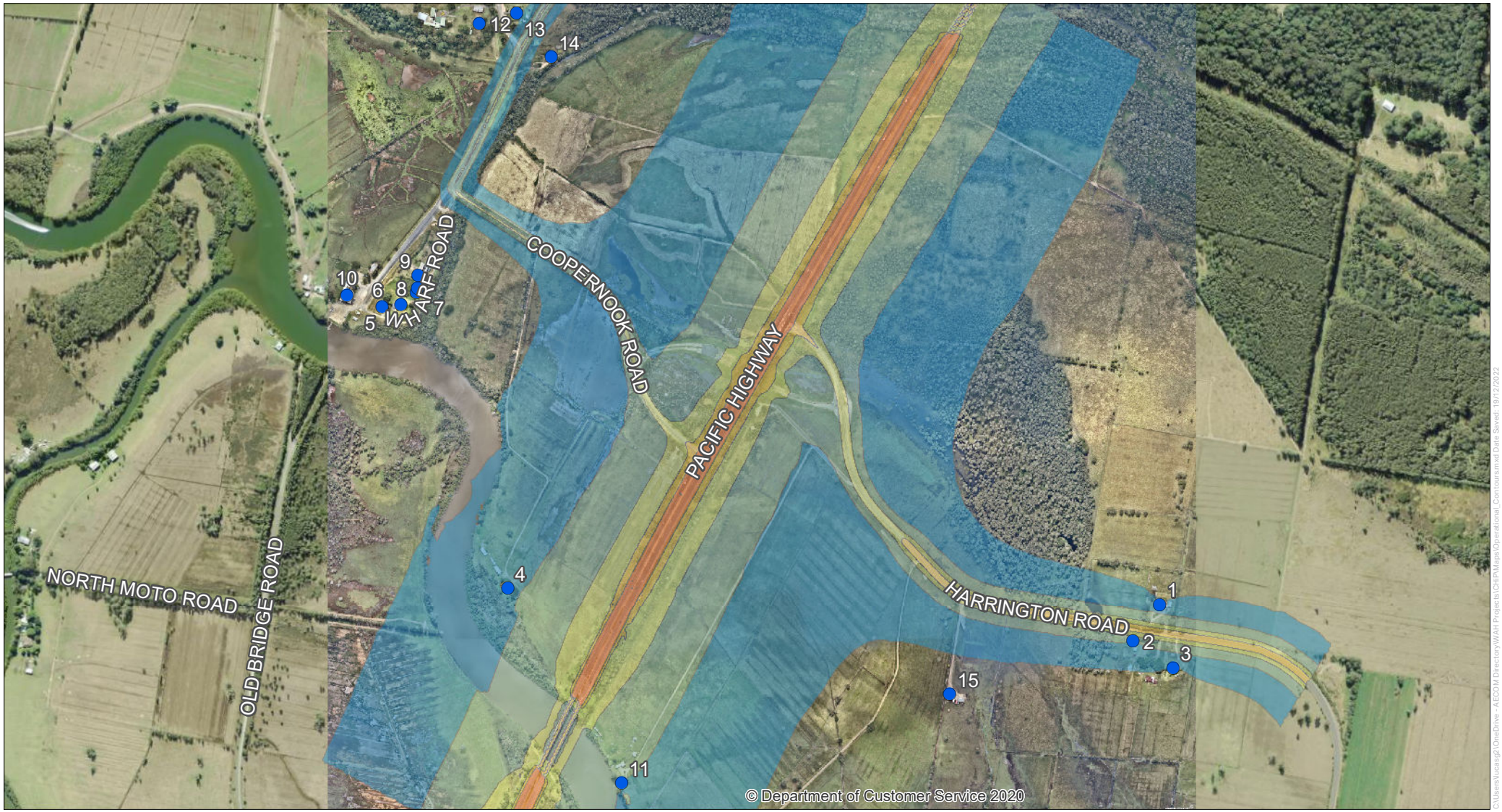
# Appendix E

## Operational $L_{Aeq}$ receiver levels

| Receiver ID | Address | Use | Façade | | | | Predicted noise level Opening Year 2028 | | | | Predicted noise level Design Year 2038 | | | | Change in noise level (Build - No Build) | | | | Do noise levels increase by 2dB or more? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | X | Y | Floor level | Direction | No Build | | Build | | No Build | | Build | | Opening Year 2028 | | Design Year 2038 | | |
| | | | | | | | Day | Night | Day | Night | Day | Night | Day | Night | Day | Night | Day | Night | |
| 1 | 173 HARRINGTON ROAD COOPERNOOK | Residential | 464465.8 | 6477375.7 | GF | S | 60 | 51 | 60 | 51 | 61 | 53 | 61 | 53 | 0.0 | 0.0 | 0.0 | 0.1 | No |
| 1 | 173 HARRINGTON ROAD COOPERNOOK | Residential | 464479.3 | 6477380.6 | GF | E | 57 | 47 | 57 | 47 | 58 | 49 | 58 | 49 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 1 | 173 HARRINGTON ROAD COOPERNOOK | Residential | 464467.6 | 6477388.8 | GF | N | 51 | 46 | 51 | 47 | 52 | 47 | 52 | 47 | 0.1 | 0.1 | 0.1 | 0.1 | No |
| 1 | 173 HARRINGTON ROAD COOPERNOOK | Residential | 464454.1 | 6477383.9 | GF | W | 58 | 51 | 58 | 51 | 59 | 52 | 59 | 52 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 2 | 172 HARRINGTON ROAD COOPERNOOK | Residential | 464403.1 | 6477306.9 | GF | W | 61 | 53 | 61 | 53 | 62 | 54 | 63 | 54 | 0.0 | 0.0 | 0.1 | 0.1 | No |
| 2 | 172 HARRINGTON ROAD COOPERNOOK | Residential | 464408.9 | 6477299.6 | GF | S | 53 | 46 | 53 | 47 | 54 | 47 | 54 | 47 | 0.0 | 0.1 | 0.0 | 0.0 | No |
| 2 | 172 HARRINGTON ROAD COOPERNOOK | Residential | 464416.5 | 6477305.1 | GF | E | 61 | 51 | 61 | 51 | 62 | 53 | 62 | 53 | 0.0 | 0.1 | 0.1 | 0.1 | No |
| 2 | 172 HARRINGTON ROAD COOPERNOOK | Residential | 464410.7 | 6477312.4 | GF | N | 65 | 56 | 65 | 56 | 66 | 58 | 66 | 58 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 3 | 180 HARRINGTON ROAD COOPERNOOK | Residential | 464485.2 | 6477248.3 | GF | W | 56 | 49 | 56 | 49 | 57 | 50 | 57 | 50 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 3 | 180 HARRINGTON ROAD COOPERNOOK | Residential | 464489.4 | 6477238.2 | GF | S | 51 | 45 | 51 | 45 | 52 | 46 | 52 | 46 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 3 | 180 HARRINGTON ROAD COOPERNOOK | Residential | 464495.3 | 6477241.8 | GF | E | 51 | 42 | 51 | 42 | 52 | 43 | 52 | 43 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 3 | 180 HARRINGTON ROAD COOPERNOOK | Residential | 464497.2 | 6477244.0 | GF | S | 50 | 41 | 50 | 41 | 51 | 43 | 51 | 43 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 3 | 180 HARRINGTON ROAD COOPERNOOK | Residential | 464501.0 | 6477245.8 | GF | E | 49 | 41 | 49 | 41 | 50 | 42 | 50 | 42 | -0.1 | 0.0 | 0.0 | 0.0 | No |
| 3 | 180 HARRINGTON ROAD COOPERNOOK | Residential | 464503.0 | 6477245.9 | GF | S | 50 | 41 | 50 | 41 | 51 | 43 | 51 | 43 | 0.0 | 0.1 | 0.0 | 0.0 | No |
| 3 | 180 HARRINGTON ROAD COOPERNOOK | Residential | 464507.5 | 6477250.3 | GF | E | 56 | 47 | 56 | 47 | 57 | 49 | 58 | 49 | 0.0 | 0.0 | 0.1 | 0.0 | No |
| 3 | 180 HARRINGTON ROAD COOPERNOOK | Residential | 464497.2 | 6477256.5 | GF | N | 59 | 51 | 59 | 51 | 60 | 52 | 60 | 52 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 4 | 20 COOPERNOOK ROAD COOPERNOOK | Residential | 463088.4 | 6477410.5 | GF | SW | 58 | 54 | 58 | 54 | 58 | 55 | 58 | 55 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 4 | 20 COOPERNOOK ROAD COOPERNOOK | Residential | 463105.1 | 6477406.5 | GF | SE | 62 | 58 | 61 | 58 | 62 | 59 | 62 | 58 | -0.2 | -0.2 | -0.2 | -0.1 | No |
| 4 | 20 COOPERNOOK ROAD COOPERNOOK | Residential | 463100.3 | 6477423.0 | GF | NE | 60 | 56 | 59 | 56 | 60 | 56 | 60 | 56 | -0.2 | -0.3 | -0.2 | -0.2 | No |
| 4 | 20 COOPERNOOK ROAD COOPERNOOK | Residential | 463083.6 | 6477427.1 | GF | NW | 52 | 49 | 51 | 47 | 53 | 49 | 51 | 48 | -1.4 | -1.5 | -1.4 | -1.4 | No |
| 5 | 3 WHARF ROAD COOPERNOOK | Residential | 462879.3 | 6478014.0 | GF | E | 54 | 51 | 54 | 51 | 55 | 51 | 55 | 51 | 0.0 | 0.1 | 0.1 | 0.1 | No |
| 5 | 3 WHARF ROAD COOPERNOOK | Residential | 462869.5 | 6478021.8 | GF | N | 49 | 45 | 49 | 45 | 49 | 46 | 49 | 46 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 5 | 3 WHARF ROAD COOPERNOOK | Residential | 462859.8 | 6478013.8 | GF | W | 46 | 42 | 46 | 42 | 46 | 43 | 46 | 43 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 5 | 3 WHARF ROAD COOPERNOOK | Residential | 462869.6 | 6478006.0 | GF | S | 53 | 49 | 53 | 49 | 54 | 50 | 54 | 50 | 0.1 | 0.0 | 0.1 | 0.0 | No |
| 6 | 3 WHARF ROAD COOPERNOOK | Residential | 462834.8 | 6478007.0 | GF | E | 53 | 49 | 53 | 49 | 54 | 50 | 54 | 50 | 0.1 | 0.0 | 0.0 | 0.0 | No |
| 6 | 3 WHARF ROAD COOPERNOOK | Residential | 462830.9 | 6478014.8 | GF | N | 49 | 45 | 49 | 45 | 50 | 45 | 50 | 45 | 0.0 | 0.0 | -0.1 | 0.0 | No |
| 6 | 3 WHARF ROAD COOPERNOOK | Residential | 462823.5 | 6478010.2 | GF | W | 42 | 38 | 42 | 38 | 42 | 38 | 42 | 38 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 6 | 3 WHARF ROAD COOPERNOOK | Residential | 462827.3 | 6478002.4 | GF | S | 52 | 48 | 52 | 48 | 53 | 49 | 53 | 49 | 0.1 | 0.1 | 0.1 | 0.1 | No |
| 7 | 3 WHARF ROAD COOPERNOOK | Residential | 462899.4 | 6478034.1 | GF | S | 52 | 49 | 52 | 49 | 53 | 49 | 53 | 49 | 0.1 | 0.1 | 0.1 | 0.1 | No |
| 7 | 3 WHARF ROAD COOPERNOOK | Residential | 462906.6 | 6478037.1 | GF | E | 54 | 50 | 54 | 50 | 55 | 51 | 55 | 51 | 0.1 | 0.1 | 0.0 | 0.0 | No |
| 7 | 3 WHARF ROAD COOPERNOOK | Residential | 462902.8 | 6478043.9 | GF | N | 49 | 45 | 49 | 45 | 49 | 45 | 49 | 45 | 0.1 | 0.1 | 0.1 | 0.1 | No |
| 7 | 3 WHARF ROAD COOPERNOOK | Residential | 462895.6 | 6478040.9 | GF | W | 42 | 38 | 42 | 38 | 43 | 39 | 43 | 39 | 0.1 | 0.0 | 0.0 | 0.1 | No |
| 8 | 3 WHARF ROAD COOPERNOOK | Residential | 462909.4 | 6478047.1 | GF | SE | 54 | 50 | 54 | 50 | 55 | 51 | 55 | 51 | 0.1 | 0.1 | 0.0 | 0.0 | No |
| 8 | 3 WHARF ROAD COOPERNOOK | Residential | 462906.7 | 6478053.5 | GF | NE | 52 | 48 | 52 | 48 | 52 | 48 | 52 | 48 | 0.1 | 0.1 | 0.1 | 0.0 | No |
| 8 | 3 WHARF ROAD COOPERNOOK | Residential | 462900.1 | 6478051.2 | GF | NW | 42 | 38 | 42 | 38 | 43 | 39 | 43 | 39 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 8 | 3 WHARF ROAD COOPERNOOK | Residential | 462902.8 | 6478044.8 | GF | SW | 48 | 44 | 48 | 44 | 49 | 45 | 49 | 45 | 0.1 | 0.1 | 0.0 | 0.1 | No |
| 9 | 189 GEORGE GIBSON DRIVE COOPERNOOK | Residential | 462897.7 | 6478072.7 | GF | SW | 48 | 44 | 48 | 44 | 49 | 45 | 49 | 45 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 9 | 189 GEORGE GIBSON DRIVE COOPERNOOK | Residential | 462897.7 | 6478072.7 | F 1 | SW | 51 | 48 | 51 | 48 | 52 | 48 | 52 | 48 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 9 | 189 GEORGE GIBSON DRIVE COOPERNOOK | Residential | 462903.9 | 6478068.6 | GF | SE | 50 | 46 | 50 | 46 | 50 | 47 | 50 | 47 | 0.0 | -0.1 | 0.0 | 0.0 | No |
| 9 | 189 GEORGE GIBSON DRIVE COOPERNOOK | Residential | 462903.9 | 6478068.6 | F 1 | SE | 52 | 48 | 52 | 48 | 53 | 49 | 53 | 49 | 0.0 | 0.0 | 0.0 | 0.1 | No |
| 9 | 189 GEORGE GIBSON DRIVE COOPERNOOK | Residential | 462904.5 | 6478067.9 | GF | SW | 50 | 47 | 50 | 47 | 51 | 47 | 51 | 47 | -0.1 | 0.0 | 0.0 | 0.0 | No |
| 9 | 189 GEORGE GIBSON DRIVE COOPERNOOK | Residential | 462904.5 | 6478067.9 | F 1 | SW | 53 | 49 | 53 | 49 | 53 | 49 | 53 | 49 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 9 | 189 GEORGE GIBSON DRIVE COOPERNOOK | Residential | 462908.9 | 6478067.8 | GF | SE | 53 | 49 | 53 | 49 | 53 | 50 | 54 | 50 | 0.0 | 0.1 | 0.1 | 0.1 | No |
| 9 | 189 GEORGE GIBSON DRIVE COOPERNOOK | Residential | 462908.9 | 6478067.8 | F 1 | SE | 54 | 50 | 54 | 50 | 55 | 51 | 55 | 51 | 0.0 | 0.1 | 0.1 | 0.1 | No |
| 9 | 189 GEORGE GIBSON DRIVE COOPERNOOK | Residential | 462910.0 | 6478068.5 | GF | SW | 52 | 48 | 52 | 48 | 53 | 49 | 53 | 49 | 0.2 | 0.1 | 0.1 | 0.1 | No |
| 9 | 189 GEORGE GIBSON DRIVE COOPERNOOK | Residential | 462910.0 | 6478068.5 | F 1 | SW | 53 | 50 | 53 | 50 | 54 | 50 | 54 | 50 | 0.1 | 0.1 | 0.1 | 0.1 | No |
| 9 | 189 GEORGE GIBSON DRIVE COOPERNOOK | Residential | 462915.2 | 6478070.2 | GF | SE | 54 | 50 | 54 | 50 | 55 | 51 | 55 | 51 | 0.1 | 0.1 | 0.1 | 0.1 | No |
| 9 | 189 GEORGE GIBSON DRIVE COOPERNOOK | Residential | 462915.2 | 6478070.2 | F 1 | SE | 55 | 51 | 55 | 51 | 56 | 52 | 56 | 52 | 0.1 | 0.1 | 0.1 | 0.1 | No |
| 9 | 189 GEORGE GIBSON DRIVE COOPERNOOK | Residential | 462915.6 | 6478077.5 | GF | NE | 53 | 49 | 53 | 49 | 54 | 50 | 54 | 50 | 0.1 | 0.1 | 0.1 | 0.1 | No |
| 9 | 189 GEORGE GIBSON DRIVE COOPERNOOK | Residential | 462915.6 | 6478077.5 | F 1 | NE | 54 | 50 | 54 | 50 | 55 | 51 | 55 | 51 | 0.1 | 0.1 | 0.1 | 0.1 | No |
| 9 | 189 GEORGE GIBSON DRIVE COOPERNOOK | Residential | 462909.5 | 6478079.1 | GF | NW | 48 | 43 | 48 | 43 | 49 | 44 | 49 | 44 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 9 | 189 GEORGE GIBSON DRIVE COOPERNOOK | Residential | 462909.5 | 6478079.1 | F 1 | NW | 49 | 45 | 49 | 45 | 50 | 45 | 50 | 45 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 9 | 189 GEORGE GIBSON DRIVE COOPERNOOK | Residential | 462905.8 | 6478081.2 | GF | NE | 51 | 46 | 51 | 46 | 51 | 47 | 51 | 47 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 9 | 189 GEORGE GIBSON DRIVE COOPERNOOK | Residential | 462905.8 | 6478081.2 | F 1 | NE | 52 | 48 | 52 | 48 | 53 | 48 | 53 | 48 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 9 | 189 GEORGE GIBSON DRIVE COOPERNOOK | Residential | 462897.4 | 6478081.9 | GF | NW | 46 | 41 | 46 | 41 | 47 | 42 | 47 | 42 | 0.0 | 0.0 | 0.1 | 0.0 | No |
| 9 | 189 GEORGE GIBSON DRIVE COOPERNOOK | Residential | 462897.4 | 6478081.9 | F 1 | NW | 48 | 43 | 48 | 43 | 49 | 44 | 49 | 44 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 10 | 240 GEORGE GIBSON DRIVE COOPERNOOK | Commercial | 462768.4 | 6478029.8 | GF | E | 53 | 49 | 52 | 49 | 53 | 49 | 53 | 49 | -0.1 | -0.1 | -0.1 | -0.1 | No |
| 10 | 240 GEORGE GIBSON DRIVE COOPERNOOK | Commercial | 462768.4 | 6478029.8 | F 1 | E | 54 | 50 | 54 | 50 | 54 | 51 | 54 | 50 | -0.1 | -0.1 | -0.1 | -0.1 | No |
| 10 | 240 GEORGE GIBSON DRIVE COOPERNOOK | Commercial | 462767.9 | 6478044.6 | GF | N | 49 | 45 | 49 | 45 | 50 | 46 | 50 | 46 | 0.1 | 0.0 | 0.1 | 0.0 | No |
| 10 | 240 GEORGE GIBSON DRIVE COOPERNOOK | Commercial | 462767.9 | 6478044.6 | F 1 | N | 51 | 47 | 51 | 47 | 52 | 48 | 52 | 48 | 0.1 | 0.0 | 0.1 | 0.1 | No |
| 10 | 240 GEORGE GIBSON DRIVE COOPERNOOK | Commercial | 462761.7 | 6478041.4 | GF | W | 36 | 32 | 36 | 32 | 37 | 33 | 37 | 33 | 0.0 | 0.1 | 0.1 | 0.0 | No |
| 10 | 240 GEORGE GIBSON DRIVE COOPERNOOK | Commercial | 462761.7 | 6478041.4 | F 1 | W | 41 | 37 | 41 | 37 | 42 | 38 | 42 | 38 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 10 | 240 GEORGE GIBSON DRIVE COOPERNOOK | Commercial | 462758.7 | 6478039.3 | GF | N | 40 | 34 | 40 | 34 | 41 | 35 | 41 | 35 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 10 | 240 GEORGE GIBSON DRIVE COOPERNOOK | Commercial | 462758.7 | 6478039.3 | F 1 | N | 44 | 39 | 44 | 39 | 44 | 40 | 44 | 40 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 10 | 240 GEORGE GIBSON DRIVE COOPERNOOK | Commercial | 462757.4 | 6478043.0 | GF | E | 47 | 43 | 47 | 43 | 47 | 43 | 47 | 43 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 10 | 240 GEORGE GIBSON DRIVE COOPERNOOK | Commercial | 462757.4 | 6478043.0 | F 1 | E | 49 | 45 | 49 | 45 | 49 | 45 | 49 | 45 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 10 | 240 GEORGE GIBSON DRIVE COOPERNOOK | Commercial | 462753.5 | 6478049.7 | GF | N | 49 | 45 | 49 | 45 | 50 | 46 | 50 | 46 | 0.1 | 0.1 | 0.1 | 0.1 | No |
| 10 | 240 GEORGE GIBSON DRIVE COOPERNOOK | Commercial | 462753.5 | 6478049.7 | F 1 | N | 50 | 46 | 50 | 47 | 51 | 47 | 51 | 47 | 0.0 | 0.1 | 0.1 | 0.1 | No |
| 10 | 240 GEORGE GIBSON DRIVE COOPERNOOK | Commercial | 462743.8 | 6478037.7 | GF | W | 36 | 32 | 36 | 32 | 37 | 33 | 37 | 33 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 10 | 240 GEORGE GIBSON DRIVE COOPERNOOK | Commercial | 462743.8 | 6478037.7 | F 1 | W | 41 | 37 | 41 | 37 | 42 | 38 | 42 | 38 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 10 | 240 GEORGE GIBSON DRIVE COOPERNOOK | Commercial | 462751.9 | 6478020.3 | GF | S | 51 | 47 | 51 | 47 | 52 | 48 | 52 | 48 | 0.0 | 0.0 | 0.0 | -0.1 | No |
| 10 | 240 GEORGE GIBSON DRIVE COOPERNOOK | Commercial | 462751.9 | 6478020.3 | F 1 | S | 52 | 48 | 52 | 48 | 53 | 49 | 53 | 49 | 0.0 | 0.0 | 0.0 | -0.1 | No |
| 11 | 90 HARRINGTON ROAD COOPERNOOK | Residential | 463333.6 | 6477013.4 | GF | N | 60 | 57 | 60 | 57 | 61 | 57 | 61 | 57 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 11 | 90 HARRINGTON ROAD COOPERNOOK | Residential | 463332.0 | 6477013.6 | GF | E | 60 | 56 | 60 | 56 | 60 | 57 | 60 | 57 | 0.0 | 0.1 | 0.0 | 0.0 | No |
| 11 | 90 HARRINGTON ROAD COOPERNOOK | Residential | 463328.2 | 6477015.2 | GF | N | 63 | 60 | 63 | 60 | 64 | 60 | 64 | 60 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 11 | 90 HARRINGTON ROAD COOPERNOOK | Residential | 463326.5 | 6477011.5 | GF | W | 63 | 60 | 63 | 60 | 64 | 60 | 64 | 60 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 11 | 90 HARRINGTON ROAD COOPERNOOK | Residential | 463329.0 | 6477006.2 | GF | W | 62 | 59 | 62 | 59 | 63 | 59 | 63 | 59 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 11 | 90 HARRINGTON ROAD COOPERNOOK | Residential | 463330.6 | 6477000.0 | GF | W | 62 | 59 | 62 | 59 | 63 | 59 | 63 | 59 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 11 | 90 HARRINGTON ROAD COOPERNOOK | Residential | 463336.5 | 6476998.7 | GF | S | 59 | 55 | 59 | 55 | 59 | 56 | 59 | 55 | 0.0 | 0.0 | 0.0 | -0.1 | No |
| 11 | 90 HARRINGTON ROAD COOPERNOOK | Residential | 463340.1 | 6477003.5 | GF | E | 58 | 54 | 58 | 54 | 58 | 55 | 58 | 55 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 11 | 90 HARRINGTON ROAD COOPERNOOK | Residential | 463338.6 | 6477009.9 | GF | E | 59 | 55 | 59 | 55 | 59 | 56 | 59 | 56 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 12 | 61 MACQUARIE STREET COOPERNOOK | School | 463041.5 | 6478604.4 | GF | E | 55 | 50 | 55 | 50 | 55 | 51 | 55 | 51 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 12 | 61 MACQUARIE STREET COOPERNOOK | School | 463036.3 | 6478614.6 | GF | N | 50 | 46 | 50 | 46 | 51 | 47 | 51 | 47 | 0.0 | 0.1 | 0.0 | 0.0 | No |
| 12 | 61 MACQUARIE STREET COOPERNOOK | School | 463029.7 | 6478612.5 | GF | W | 41 | 37 | 41 | 37 | 42 | 38 | 42 | 38 | 0.0 | 0.1 | 0.0 | 0.1 | No |
| 12 | 61 MACQUARIE STREET COOPERNOOK | School | 463028.6 | 6478611.7 | GF | N | 41 | 37 | 41 | 37 | 42 | 38 | 42 | 38 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 12 | 61 MACQUARIE STREET COOPERNOOK | School | 463024.9 | 6478605.3 | GF | W | 45 | 41 | 45 | 41 | 46 | 42 | 46 | 42 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 12 | 61 MACQUARIE STREET COOPERNOOK | School | 463027.1 | 6478598.3 | GF | S | 52 | 48 | 52 | 48 | 53 | 49 | 53 | 49 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 12 | 61 MACQUARIE STREET COOPERNOOK | School | 463028.2 | 6478598.4 | GF | S | 51 | 47 | 51 | 47 | 52 | 47 | 52 | 47 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 12 | 61 MACQUARIE STREET COOPERNOOK | School | 463034.1 | 6478595.7 | GF | S | 54 | 49 | 54 | 49 | 54 | 50 | 54 | 50 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 13 | 50 MACQUARIE STREET COOPERNOOK | Residential | 463113.6 | 6478618.3 | GF | S | 56 | 50 | 56 | 50 | 57 | 51 | 57 | 51 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 13 | 50 MACQUARIE STREET COOPERNOOK | Residential | 463125.6 | 6478626.6 | GF | E | 57 | 51 | 57 | 51 | 58 | 52 | 58 | 52 | 0.0 | 0.1 | 0.0 | 0.0 | No |
| 13 | 50 MACQUARIE STREET COOPERNOOK | Residential | 463117.2 | 6478634.2 | GF | N | 52 | 46 | 52 | 46 | 53 | 47 | 53 | 47 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 13 | 50 MACQUARIE STREET COOPERNOOK | Residential | 463111.0 | 6478634.7 | GF | E | 51 | 46 | 51 | 46 | 52 | 47 | 52 | 47 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 13 | 50 MACQUARIE STREET COOPERNOOK | Residential | 463105.8 | 6478637.2 | GF | N | 51 | 46 | 51 | 46 | 52 | 47 | 52 | 47 | 0.1 | 0.0 | 0.0 | 0.0 | No |
| 13 | 50 MACQUARIE STREET COOPERNOOK | Residential | 463101.0 | 6478627.4 | GF | W | 49 | 44 | 49 | 44 | 50 | 45 | 50 | 45 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 14 | 145 GEORGE GIBSON DRIVE COOPERNOOK | Residential | 463194.4 | 6478539.4 | GF | NE | 54 | 50 | 54 | 50 | 54 | 50 | 54 | 50 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 14 | 145 GEORGE GIBSON DRIVE COOPERNOOK | Residential | 463183.4 | 6478539.9 | GF | NW | 52 | 45 | 52 | 45 | 53 | 46 | 53 | 46 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 14 | 145 GEORGE GIBSON DRIVE COOPERNOOK | Residential | 463177.4 | 6478530.7 | GF | SW | 53 | 48 | 53 | 48 | 54 | 49 | 54 | 49 | 0.0 | 0.0 | -0.1 | -0.1 | No |
| 14 | 145 GEORGE GIBSON DRIVE COOPERNOOK | Residential | 463188.4 | 6478530.2 | GF | SE | 54 | 50 | 54 | 50 | 55 | 51 | 55 | 51 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 15 | 140 HARRINGTON ROAD COOPERNOOK | Residential | 464023.6 | 6477186.6 | GF | S | 51 | 47 | 51 | 47 | 52 | 48 | 52 | 48 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 15 | 140 HARRINGTON ROAD COOPERNOOK | Residential | 464032.0 | 6477192.6 | GF | E | 50 | 43 | 50 | 43 | 51 | 44 | 51 | 44 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 15 | 140 HARRINGTON ROAD COOPERNOOK | Residential | 464026.1 | 6477201.0 | GF | N | 54 | 49 | 54 | 49 | 55 | 50 | 55 | 50 | 0.0 | 0.0 | 0.0 | 0.0 | No |
| 15 | 140 HARRINGTON ROAD COOPERNOOK | Residential | 464017.7 | 6477195.1 | GF | W | 54 | 50 | 54 | 50 | 55 | 51 | 55 | 51 | 0.1 | 0.1 | 0.1 | 0.1 | No |

# Appendix F

## Operational $L_{Aeq}$ contour maps




CHiP - Operational Noise Contours - No Build - Daytime

Receivers

**Sound Pressure Level, $L_{Aeq\ 15hr}$ dB(A)**

55 60 65 70 75 80

N

0 150 300 Meters

AECOM

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CHiP - Operational Noise Contours - Build - Daytime

Receivers

**Sound Pressure Level, $L_{Aeq\ 15hr}$ dB(A)**

55 60 65 70 75 80

N

0 150 300 Meters

AECOM

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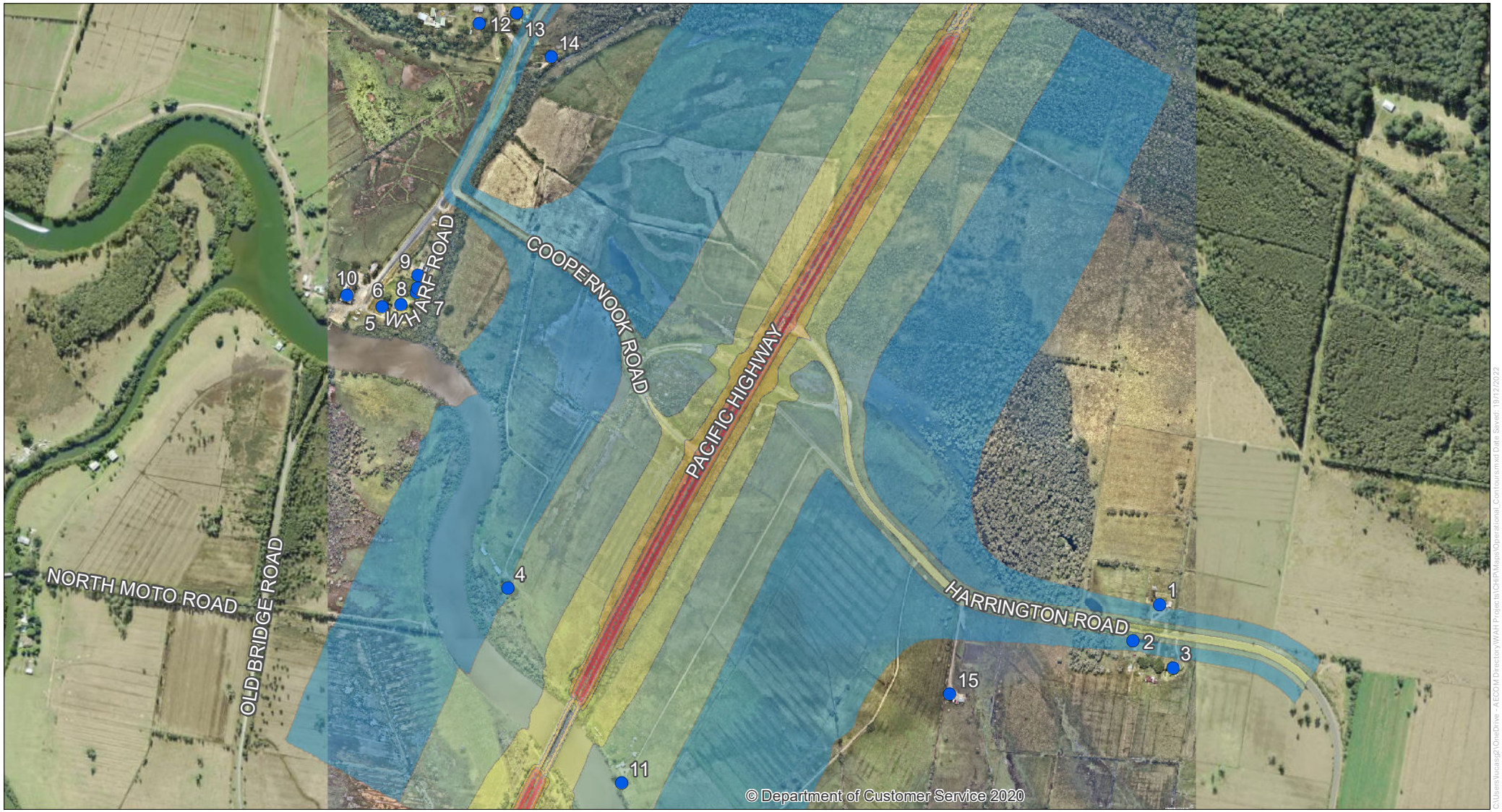


CHiP - Operational Noise Contours - No Build - Night-time

Receivers

**Sound Pressure Level, $L_{Aeq\ 9hr}$ dB(A)**

50 55 60 65 70 75

N

0 150 300 Meters

AECOM

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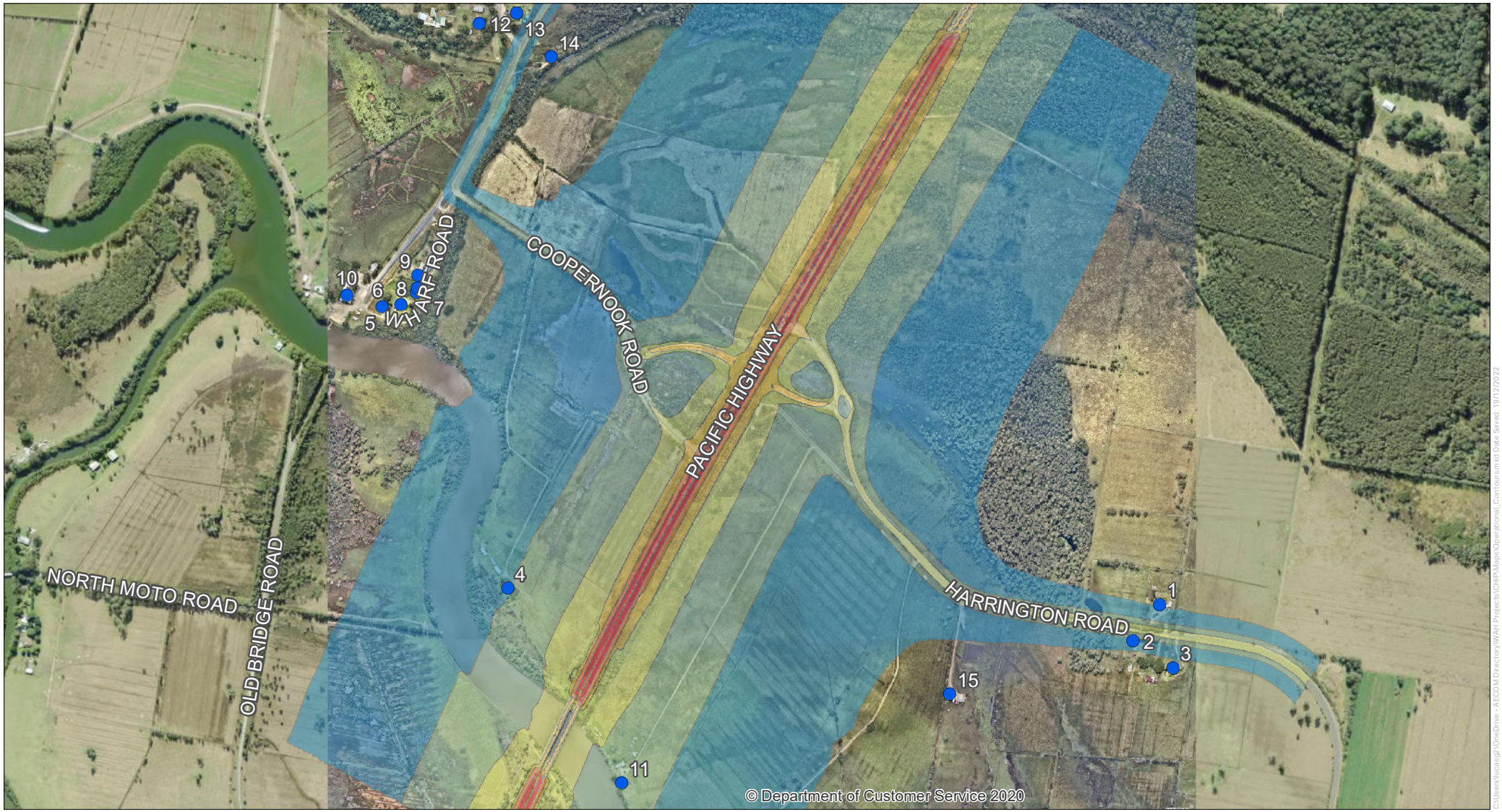


CHiP - Operational Noise Contours - Build - Night-time

Receivers

**Sound Pressure Level, $L_{Aeq\ 9hr}$ dB(A)**

50 55 60 65 70 75

N

0 150 300 Meters

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